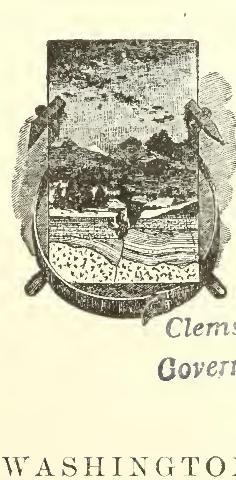
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR
1906



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MINERAL RESOURCES OF THE UNITED STATES, 1906.

INTRODUCTION.

By David T. Day and E. W. Parker.

Volume for 1906.

This volume contains a statement of the production of mineral substances in the United States during 1906. In addition, it shows the chief features of mining progress during the year.

It is manifestly impossible to present in each volume of this series a historical review of each industry in previous years. Comparisons of present and past conditions constitute, however, one of the most valuable features of a work of this kind; and therefore the statistics of past years are annually repeated in tabular form. To aid comparison the method of presentation is kept as uniform as possible. Thus practically the same form of arrangement has been preserved in all of the twenty-two preceding volumes of the series, and it has become so familiar to the mining fraternity as to render any description unnecessary. But for those to whom this volume comes as a new book of reference it may be explained that the statistics herein contained are not grouped by States. The book is divided into chapters, each of which treats of a separate mining industry for the whole United States. The student who consults this report to find a combined statement of the mineral resources of a given State is referred to the tabular statement of output by States in the summary and to the index, in which under each State is a list of the minerals produced therein. The effort is also made to show the conditions of the domestic industry in relation to foreign conditions in the same mineral industry. This effort to reflect the conditions of each industry extends even to the complicated units of measurement in common use by the industrials. No better argument could be offered for the adoption of the metric system than the discordant units which this report must employ in its reviews.

The fact that this general arrangement has been consistent for twenty-five years makes it easy for the student of any industry to obtain a historical grasp of his subject by consulting all the volumes, which are usually accessible in public libraries.

It is important also for the new reader to know that this volume is simply the consolidation of the separate chapters after they have been published in pamphlet form, frequently months in advance, and that these pamphlet reports and not the final volume mark the dates at which the reviews become available. Further, for greater statistical promptness, the principal figures are given to the public press in advance even of the publication of the chapters in pamphlet form.

Several new names appear in this volume as the responsible authorities in charge of individual chapters. This is in pursuance of the policy announced in the volume for 1905 of assigning all subjects to members of the Survey staff, who in this work and in allied problems are employed solely in the Government service.

The report on iron ores for 1906 was prepared by Mr. Edwin C. Eckel, who in past years has made a special study of the iron ores of the South. The series of iron-ore reports for the United States, however, owes its statistical development entirely to Mr. John Birkinbine, of Philadelphia, who, in addition to being an expert on iron ores, is also one of our chief blast-furnace engineers. Under his direction the statistics of iron-ore production have been developed to an exceptionally high degree of accuracy. This has been due not only to the close scrutiny and careful compilation of the returns, but fundamentally to the great confidence given him by iron-ore producers, among whom Mr. Birkinbine has developed a spirit of fraternity similar to that which Mr. James M. Swank, the general manager of the American Iron and Steel Association, has evoked among the iron and steel manufacturers.

The reviews of the copper, lead, and zinc trades in preceding years have likewise been developed entirely by Mr. Charles Kirchhoff, of the Iron Age, New York. These reports have become classic for their statistical accuracy and for their keen and fair analysis of the trade situation. They were based chiefly upon the returns of smelters, and in developing the method of collecting these statistics into an annual canvass of the mines themselves the charge of these reports has been intrusted to Mr. L. C. Graton for copper and to Mr. J. M. Boutwell for lead and zinc. The smelter returns are still used, and in connection with them it is gratifying to acknowledge the continued and hearty cooperation of Mr. Kirchhoff.

This volume also records the change of the administrative head of the Division of Mining and Mineral Resources from Dr. David T. Day to Mr. Edward W. Parker, Doctor Day taking charge of the reports on petroleum and natural gas. It is not possible for the former to leave the charge of the division without a hearty expression of his obligation to the staff, whose labors he has directed in developing this series. To the three Directors of the Survey who have successively supported and developed this branch of the institution, he offers in return not only appreciative acknowledgment but pride in the established results.

The change of administration includes the placing of the statistics of metal production (except iron ores) under the supervision of Mr. Waldemar Lindgren, who has as chief assistants Mr. Chas. G. Yale, of San Francisco; Mr. Victor C. Heikes, of Salt Lake City; Mr. Chester Naramore, of Denver, and Messrs. Boutwell, Graton, McCaskey, and Siebenthal, of Washington. This arrangement has materially strengthened the work of the division.

As to what may be expected of this work in the future, it must be borne in mind that the collection of statistics for each industry has after continued development reached the stage of a complete census each year, confidential reports being obtained at first hand from the producers themselves—with one exception, that of petroleum, and this exception will be brought to a condition coordinate with that of the other industries at the earliest date possible.

It is designed also to supplement the statistical data with the results of geological and chemical research in so far as they pertain to the economic development of our mineral resources. The Division of Mining and Mineral Resources has been for some years an integral part of the geologic branch of the Survey, this incorporation having been accomplished when the present plan of organization was adopted. The results of this arrangement have been highly satisfactory in that a better system of cooperation with the workers in the other divisions of the geologic branch has been effected. It is proposed to improve and extend this plan of cooperation by taking advantage of the observations made by the men engaged in economic geologic work in the field and in utilizing the services of those who are expert in special lines of investigation. Each volume will therefore not only summarize the statistics of production, but will give all conservative information in regard to both the extent of mineral deposits and the quality and quantity of the useful minerals which they can yield.

It has been found by experience that the proper collection and compilation of mining statistics can best be made under the supervision of technical men, and it is believed and expected that the present arrangement will make the volumes of Mineral Resources of even greater value than heretofore.

Scope of the Series.

By way of review and summary it may be repeated that in the twenty-seven years covered by these twenty-three reports the scope of the work has remained practically the same—an annual review of the mineral production of the United States and of the state of knowledge of the mineral deposits from which the products come. But the work involved has multiplied in two directions. In the beginning the statistical feature of the work was satisfied by an estimate as to the total output of each useful mineral. This estimate was based upon the best commercial estimates available, and the statistical correspondence was limited to a few hundred letters each year. When the control of the work passed into the hands of Doctor Day, he took it with the intention of developing each statistical inquiry from an estimate into an accurate annual census as rapidly as facilities would permit. This result has now been achieved with every industry except petroleum, and to this particular and difficult task he will henceforth limit his work. The correspondence necessary for this annual census of the mines of the United States has grown from a few hundred letters a year to an average of three written or printed communications a year to every known mine operator of the United States—more than 150,000 in all. In order to make such correspondence successful, it has been necessary to send agents to the mines themselves, both for scrutiny of the statistical returns and in order to acquaint the operator with the nature of this inquiry, and thus to secure the cooperation essential to success.

This growth of statistical work would have been necessary even if the mine development had remained stationary. Instead, the rate of increase has been far beyond all reasonable prophecy. In the twenty-seven years from 1880 to 1906, inclusive, the value of the mineral output of the United States has increased nearly five and one-fourth times. This marvelous growth is of additional interest in that it shows approximately by its fluctuations the financial ebb and flow of the whole country. From $364,928,298 in 1880 the value rose to $451,000,000 in 1882, declined to $406,000,000 in 1884, rose steadily to $606,000,000 in 1890, declined slightly to $605,000,000 in 1891, rose to $622,000,000 in 1892, fell to less than $550,000,000 in 1893 and 1894, rose to $640,000,000 in 1895, remained at the same figure in 1896, rose rapidly to $1,491,000,000 in 1903, declined to $1,361,000,000 in 1904, rose to $1,623,000,000 in 1905, and advanced to the immense sum of $1,902,517,565 in 1906. Keeping pace with this growth has been a strain, and it is gratifying that the system has so expanded that the statistics of this wonderful production continually increase in completeness and accuracy. This attainment is largely the result of the hearty cooperation of the producers, due to their faith in the Survey.

During the last ten years similarly increased facilities have been developed for reviewing in these volumes the conditions of occurrence of mineral deposits by the aid of the general staff of geologists engaged primarily in the making of a geologic map of the United States. The development of this geologic work has been continually in the direction of greater attention to economic geology, and in proportion as it became quantitative in its character it has become available for use and for reference in the volumes of Mineral Resources to their great advantage.

In carrying out the plan of cooperation with the other divisions of the geologic branch a twofold advantage is secured. It brings to the statistical work, on the one hand, a corps of trained men whose field observations have developed a keen appreciation of the geologic and economic importance of each mineral product. This has been particularly illustrated in the reports made by Mr. Lindgren and other mining geologists on gold and silver in the volume for 1905 and the reports on the same subjects and also on copper, lead, zinc, and quicksilver in the present volume. On the other hand, the mining geologists have obtained and will continue to derive from their statistical work an insight into the industrial and commercial conditions which so largely affect the demand for the different minerals and lead to the search for and the development of the mineral deposits with the geological relations of which their field work makes them acquainted.

The bringing together of these two classes of study of our mineral resources, that of their geology and manner of occurrence and that of their statistics and economic conditions, is to be one of the special features of the future work of this division.

SUMMARY OF THE MINERAL PRODUCTION OF THE UNITED STATES IN 1906.

Compiled by Wm. Taylor Thom.

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; the value in 1905 was about 9 per cent greater than that for 1903.

In 1906, for the second time, the total value of our mineral production exceeded the enormous sum of $1,500,000,000.

The exact figures for 1906 are $1,902,517,565, as compared with $1,623,928,720 in 1905, with $1,361,067,554 in 1904, with $1,491,-928,980 in 1903, and with $1,323,102,717 in 1902; a gain in 1906 over 1905 of $278,588,845, or 17.15 per cent; a gain in 1906 over 1904 of $541,450,011, or 39.78 per cent; over 1903 of $410,588,585, or 27.52 per cent, and over 1902 of $579,414,848, or 43.79 per cent.

As heretofore, iron and coal are the most important of our mineral products. The value of the iron in 1906 was $505,700,000; the value of the coal $513,079,809. The fuels increased from $602,-257,548 in 1905, to $652,398,476 in 1906, a gain of $50,140,928, or 8.33 per cent. Anthracite coal showed a decrease in value of $9,961,306, from $141,879,000 in 1905 to $131,917,694 in 1906. The average price of anthracite coal per long ton at the mine was $2.30, as against $2.25 in 1905, $2.35 in 1904, $2.50 in 1903, and $2.35 in 1902; and the average price per short ton for bituminous coal at the mine was $1.11, as against $1.06 in 1905, $1.10 in 1904, $1.24 in 1903, and $1.12 in 1902. The increase in value of the bituminous coal output over 1905 was $46,503,821—a combined increase in value of coal of $36,542,515, or 7.67 per cent.

The gain of $278,588,845 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 $702,453,101 in 1905 to $886,110,856 in 1906, a gain of $183,657,755, and the nonmetallic products showing an increase from $921,075,619 in 1905 to $1,016,-206,709 in 1906, a gain of $95,131,090. To these products should be added estimated unspecified products, including molybdenum, bismuth, and other mineral products, valued at $200,000, making a total mineral production for 1906 of $1,902,517,565.

METALS.

Iron and steel.—Twenty States produced pig iron in 1906, as against 20 in 1905, 20 in 1904, 22 in 1903, 22 in 1902, 20 in 1901, and 21 in 1900 and 1899. The total production of pig iron in 1906 was 25,307,191 long tons, as against 22,992,380 long tons in 1905; 16,497,033 long tons in 1904; 18,009,252 tons in 1903; 17,821,307 tons in 1902; and 15,878,354 tons in 1901. The production of 1906 shows an increase in quantity of 2,314,811 long tons, or over 10 per cent, over the production of 1905, and an increase in value from $382,450,000 to $505,700,000, amounting to $123,250,000, or 32.25 per cent. The average price per long ton of pig iron increased from $16.63 in 1905 to $19.98 in 1906. The average prices per long ton in recent years have been as follows: 1904, $14.13; 1903, $19.12; 1902, $20.92; 1901, $15.25.

Iron ores.—The production of iron ores in 1906 amounted to 47,749,728 long tons, as compared with 42,526,133 long tons in 1905, with 27,644,330 long tons in 1904, with 35,019,308 long tons in 1903, and with 35,554,135 tons in 1902. The value at the mines of the ore mined in 1906 was $100,597,106, as compared with $75,165,604 in 1905. As in the seven preceding years, the production of iron ores in the United States in 1906 was never equaled by that of any other country.

Manganese ores.—The production of manganese ores was 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 and with $8.97 in 1903. In 1906 the production of manganese ores was 6,921 long tons, valued at $88,132. The average price was $12.73 per ton. Manganiferous iron ores, carrying from 20 to 40 per cent of manganese, were produced to the extent of 41,300 long tons, valued at $122,400.

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, and to 4,565,333 ounces, valued at $94,373,800, in 1906, an increase in 1906 of 299,591 ounces in quantity and of $6,193,100 in value.

Silver.—The production of silver increased in quantity from 55,999,864 ounces in 1904 to 56,101,600 ounces in 1905, and to 56,517,900 ounces in 1906; it increased in commercial value from $32,035,378 in 1904 to $34,221,976 in 1905, and to $38,256,400 in 1906, a gain in 1906 of $4,034,424.

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, and to 917,805,682 pounds, valued at $177,595,888, in 1906, an increase in 1906 of 15,897,839 pounds in quantity, and of $37,800,172 in value.

Lead.—The production of lead in 1906 was 350,153 short tons, as against 302,000 short tons in 1905, 307,000 short tons in 1904, and 282,000 short tons in 1903. The value of the production in 1906 was $39,917,442, as compared with $28,690,000 in 1905, with $26,402,000 in 1904, and with $23,520,000 in 1903.

Zinc.—The production of zinc in 1906 was 199,694 short tons, as against 203,849 short tons in 1905, 186,702 short tons in 1904, and

159,219 short tons in 1903. The value of the zinc production in 1906 was $24,362,668, as compared with $24,054,182 in 1905, with $18,670,200 in 1904, and with $16,717,995 in 1903.

Bauxite.—In 1906 the production of bauxite was 75,332 long tons, valued at $368,311, as compared with 48,129 long tons, valued at $240,292, in 1905, with 47,661 long tons, valued at $235,704, in 1904, and with 48,087 long tons, valued at $171,306, in 1903.

Aluminum.—The consumption of aluminum during 1906 was 14,910,000 pounds, valued at 4,262,286, as against 11,347,000 pounds, valued at $3,246,300, in 1905, and 8,600,000 pounds, valued at $2,477,000, in 1904.

Quicksilver.—The production of quicksilver during 1906 amounted to 26,238 flasks (of 76½ avoirdupois pounds net; 75 avoirdupois pounds net after June, 1904), as compared with 30,451 flasks in 1905, with 34,570 flasks in 1904, with 35,620 flasks in 1903, and with 34,291 flasks in 1902. The value of the quicksilver produced in 1906 was $958,634, as compared with $1,103,120 in 1905, with $1,503,795 in 1904, with $1,544,934 in 1903, and with $1,467,848 in 1902. California reported 20,310 flasks, as compared with 24,635 flasks in 1905, with 29,217 flasks in 1904, with 30,526 flasks in 1903, and with 28,972 flasks in 1902; and Texas reported 4,761 flasks, as against 4,723 flasks in 1905, 5,336 flasks in 1904, 5,029 flasks in 1903, and 5,319 flasks in 1902. Utah reported 1,164 flasks and Oregon 3 flasks in 1906.

Chromic iron ore.—California was the only State producing chromite during 1906, the quantity being 107 long tons, valued at $1,800, as compared with 22 long tons, valued at $375 in 1905, with 123 long tons, valued at $1,845 in 1904; with 150 long tons, valued at $2,250, in 1903; and with 315 long tons, valued at $4,567 in 1902.

Molybdenum.—The commercial production of molybdenum in 1906 was approximately the same as the production of 1905, which, in turn, was in excess of the 1904 production of 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 1906 as 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, and of 5,748 pounds in 1902. The value in 1904 was $11,400, as against $45,900 in 1903, and $2,701 in 1902. The imports of nickel in 1906 were valued at $1,902,367, as against $1,962,131 in 1905, $1,121,491 in 1904, $1,493,889 in 1903, and $1,437,649 in 1902.

Rutile.—A small production of rutile, chiefly from Virginia, was reported in 1906.

Tungsten.—The commercial production of concentrated tungsten ores during 1906 amounted approximately to 928 short tons, valued at $348,867, as against 803 short tons, valued at $268,676 in 1905; 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.

Uranium and vanadium.—The production of uranium and vanadium minerals in 1906, as reported to the Survey and included under unspecified products, was the largest of recent years. The production in 1905 was valued at $375, as against $10,600 in 1904, $5,625 in 1903, and $48,125 in 1902.

Tantalum.—A commercial production of tantalum in 1906 was reported from Colorado and South Dakota.

Platinum.—The production of platinum from domestic ores in 1906 was 1,439 ounces, valued at $45,189, as compared with 318 ounces, valued at $5,320, in 1905; with 200 ounces, valued at $4,160, in 1904; with 110 ounces, valued at $2,080, in 1903; and with 94 ounces, valued at $1,814, in 1902. 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 January, 1906, it was $20.50, in February, 1906, it advanced to $25; in September, 1906, it rose to $33; in November it was $38, remaining at that price until late in February, 1907, when hard platinum was quoted at $41 per ounce. This price declined on June 15 to $26 for ordinary, and $28.50 for hard; then it rose to $27 and $29, respectively, on July 27, and stands now (August 3, 1907), at $28 for ordinary and $29.50 for hard.

Antimony.—The antimony obtained from the smelting of domestic ores in 1906 amounted to 404 short tons, valued at $58,149, and the antimony obtained from hard lead produced from foreign and domestic lead ores was 1,362 short tons, valued at $286,004, a total production for 1906 of 1,766 short tons, valued at $602,949, as compared with 3,240 short tons, valued at $705,787 in 1905; with 3,057 short tons, valued at $505,524, in 1904; with 3,128 short tons, valued at $548,433, in 1903; and with 3,561 short tons, valued at $634,506, in 1902.

Bismuth.—The marketed production of bismuth ore in 1906 was 8,334 pounds, valued at $12,500; in 1905 it 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.

Tin.—There was a small production of metallic tin in South Dakota in 1906, which, with concentrates from Alaska and from the North Carolina-South Carolina deposits, was valued at $35,600.

FUELS.

Coal.—For the first time in the history of the United States the production of coal in 1906 reached a total of over 400,000,000 short tons, showing an actual output of 414,157,278 tons of 2,000 pounds, valued at $513,079,809. Of this total, the output of anthracite coal amounted to 63,645,010 long tons (equivalent to 71,282,411 short tons), which, as compared with the production of 69,339,152 long tons in 1905, was a decrease of 5,694,142 long tons, or over 8 per cent. The value of anthracite coal at the mines in 1906 was $131,917,694, as against $141,879,000 in 1905, $138,974,020 in 1904, $152,036,448 in 1903, and $76,173,586 in 1902. The average price of the marketed anthracite coal sold during the year at the mines was $2.30 per long ton, as against $2.25 per long ton in 1905, $2.35 in 1904, $2.50 in 1903, and $2.35 in 1902.

The output of bituminous coal (which includes semianthracite and all semibituminous and lignite coals), amounted in 1906 to 342,874,867 short tons, valued at $381,162,115, as compared with 315,062,785 short tons, valued at $334,658,294, in 1905; 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; and with 260,216,844 short tons, valued at $290,858,483, in 1902. The increase in the production of bituminous coal in 1906 over 1905 was therefore 27,812,082 short tons in quantity and $46,503,821 in value. The average price of bituminous coal per ton at the mines during 1906 was $1.11, as against $1.06 in 1905, $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 1906, which included the output, 4,558,127 short tons, from 3,362 retort or by-product ovens, amounted to 36,401,217 short tons, as compared with 32,231,129 short tons in 1905, with 23,661,106 short tons in 1904, with 25,274,281 short tons in 1903, and with 25,401,730 short tons in 1902. The increase in quantity in 1906 from 1905 was 4,159,088 short tons, or over 12 per cent. The total value was $91,608,034, as against $72,476,196 in 1905, a gain of $19,157,338, or 26 per cent. The average price per ton in 1906 was $2.52, against $2.25 in 1905. The average output from the by-product ovens in 1906 was 1,356 tons per oven, against an average of 373.6 tons per oven from the beehive ovens.

Natural gas.—The value of the natural gas produced in 1906 was $46,873,932, as compared with $41,562,855 in 1905, with $38,496,760 in 1904, with $35,807,860 in 1903, and with $30,867,863 in 1902—a gain of about 13 per cent in 1906 over 1905.

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. No report has been prepared for 1906; the estimated value of the products is distributed among the respective States in the table of output and value by States.

Petroleum.—The total production of crude petroleum in the United States in 1906 was 126,493,936 barrels, as against 134,717,580 barrels in 1905, 117,080,960 barrels in 1904, and 100,461,337 barrels in 1903, a decrease in 1906 of 8,277,644 barrels, or 6.14 per cent from the production of 1905. Among the noteworthy changes in production in 1906 were gains, as compared with 1905, of nearly 10,000,000 barrels in the Mid-Continent field and of over 4,000,000 barrels in the Illinois field; these gains were more than offset by losses of over 15,000,000 barrels in Texas, over 3,000,000 barrels in Indiana, and of over 1,000,000 barrels each in Ohio and West Virginia.

The value of crude petroleum produced during 1906 was $92,444,735, or an average price of 73.1 cents per barrel, as against $84,157,399, or an average price of 62.47 cents per barrel, in 1905; against $101,175,-455, or 86.41 cents per barrel, in 1904, and against $94,694,050, or 94.26 cents per barrel, in 1903.

STRUCTURAL MATERIALS.

Cement.—The total production of hydraulic cement in the United States in 1906 was 51,000,445 barrels, valued at $55,302,277, as compared with 40,102,308 barrels, valued at $35,931,533, in 1905; with 31,675,257 barrels, valued at $26,031,920, in 1904; with 29,899,140 barrels, valued at $31,931,341, in 1903, and with 25,753,504 barrels, valued at $25,366,380, in 1902. The Portland cement production in 1906 was 46,463,424 barrels, valued at $52,466,186, as compared with 35,246,812 barrels, valued at $33,245,867, in 1905; with 26,505,881 barrels, valued at $23,355,119, in 1904; with 22,342,973 barrels, valued at $27,713,319, in 1903, and with 17,230,644 barrels, valued at $20,864,078, in 1902—an increase in quantity in 1906, as compared with 1905, of 11,216,612 barrels, and in value of $19,220,319. The production of natural cement in 1906 was 4,055,797 barrels, valued at $2,423,170, as compared with 4,473,049 barrels, valued at $2,413,052, in 1905; with 4,866,331 barrels, valued at $2,450,150, in 1904; with 7,030,271 barrels, valued at $3,675,520, in 1903, and with 8,044,305 barrels, valued at $4,076,630, in 1902—a decrease in quantity in 1906 of 417,252 barrels and an increase in value of $10,118. The production of slag cement in 1906 amounted to 481,224 barrels, valued at $412,921, as against 382,447 barrels, valued at $272,614, in 1905; 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, which increase continued in 1906. The value of all clay products, as reported to this office in 1906, was $161,032,722, as against $149,697,188 in 1905, $131,023,248 in 1904, $131,062,421 in 1903, and $122,169,531 in 1902. The brick and tile products in 1906 were valued at $129,591,838, as against $121,778,294 in 1905, $105,864,978 in 1904, $105,626,369 in 1903, and $98,042,078 in 1902. The pottery products were valued in 1906 at $31,440,884, as against $27,918,894 in 1905, $25,158,270 in 1904, $25,436,052 in 1903, and $24,127,453 in 1902.

The commercial production of clay mined and sold in 1906 by those not manufacturing the clay themselves was valued at $3,245,256, as against $2,768,006 in 1905, $2,320,162 in 1904, and $2,594,042 in 1903.

Lime.—The production of lime in 1906 was 3,197,754 short tons, valued at $12,480,653, as against 2,984,100 short tons, valued at $10,941,680, in 1905, and against 2,707,809 short tons, valued at $9,951,456, in 1904. The output was valued at $9,255,882 in 1903 and at $9,335,618 in 1902. The average price per short ton was $3.67 in 1905 and $3.90 in 1906.

Sand-lime brick.—The production of sand-lime brick in 1906 was valued at $1,170,005, as against $972,064 in 1905, $463,128 in 1904, and $155,040 in 1903.

Slate.—The production of slate in 1906 was valued at $5,668,346, as against $5,496,207 in 1905, $5,617,195 in 1904, $6,256,885 in 1903, and $5,696,051 in 1902.

Stone.—The value of all kinds of stone produced in the United States during 1906 amounted to $66,378,794, as compared with $63,798,748 in 1905, with $58,765,715 in 1904, with $57,433,141 in 1903, and with $54,798,682 in 1902.

Included under stone is the limestone used for fluxing in blast furnaces, which in 1906 was 16,077,202 long tons, valued at $7,612,692, as compared with 15,387,891 long tons, valued at $7,004,265, in 1905; with 10,657,038 long tons, valued at $4,702,768, in 1904, and with 12,029,719 long tons, valued at $5,423,732, in 1903.

ABRASIVE MATERIALS.

Alundum or artificial corundum.—The production of alundum by the Norton Emery Wheel Company amounted in 1906 to 4,712,000 pounds, valued at $282,720, an average of 6 cents per pound, as compared with 3,612,000 pounds manufactured in 1905, valued at $252,840, an average of 7 cents per pound, and with 4,020,000 pounds manufactured in 1904.

Carborundum.—The production of carborundum in 1906 was 6,225,300 pounds as against 5,596,000 pounds in 1905, 7,060,380 pounds in 1904, 4,759,890 pounds in 1903, and 3,741,500 pounds in 1902. The value of the carborundum varies from 7 to 10 cents a pound.

Corundum and emery.—The combined production of corundum and emery in 1906 amounted to 1,160 short tons, valued at $44,310, as against 2,126 short tons, valued at $61,464, in 1905; 1,916 short tons, valued at $56,985, in 1904; 2,542 short tons, valued at $64,102, in 1903; and 4,251 short tons, valued at $104,605, in 1902.

Crushed steel.—The production of crushed steel in 1906 was 837,000 pounds, as against 612,000 pounds in 1905, 790,000 pounds in 1904, 755,000 pounds in 1903, and 735,000 pounds in 1902.

Crystalline quartz.—In 1906 the production of crystalline quartz included under abrasives amounted to 24,082 short tons, valued at $121,671, as against 19,039 short tons, valued at $88,118, in 1905; against 31,940 short tons, valued at $74,850, in 1904; 8,938 short tons, valued at $76,908, in 1903, and 15,104 short tons, valued at $84,335 in 1902.

Garnet.—The production of abrasive garnet in the United States during 1906 amounted to 4,650 short tons, valued at $157,000, as against 5,050 short tons, valued at $148,095, in 1905; 3,854 short tons, valued at $117,581, in 1904; 3,950 short tons, valued at $132,500, in 1903; and 3,926 short tons, valued at $132,820, in 1902. The average price for the 1906 production is reported at $33.98 per ton.

Grindstones.—The total value of all kinds of grindstones produced during 1906 was $744,894, as against $777,606 in 1905, $881,527 in 1904, $721,446 in 1903, and $667,431 in 1902. 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.

Infusorial earth and tripoli.—In 1906 the production of infusorial earth and tripoli amounted to 8,099 short tons, valued at $72,108, as against 10,977 short tons, valued at $64,637, in 1905; against 6,274 short tons, valued at $44,164, in 1904; 9,219 short tons, valued at $76,273, in 1903; and 5,665 short tons, valued at $53,244, in 1902.

Millstones and buhrstones.—The value of the production of millstones and buhrstones in 1906 was $48,590, as against $37,974, in 1905, $37,338 in 1904, $52,552 in 1903, and $59,808 in 1902. 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, 1905, and 1906.

Oilstones and whetstones.—There was a continued increase in the commercial domestic production of oilstones and whetstones during 1906, the value rising from $188,985 in 1904 to $244,546 in 1905 and to $268,070 in 1906. The production was valued at $366,857 in 1903 and at $221,762 in 1902.

Pumice.—The production of pumice amounted in 1906 to 12,200 short tons, valued at $16,750, as against 1,832 short tons, valued at $5,540 in 1905; 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 1906 was 1,474,000 pounds, valued at $63,460, as against 1,507,386 pounds, valued at $35,210, in 1905; 72,413 pounds, valued at $2,185, in 1904; 1,222,000 pounds, valued at $36,691, in 1903; and 2,706,000 pounds, valued at $81,180, in 1902.

Borax.—The reported returns for 1906 gave an aggregate production of crude borax of 58,173 short tons, valued at $1,182,410, as against 46,334 short tons, valued at $1,019,154, in 1905; 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 1906, including the bromine contained in potassium bromide, amounted to 1,283,250 pounds, valued at $165,204, as compared with 1,192,758 pounds, valued at $178,914, in 1905; with 897,100 pounds, valued at $269,130, in 1904; with 598,500 pounds, valued at $167,580, in 1903; and with 513,893 pounds, valued at $128,472, in 1902.

Fluorspar.—The total commercial production of fluorspar in 1906 was 40,796 short tons, valued at $244,025, as compared with 57,385 short tons, valued at $362,488, in 1905; with 36,452 short tons, valued at $234,755, in 1904; and with 42,523 short tons, valued at $213,617, in 1903. The prices of crude fluorspar in 1906 were reported as ranging from $3.60 to $6 per ton and the prices of ground fluorspar as ranging from $9 to $12 per ton.

Gypsum.—The output of crude gypsum in 1906 was 1,540,585 short tons, valued in its first marketable condition at $3,837,975, as compared with 1,043,202 short tons, valued at $3,029,227, in 1905; 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; and with 816,478 short tons, valued at $2,089,341, in 1902. 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.

Lithium minerals.—The production of lithium minerals in 1906 was 383 short tons, valued at $7,411, as against 79 short tons, valued at $1,412, in 1905; 577 short tons, valued at $5,155, in 1904; and 1,155 short tons, valued at $23,425, in 1903. The output in 1905 and 1906 came from California and South Dakota. There were no imports of lithium salts in either 1905 or 1906.

Marls.—The production of marls in the United States in 1906 was 19,104 short tons, valued at $7,341; in 1905 it was 38,026 short tons, valued at $16,494; in 1904 it was 18,989 short tons, valued at $13,145, and in 1903 it was 34,211 short tons, valued at $22,521.

Phosphate rock.—The total commercial production of phosphate rock reported to the Survey in 1906 amounted to 2,080,957 long tons, valued at $8,579,437, as compared with 1,947,190 long tons, valued at $6,763,403, in 1905; with 1,874,428 long tons, valued at $6,580,875, in 1904, and with 1,581,576 long tons, valued at $5,319,294, in 1903. The total quantity of phosphate rock reported as mined during 1906 was 2,001,394 long tons, as against 2,138,309 long tons mined in 1905 and 1,991,169 long tons mined in 1904.

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 1906 amounted to 28,172,380 barrels of 280 pounds, valued at $6,658,350, as compared with 25,966,122 barrels, valued at $6,095,922, in 1905; with 22,030,002 barrels, valued at $6,021,222, in 1904; with 18,968,089 barrels, valued at $5,286,988, in 1903, and with 23,849,231 barrels, valued at $5,668,636, in 1902.

Sulphur and pyrite.—The domestic production of sulphur in 1906 was 294,153 long tons, valued at $5,096,678; the production of pyrite was 261,422 long tons, valued at $931,305. The combined production in 1906 of sulphur and pyrite for the manufacture of sulphuric acid amounted to 555,575 long tons, valued at $6,027,983, as compared with 434,677 long tons, valued at $4,645,052, in 1905; with 334,373 long tons, valued at $3,478,568, in 1904; with 233,127 long tons, valued at $1,109,818, in 1903, and with 207,874 long tons, valued at $947,089, in 1902.

PIGMENTS.

Barytes.—The production of crude barytes in 1906 was 50,231 short tons, valued at $160,367, as compared with 48,235 short tons, valued at $148,803, in 1905; with 65,727 short tons, valued at $174,958, in 1904; with 50,397 short tons, valued at $152,150, in 1903, and with 61,668 short tons, valued at $203,154, in 1902.

Cobalt oxide.—There was no production of cobalt oxide reported in 1905 and 1906. In 1904 it was 22,000 pounds, valued at $42,000; in 1903 it was 120,000 pounds, valued at $228,000; in 1902 it was 3,730 pounds, valued at $6,714. 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 1906 amounted to 49,921 short tons, valued at $521,729, as compared with 56,599 short tons, valued at $724,933, in 1905; 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.

Zinc white.—The production of zinc white in 1906 amounted to 74,680 short tons, valued at $5,999,375, as compared with 68,603 short tons, valued at $5,520,240, in 1905; with 63,363 short tons, valued at $4,808,482, in 1904; with 62,962 short tons, valued at $4,801,718, in 1903, and with 52,645 short tons, valued at $4,016,499, in 1902.

MISCELLANEOUS.

Asbestos.—The asbestos commercially produced in the United States in 1906 was obtained chiefly from deposits in Georgia, Virginia, and Wyoming, with small quantities from Arizona, California, and Massachusetts. The total commercial production was 1,695 short tons, valued at $28,565, as against 3,109 short tons, valued at $42,975, in 1905; against 1,480 short tons, valued at $25,740, in 1904, and 887 short tons, valued at $16,760, in 1903.

Asphalt.—Under this title are included the various bitumens or hydrocarbons not discussed elsewhere under the heading "Petroleum." The commercial production in 1906 was 138,059 short tons, valued at $1,290,340, as against 115,267 short tons, valued at $758,153, in 1905; 108,572 short tons, valued at $879,836, in 1904; 101,255 short tons, valued at $1,005,446, in 1903, and 105,458 short tons, valued at $765,048, in 1902.

Feldspar.—The production of feldspar in 1906 was 75,656 short tons, valued at $401,531, as against 35,419 short tons, valued at $226,157, in 1905; 45,188 short tons, valued at $266,326, in 1904; 41,891 short tons, valued at $256,733, in 1903, and 45,287 short tons valued at $250,424, in 1902.

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 1906 the production was 61,672 short tons, valued at $557,200, as against 56,500 short tons, valued at $445,000, in 1905; 64,005 short tons, valued at $507,400, in 1904; 60,230 short tons, valued at $421,600, in 1903, and 71,100 short tons, valued at $615,350, in 1902.

Fuller's earth.—As reported to the Survey, the production of fuller's earth in 1906 was 32,040 short tons, valued at $265,400, as against 25,178 short tons, valued at $214,497, in 1905; 29,480 short tons, valued at $168,500, in 1904, and 20,693 short tons, valued at $190,277, in 1903. The imports in 1906 were valued at $108,695, as against $105,997 in 1905.

Glass sand.—The production of glass sand in 1906 was 1,089,430 short tons, valued at $1,208,788, as against 1,060,334 short tons, valued at $1,107,730, in 1905; 858,719 short tons, valued at $796,492, in 1904, and 823,044 short tons, valued at $855,828, in 1903.

Graphite.—The commercial production of crystalline graphite during 1906 amounted to 5,887,982 pounds, valued at $238,064, as compared with 6,036,567 pounds, valued at $237,572, in 1905; with 5,681,177 pounds, valued at $238,447, in 1904, and with 4,538,155 pounds, valued at $154,170, in 1903. The production of amorphous graphite in 1906 was 16,853 short tons, valued at $102,175, as compared with 21,953 short tons, valued at $80,639, in 1905; with 16,927 short tons, valued at $82,925, in 1904, and with 16,591 short tons, valued at $71,384, in 1903. The production of artificial graphite in 1906 was 5,074,757 pounds, valued at $337,204, the average price being 6.64 cents per pound, as compared with 4,591,550 pounds, valued at $313,980, the average price being 6.83 cents per pound, in 1905; 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 1906 the commercial production reported was 7,805 short tons, valued at $23,415, as compared with 3,933 short tons, valued at $15,221, in 1905; with 2,850 short tons, valued at $9,298, in 1904; and with 3,744 short tons, valued at $10,595, in 1903.

Mica.—The total production of mica in 1906 was 1,423,100 pounds of sheet mica, valued at $252,248, and 1,489 short tons of scrap mica, valued at $22,742, as against 924,875 pounds of sheet mica, valued at $160,732, and 1,126 short tons of scrap mica, valued at $17,856, in 1905; and 668,358 pounds of sheet mica, valued at $109,462, and 1,096 short tons of scrap mica, valued at $10,854, in 1904.

Mineral waters.—The total production of mineral waters in 1906 was 51,407,668 gallons, valued at $8,559,650, as compared with 47,590,081 gallons, valued at $6,811,611, in 1905; with 50,723,500 gallons, valued at $7,198,450, in 1904; and with 51,242,757 gallons, valued at $9,041,078, in 1903.

Monazite and zircon.—The production of monazite is confined exclusively to North Carolina and South Carolina, about five-sixths being obtained from the former State. In 1906 the production was 847,275 pounds of concentrates, valued at $152,560. 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), in 1903; and with 802,000 pounds of monazite, valued at $64,160, in 1902.

Peat.—There was no commercial production of peat in 1906. 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.

Potassium salts.—There was no production of potassium salts in the United States in 1906; the imports amounted to 226,859,750 pounds, valued at $5,941,217.

Precious stones.—The value of the gems and precious stones found in the United States in 1906 was reported as $208,000, as against $326,350 in 1905, $324,300 in 1904, $307,900 in 1903, and $328,450 in 1902. There has been a great advance in the lapidary industry in the United States since 1894. The cutting of our native gems has grown to the proportions of an industry.

Quartz (flint).—The production of flint in 1906 was 66,697 short tons, valued at $243,012, as against 51,145 short tons, valued at $104,109, in 1905; 52,270 short tons, valued at $100,590, in 1904; 55,233 short tons, valued at $156,947, in 1903; and 36,365 short tons, valued at 144,209, in 1902.

Sand and gravel.—The production of sand for molding, building, engine, furnace, and other purposes, and of gravel, reported in 1906, was 31,842,572 short tons, valued at $11,489,420, as against 22,144,633 short tons valued at $10,115,915, in 1905; and 9,821,009 short tons, valued at $4,951,607, in 1904.

Selenium.—There was a small production of selenium in 1906 in the electrolytic refining of copper.

Talc and soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1906 amounted to 58,972 short tons, valued at $874,356, as compared with 40,134 short tons, valued at $637,062, in 1905; with 27,184 short tons, valued at $433,331, in 1904; with 26,671 short tons, valued at $418,460, in 1903; and with 26,854 short tons, valued at $525,157, in 1902.

Cadmium.—Cadmium is being produced by the Grasselli Chemical Company, of Cleveland, Ohio, and the product is shipped to Germany. It is noteworthy that cadmium is now exported from the United States rather than imported, as has heretofore been the case.

No information is at hand as to the source of the ores nor as to the process used in reducing the metal.

MINERAL PRODUCTS OF THE UNITED STATES IN 1905 AND 1906.

The two following sets of tables should be sharply discriminated. From the tabular statement headed "Mineral products of the United States in 1905 and 1906," including also the tables for the years 1880 to 1906, all unnecessary duplication has been excluded. The manufactured coke product, amounting in 1906 to 36,401,217 short tons and valued at $91,608,034, 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 white or zinc oxide, 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 tabular statement, however, under the heading "Output and value, by States and Territories, of mineral products of the United States in the calendar years 1905 and 1906," raw clay, iron ores, lead paints, and the coal products are included under the respective producing States.

It will be seen that the two tabular statements differ materially. They both give the value of the mineral products in the years 1905 and 1906; 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 and 1906 in the first table are the official figures agreed upon by the United States Geological Survey and the Director of the Mint.

Mineral products of the United

	Product.	1905.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron,[a] spot value[b] .... [c]long tons..	22,992,380	$382,450,000
2	Silver, commercial value[d] .... troy ounces..	56,101,600	34,221,976
3	Gold, coining value[e] .... do....	4,265,742	88,180,700
4	Copper, value at New York City .... pounds..	901,907,843	139,795,716
5	Lead,[f] value at New York City .... short tons..	302,000	28,690,000
6	Zinc, value at New York City .... do....	203,849	24,054,182
7	Quicksilver, value at San Francisco .... [g]flasks..	30,451	1,103,120
8	Aluminum, value at Pittsburg .... pounds..	[h]11,347,000	3,246,300
9	Antimony,[i] value at San Francisco .... short tons..	3,240	705,787
10	Nickel,[j] value at Philadelphia .... pounds..	....	([k])
11	Tin .... do....	....	([l])
12	Platinum, value (crude) at New York City .... troy ounces..	318	5,320
13	Total value of metallic products	....	702,453,101
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal[m] .... short tons..	315,062,785	334,658,294
15	Pennsylvania anthracite .... long tons..	69,339,152	141,879,000
16	Natural gas	....	41,562,855
17	Petroleum .... [n]barrels..	134,717,580	84,157,399
18	Clay products[o]	....	149,697,188
19	Cement .... [p]barrels..	40,102,308	35,931,533
20	Lime .... short tons..	2,984,100	10,941,680
21	Sand-lime brick	....	972,064
22	Slate	....	5,496,207
23	Stone[q]	....	63,798,748
24	Corundum and emery .... short tons..	2,126	61,464
25	Crystalline quartz .... do....	19,039	88,118
26	Garnet for abrasive purposes .... do....	5,050	148,095
27	Grindstones	....	777,606
28	Infusorial earth and tripoli .... short tons..	10,977	64,637
29	Millstones	....	37,974
30	Oilstones, etc	....	244,546
31	Arsenious oxide .... pounds..	1,507,386	35,210
32	Borax (crude) .... short tons..	46,334	1,019,154
33	Bromine .... pounds..	1,192,758	178,914
34	Fluorspar .... short tons..	57,385	362,488
35	Gypsum .... do....	1,043,202	3,029,227
36	Lithium minerals .... do....	79	1,412
37	Marls .... do....	38,026	16,494
38	Phosphate rock .... long tons..	1,947,190	6,763,403
39	Pyrite .... do....	253,000	938,492
40	Sulphur .... do....	181,677	3,706,560
41	Salt .... [r]barrels..	25,966,122	6,095,922
42	Barytes (crude) .... short tons..	48,235	148,803
43	Cobalt oxide .... pounds..	....	([k])
44	Mineral paints[s] .... short tons..	56,599	724,933
45	Zinc white .... do....	68,603	5,520,240
46	Asbestos .... do....	3,109	42,975
47	Asphalt .... do....	115,267	758,153
48	Bauxite .... long tons..	48,129	240,292
49	Chromic iron ore .... do....	22	375
50	Feldspar .... short tons..	35,419	226,157
51	Fibrous talc .... do....	56,500	445,000
52	Fuller's earth .... do....	25,178	214,497
53	Glass sand .... do....	1,060,334	1,107,730
54	{Graphite (crystalline) .... pounds..	6,036,567	} 318,211
	{Graphite (amorphous) .... short tons..	21,953	}
55	Magnesite .... do....	3,933	15,221

[a] Production of iron ore—1897: 17,518,046 long tons; value at mines, $18,953,221. 1898: 19,433,716 long tons; value at mines, $22,060,887. 1899: 24,683,173 long tons; value at mines, $34,999,077. 1900: 27,553,161 long tons; value at mines, $66,590,504. 1901: 28,887,479 long tons; value at mines, $49,256,245. 1902: 35,554,135 long tons; value at mines, $65,412,950. 1903: 35,019,308 long tons; value at mines, $66,328,415. 1904: 27,644,330 long tons; value at mines, $43,186,741. 1905: 42,526,133 long tons; value at mines, $75,165,604. 1906: 47,749,728 long tons; value at mines, $100,597,106. Statistics for iron ore are collected by the Survey; statistics for pig iron are furnished by the American Iron and Steel Association.

[b] By "spot" value is meant value at the point of production.

[c] Long tons are tons of 2,240 avoirdupois pounds; short tons are tons of 2,000 avoirdupois pounds.

[d] Average price per troy ounce in 1906 was 67 cents.

[e] Prior to 1905, coining value, $20.6718 per troy ounce; in 1905, coining value, $20.671834; in 1906, coining value, $20.671834625323.

[f] The product from domestic ores only.

[g] Of 76½ avoirdupois pounds net; of 75 avoirdupois pounds net since June, 1904.

[h] Consumption in 1904, 1905, and 1906.

[i] Includes antimony smelted from imported ores and antimony contained in hard lead.

[j] Including nickel in copper-nickel alloy and in exported ore and matte.

States in 1905 and 1906.

1906.		Increase (+) or decrease (−) in 1906.		Percentage of increase (+) or decrease (−) in 1906.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
25,307,191	$505,700,000	+ 2,314,811	+$123,250,000	+ 10.07	+ 32.23	1
56,517,900	38,256,400	+ 416,300	+ 4,034,424	+ .74	+ 11.79	2
4,565,333	94,373,800	+ 299,591	+ 6,193,100	+ 7.02	+ 7.02	3
917,805,682	177,595,888	+15,897,839	+ 37,800,172	+ 1.76	+ 27.04	4
350,153	39,917,442	+ 48,153	+ 11,227,442	+ 15.94	+ 39.13	5
199,694	24,362,668	− 4,155	+ 308,486	− 2.04	+ 1.28	6
26,238	958,634	− 4,213	− 144,486	− 13.84	− 13.10	7
h 14,910,000	4,262,286	+ 3,563,000	+ 1,015,986	+ 31.40	+ 31.30	8
1,766	602,949	− 1,474	− 102,838	− 45.49	− 14.57	9
....	(k)	....	....	....	....	10
....	35,600	....	....	....	....	11
1,439	45,189	+ 1,121	+ 39,869	+352.52	+749.42	12
....	886,110,856	....	+ 183,657,755	....	+ 26.15	13
342,874,867	381,162,115	+27,812,082	+ 46,503,821	+ 8.83	+ 13.90	14
63,645,010	131,917,694	− 5,694,142	− 9,961,306	− 8.21	− 7.02	15
....	46,873,932	....	+ 5,311,077	....	+ 12.78	16
126,493,936	92,444,735	− 8,223,644	+ 8,287,336	− 6.10	+ 9.85	17
....	161,032,722	....	+ 11,335,534	....	+ 7.57	18
51,000,445	55,302,277	+10,898,137	+ 19,370,744	+ 27.18	+ 53.91	19
3,197,754	12,480,653	+ 213,654	+ 1,538,973	+ 7.16	+ 14.07	20
....	1,170,005	....	+ 197,941	....	+ 20.36	21
....	5,668,346	....	+ 172,139	....	+ 3.13	22
....	66,378,794	....	+ 2,580,046	....	+ 4.04	23
1,160	44,310	− 966	− 17,154	− 45.44	− 27.91	24
24,082	121,671	+ 5,043	+ 33,553	+ 26.49	+ 38.08	25
4,650	157,000	− 400	+ 8,905	− 7.92	+ 6.01	26
....	744,894	....	− 32,712	....	− 4.21	27
8,099	72,108	− 2,878	+ 7,471	− 26.22	+ 11.56	28
....	48,590	....	+ 10,616	....	+ 27.96	29
....	268,070	....	+ 23,524	....	+ 9.62	30
1,474,000	63,460	− 33,386	+ 28,250	− 2.21	+ 80.23	31
58,173	1,182,410	+ 11,839	+ 163,256	+ 25.55	+ 16.02	32
1,283,250	165,204	+ 90,492	− 13,710	+ 7.59	− 7.66	33
40,796	244,025	− 16,589	− 118,463	− 28.91	− 32.68	34
1,540,585	3,837,975	+ 497,383	+ 808,748	+ 47.68	+ 26.70	35
383	7,411	+ 304	+ 5,999	+384.81	+424.86	36
19,104	7,341	− 18,922	− 9,153	− 49.76	− 55.49	37
2,080,957	8,579,437	+ 133,767	+ 1,816,034	+ 6.87	+ 26.85	38
261,422	931,305	+ 8,422	− 7,187	+ 3.33	− .77	39
294,153	5,096,678	+ 112,476	+ 1,390,118	+ 61.91	+ 37.50	40
28,172,380	6,658,350	+ 2,206,258	+ 562,428	+ 8.50	+ 9.23	41
50,231	160,367	+ 1,996	+ 11,564	+ 4.14	+ 7.77	42
....	(k)	....	....	....	....	43
49,921	521,729	− 6,678	− 203,204	− 11.80	− 28.03	44
74,680	5,999,375	+ 6,077	+ 479,135	+ 8.86	+ 8.68	45
1,695	28,565	− 1,414	− 14,410	− 45.48	− 33.53	46
138,059	1,290,340	+ 22,792	+ 532,187	+ 19.77	+ 70.20	47
75,332	368,311	+ 27,203	+ 128,019	+ 56.52	+ 53.28	48
107	1,800	+ 85	+ 1,425	+386.36	+380.00	49
75,656	401,531	+ 40,237	+ 175,374	+113.60	+ 77.55	50
61,672	557,200	+ 5,172	+ 112,200	+ 9.15	+ 25.21	51
32,040	265,400	+ 6,862	+ 50,903	+ 27.25	+ 23.73	52
1,089,430	1,208,788	+ 29,096	+ 101,058	+ 2.74	+ 9.12	53
5,887,982 16,853	238,064 102,175	− 148,585 − 5,100	+ 22,028	− 2.46 − 23.23	+ 6.92	54
7,805	23,415	+ 3,872	+ 8,194	+ 98.45	+ 53.83	55

[k] Including nitrate of soda, carbonate of soda, sulphate of soda, and alum clays used by paper manufacturers; and bismuth, molybdenum, nickel and cobalt, tantalum, titanium, uranium, and vanadium, valued together at $48,300.

[l] Nineteen short tons of high-grade concentrates shipped to England from South Carolina in 1903. In 1904 about 142 short tons of concentrates from South Carolina, South Dakota, and Alaska shipped to England. In 1905 no production. In 1906, 2,500 pounds of metallic tin, 55 short tons of concentrates from Alaska, and 14 short tons of concentrates from North Carolina and South Carolina.

[m] Including brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania. Coke 1902: 25,401,730 short tons; value at ovens, $63,339,167. 1903: 25,274,281 short tons; value at ovens, $66,498,664. 1904: 23,661,106 short tons; value at ovens, $46,144,941. 1905: 32,231,129 short tons; value at ovens, $72,476,196. 1906: 36,401,217 short tons; value at ovens, $91,608,034.

[n] Of 42 gallons.

[o] Value of clay mined and sold as unmanufactured clay. 1897: $978,448. 1898: $1,384,766. 1899: Census returns, $1,645,328. 1900: $1,840,377. 1901: $2,576,932. 1902: $2,061,072. 1903: $2,594,042. 1904: $2,320,162. 1905: $2,768,006. 1906: $3,245,256.

[p] Of 380 pounds net.

[q] Including limestone for iron flux, but not including grindstones.

[r] Of 280 pounds net. Value is for net product exclusive of cost of packages.

[s] Including metallic paint, ocher, umber, mortar colors, sienna, and ground slate.

Mineral products of the United

	Product.	1905. Quantity.	Value.
	NONMETALLIC (SPOT VALUES)—continued.		
56	Manganese ores ..... long tons..	4,118	$36,214
	Manganiferous iron ores ..... do....	.....	.....
57	Mica (sheet) ..... pounds..	924,875	160,732
	Mica (scrap) ..... short tons..	1,126	17,856
58	Mineral waters ..... gallons sold..	47,590,081	6,811,611
59	Monazite and zircon ..... pounds..	1,352,418	163,908
60	Precious stones	.....	326,350
61	Pumice stone ..... short tons..	1,832	5,540
62	Quartz (flint) ..... do....	51,145	104,109
63	Rutile	.....	.....
64	Sand, molding, building, etc., and gravel ..... short tons..	22,144,633	10,115,915
65	Talc and soapstone ..... do....	40,134	637,062
66	Tungsten ..... do....	803	268,676
67	Uranium and vanadium ..... do....	4	375
68	Total value of nonmetallic mineral products	.....	921,075,619
69	Total value of metallic products	.....	702,453,101
70	Estimated value of mineral products unspecified [a]	.....	400,000
71	Grand total	.....	1,623,928,720

[a] Including nitrate of soda, carbonate of soda, sulphate of soda, and alum clays used by paper manufacturers; and bismuth, molybdenum, nickel and cobalt, tantalum, titanium, uranium, and vanadium, valued together at $48,300.

States in 1905 and 1906—Continued.

1906.		Increase (+) or decrease (−) in 1906.		Percentage of increase (+) or decrease (−) in 1906.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
6,921	$88,132	+ 2,803	+ $51,918	+ 68.07	+143.36	56
41,300	122,400	....	....	....	....	
1,423,100	252,248	+ 498,225	+ 91,516	+ 53.87	+ 56.94	57
1,489	22,742	+ 363	+ 4,886	+ 32.24	+ 27.36	
51,407,668	8,559,650	+ 3,817,587	+ 1,748,039	+ 8.02	+ 25.66	58
847,275	152,560	....	− 11,348	....	− 6.92	59
....	208,000	....	− 118,350	....	− 36.26	60
12,200	16,750	+ 10,368	+ 11,210	+565.94	+202.35	61
66,697	243,012	+ 15,552	+ 138,903	+ 30.41	+133.42	62
....	(a)	....	....	....	....	63
31,842,572	11,489,420	+ 9,697,939	+ 1,373,505	+ 43.79	+ 13.58	64
58,972	874,356	+ 18,838	+ 237,294	+ 46.94	+ 37.25	65
928	348,867	+ 125	+ 80,191	+ 15.57	+ 29.85	66
....	(a)	....	....	....	....	67
....	1,016,206,709	....	+ 95,131,090	....	+ 10.33	68
....	886,110,856	....	+ 183,657,755	....	+ 26.15	69
....	200,000	....	− 200,000	....	− 50.00	70
....	1,902,517,565	....	+ 278,588,845	....	+ 17.15	71

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 ores .... long tons..	5,761	86,415
34	Asphalt .... 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 1880–1906.

1881.		1882		1883.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,144,254	$87,029,334	4,623,323	$106,336,429	4,595,510	$91,910,200	1
33,257,800	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	29
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 ores .... long tons..	10,180	122,160
35	Asphalt .... 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	Colbalt 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 1880–1906—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	Asphalt .... 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 ores .... 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 1880–1906—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	$128,387,985	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	3,390	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	Asphalt........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 ores........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

[a] Including copper made from imported pyrites.

the calendar years 1880–1906—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

b Clay products.

Mineral products of the United States for

	Product.	1896. Quantity.	1896. 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	Asphalt........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 ores........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 1880–1906—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	54,356	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..	{ b1,602 c24,225	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	Asphalt..........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 ores..........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	Tungsten..........do....	46	11,040
68	Uranium and vanadium..........do....		
69	Total value of nonmetallic mineral products..........	....	594,398,501
70	Total value of metallic products..........	....	511,632,891
71	Estimated value of mineral products unspecified..........	....	1,000,000
72	Grand total..........	....	1,107,031,392

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

the calendar years 1880–1906—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	1,257,879	207,874	947,089	d 233,127	1,109,818	39
(d)	(d)	(d)	(d)			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	167,714	3,936,824	182,108	4,538,155	225,554	54
809		4,739		16,591		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	26,671	418,460	66
179	27,720	184	34,040	292	43,639	67
375	....	3,810	48,125	30	5,625	68
....	660,993,170	....	722,186,708	....	907,495,032	69
....	480,006,859	....	599,916,009	....	583,433,948	70
....	1,000,000	....	1,000,000	....	1,000,000	71
....	1,142,000,029	....	1,323,102,717	....	1,491,928,980	72

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

Mineral products of the United States for the calendar years 1880–1906—Continued.

Product.	1904.		1905.	
	Quantity.	Value.	Quantity.	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 .. flasks..	34,570	1,503,795	30,451	1,103,120
Aluminum, value at Pittsburg ...... pounds..	8,600,000	2,477,000	11,347,000	3,246,300
Antimony, value, San Francisco ..... sh. tons..	3,057	505,524	3,240	705,787
Nickel, value at Philadelphia .... pounds..	24,000	11,400	....	....
Tin .... do....	....	....	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	315,062,785	334,658,294
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	79	1,412
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 .... do....			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	....	....
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
Asphalt .... 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	1,060,334	1,107,730
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 ores .... long tons..	3,146	29,466	4,118	36,214
Mica (sheet) .... pounds..	668,358	109,462	924,875	160,732
Mica (scrap) .... short tons..	1,096	10,854	1,126	17,856
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	....	....
Sand, molding, etc., and gravel ...... sh. tons..	9,821,009	$4,951,607	22,144,633	$10,115,915
Talc and soapstone .... do....	27,184	433,331	40,134	637,062
Tungsten .... do....	740	184,000	803	268,676
Uranium and vanadium .... do....	45	10,600	4	375
Total value of nonmetallic mineral products	....	859,567,604	....	921,075,619
Total value of metallic products	....	501,099,950	....	702,453,101
Estimated value of mineral products unspecified	....	400,000	....	400,000
Grand total	....	1,361,067,554	....	1,623,928,720

Mineral products of the United States for the calendar years 1880–1906—Continued.

Product.	1906. Quantity.	Value.
METALLIC.		
Pig iron (spot value) ... long tons..	25,307,191	$505,700,000
Silver, commercial value ... troy ounces..	56,517,900	38,256,400
Gold, coining value ... do....	4,565,333	94,373,800
Copper, value at New York City ... pounds..	917,805,682	177,595,888
Lead, value at New York City ... short tons..	350,153	39,917,442
Zinc, value at New York City ... do....	199,694	24,362,668
Quicksilver, value at San Francisco ... flasks..	26,238	958,634
Aluminum, value at Pittsburg ... pounds..	14,910,000	4,262,286
Antimony, value at San Francisco ... short tons..	1,766	602,949
Nickel, value at Philadelphia ... pounds..	....	....
Tin ... do....	....	35,600
Platinum, value (crude) at New York City ... troy ounces..	1,439	45,189
Total value of metallic products	....	886,110,856
NONMETALLIC (spot values).		
Bituminous coal ... short tons..	342,874,867	381,162,115
Pennsylvania anthracite ... long tons..	63,645,010	131,917,694
Natural gas	....	46,873,932
Petroleum ... barrels..	126,493,936	92,444,735
Clay products	....	161,032,722
Cement ... barrels..	51,000,445	55,302,277
Lime ... short tons..	3,197,754	12,480,653
Sand-lime brick	....	1,170,005
Slate	....	5,668,346
Stone	....	66,378,794
Corundum and emery ... short tons..	1,160	44,310
Crystalline quartz ... do....	24,082	121,671
Garnet for abrasive purposes ... do....	4,650	157,000
Grindstones	....	744,894
Infusorial earth and tripoli ... short tons..	8,099	72,108
Millstones	....	48,590
Oilstones, etc	....	268,070
Arsenious oxide ... pounds..	1,474,000	63,460
Borax (crude) ... short tons..	58,173	1,182,410
Bromine ... pounds..	1,283,250	165,204
Fluorspar ... short tons..	40,796	244,025
Gypsum ... do....	1,540,585	3,837,975
Lithium minerals ... do....	383	7,411
Marls ... do....	19,104	7,341
Phosphate rock ... long tons..	2,080,957	8,579,437
Pyrite ... do....	261,422	931,305
Sulphur ... do....	294,153	5,096,678
Salt ... barrels..	28,172,380	6,658,350
Barytes (crude) ... short tons..	50,231	160,367
Cobalt oxide ... pounds..	....	....
Mineral paints ... short tons..	49,921	521,729
Zinc white ... do....	74,680	5,999,375
Asbestos ... do....	1,695	28,565
Asphaltum ... do....	138,059	1,290,340
Bauxite ... long tons..	75,332	368,311
Chromic iron ore ... do....	107	1,800
Feldspar ... short tons..	75,656	401,531
Fibrous talc ... do....	61,672	557,200
Fuller's earth ... do....	32,040	265,400
Glass sand ... do....	1,089,430	1,208,788
Graphite, Crystalline ... pounds..	5,887,982	238,064
Graphite, Amorphous ... short tons..	16,853	102,175
Magnesite ... do....	7,805	23,415
Manganese ores ... long tons..	6,921	88,132
Manganiferous iron ores ... do....	41,300	122,400
Mica, Sheet ... pounds..	1,423,100	252,248
Mica, Scrap ... short tons..	1,489	22,742
Mineral waters ... gallons sold..	51,407,668	8,559,650
Monazite and zircon ... pounds..	847,275	152,560
Precious stones	....	208,000
Pumice stone ... short tons..	12,200	16,750
Quartz (flint) ... do....	66,697	243,012
Rutile ... pounds..	....	....
Sand, molding, etc., and gravel ... short tons..	31,842,572	11,489,420
Talc and soapstone ... do....	58,972	874,356
Tungsten ... do....	928	348,867
Uranium and vanadium ... do....	....	....
Total value of nonmetallic mineral products	....	1,016,206,709
Total value of metallic products	....	886,110,856
Estimated value of mineral products unspecified	....	200,000
Grand total	....	1,902,517,565

OUTPUT AND VALUE, BY STATES AND TERRITORIES, OF THE MINERAL PRODUCTS OF THE UNITED STATES IN THE CALENDAR YEARS 1905 AND 1906.

In the following table are shown the quantity and the value, by States and Territories, of the mineral products of the United States in 1905 and 1906, 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 in 1905 and 1906 given under the different States are the values for the output reported to the United States Geological Survey directly from the producing mines as given in the respective sections of the chapter on gold and silver; the values for 1905 and 1906 in the preceding table are the official figures agreed upon by the United States Geological Survey and the Director of the Mint. The figures for copper, lead, and zinc are taken from their respective chapters and are based on smelter reports; they differ somewhat from the corresponding figures in the chapter on gold and silver, which are based on mines reports. The figures for the tonnage (not the value) of pig iron in 1905 and 1906 are taken from the annual reports prepared by Mr. James M. Swank, general manager of the American Iron and Steel Association.[a]

The total value of the output, raw materials and derivatives, by States, as shown in this statement for 1906 is $2,186,086,366, as against $1,853,874,155 in 1905, a gain in 1906 of $332,212,211.

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[a] Ann. Statist. Rept. Amer. Iron and Steel Association for the years 1905 and 1906.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906.

ALABAMA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay............short tons..	56,365	$22,924	45,871	$20,564
Clay products..........	....	1,392,871	....	1,688,899
Coal............short tons..	11,866,069	14,387,721	13,107,963	17,514,786
Coke............do....	2,576,986	7,646,957	3,034,501	8,477,899
Ammonium sulphate............pounds..	230,207	a 253,453	....	b 2,166,480
Coal tar............gallons..	4,592,516	128,271	....	
Gas, illuminating............cubic feet..	1,905,498,180	429,817	....	
Gas coke............short tons..	384,206	1,157,987	....	
Glass sand............do....	162	130	....	....
Gold (mines report)........fine ounces (troy)..	2,009	41,530	1,205.51	24,921
Iron ores............long tons..	3,782,831	4,257,155	3,995,098	5,123,539
Iron, pig............do....	1,604,062	b 22,680,000	1,674,848	b 28,450,000
Lime............short tons..	79,973	292,162	92,402	341,627
Mineral waters............gallons sold..	57,269	23,704	65,450	26,075
Natural gas..........	....	....	....	(c)
Sand and gravel............short tons..	197,942	93,022	216,037	129,916
Sand-lime brick..........	....	23,727	....	(d)
Silver (mines report)......fine ounces (troy)..	336	203	124	83
Stone..........	....	560,210	....	704,811
Other products..........	....	d 193,444	....	d 376,553
Total..........	....	53,585,288	....	65,046,153

a Includes Georgia.
b Estimated.
c Included under Texas.
d Includes in 1905: Bauxite, cement, graphite, natural gas, and pyrite. Includes in 1906: Barytes, bauxite, Portland and slag cement, graphite, ocher, pyrite, sand-lime brick, sienna, Venetian red.

ALASKA.

Coal............short tons..	3,774	$13,250	5,541	$17,974
Copper............pounds..	4,900,866	759,634	8,685,646	1,676,330
Gold (mines report).......fine ounces (troy)..	756,101.28	15,630,000	1,066,029.91	22,036,794
Lead............short tons..	....	(a)	8	912
Silver (mines report)......fine ounces (troy)..	132,724	80,165	166,068	111,266
Stone..........	....	710	....	(b)
Other products..........	....	....	....	b 28,379
Total..........	....	16,483,759	....	23,871,655

a Included under Miscellaneous.
b Includes in 1906: Gypsum, marble, mineral waters.

ARIZONA.

Clay products..........	....	$90,436	....	$93,694
Copper............pounds..	235,908,150	36,565,763	262,566,103	50,675,257
Gold (mines report)........fine ounces (troy)..	135,412	2,799,214	143,416.55	2,964,683
Lead............short tons..	1,986	188,670	2,884	328,776
Lime............do....	5,298	32,557	14,084	96,470
Silver (mines report).......fine ounces (troy)..	2,605,712	1,573,850	3,026,438	2,027,714
Stone..........	....	69,393	....	65,231
Zinc............short tons..	....	....	64	7,808
Other products..........	....	a 26,251	....	a 106,256
Total..........	....	41,346,134	....	56,365,889

a Includes in 1905: Asbestos, clay molybdenum, mineral waters, sand-lime brick, and tungsten. Includes in 1906: Asbestos, clay, Portland cement, mineral waters, precious stones, tungsten.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

ARKANSAS.

Product.	1905.		1906	
	Quantity.	Value.	Quantity.	Value.
Asphalt .... short tons..	1,000	$3,000	900	$5,400
Bauxite .... long tons..	32,956	164,780	50,267	242,876
Clay products	....	643,959	....	532,194
Coal .... short tons..	1,934,673	2,880,738	1,864,268	3,000,339
Coal tar .... gallons..	66,900	3,677	....	
Gas, illuminating .... cubic feet..	51,914,400	72,026	....	a 101,145
Gas coke .... short tons..	3,894	16,247	....	
Lime .... do....	29,424	114,846	30,348	121,953
Manganese ores .... long tons..	....	....	62	290
Manganiferous iron ores .... do....	....	....	8,900	24,800
Mineral waters .... gallons sold..	474,005	50,501	727,765	105,286
Natural gas	....	....	....	b 34,500
Sand and gravel .... short tons..	122,364	50,485	214,425	104,212
Slate	....	10,000	....	5,000
Stone	....	304,291	....	240,350
Zinc .... short tons..	....	....	1,801	219,722
Other products	....	c 168,587	....	c 195,832
Total	....	4,483,137	....	4,933,899

a Estimated.
b Includes Wyoming.
c Includes in 1905: Iron ores, natural gas, oilstones, and sand-lime brick. Includes in 1906: Fuller's earth, oilstones, phosphate rock, sand-lime brick, slate and shale.

CALIFORNIA.

Product.	1905.		1906	
	Quantity.	Value.	Quantity.	Value.
Asphalt .... short tons..	91,076	$568,403	91,957	$758,579
Borax .... do....	46,334	1,019,154	58,173	1,182,410
Cement, Portland .... barrels..	1,225,429	1,671,816	1,310,435	2,110,294
Chromite .... long tons..	22	375	107	1,800
Clay .... short tons..	50,850	50,290	57,413	67,418
Clay products	....	3,865,147	....	4,364,230
Coal .... short tons..	77,050	382,725	25,290	60,710
Coal tar .... gallons..	27,220	2,212	....	
Gas, illuminating .... cubic feet..	30,474,033	47,793	....	a 73,027
Gas coke .... short tons..	1,710	16,384	....	
Copper .... pounds..	16,697,489	2,588,111	28,153,202	5,433,568
Glass sand .... short tons..	9,257	8,122	7,324	6,124
Gold (mines report) .... fine ounces (troy)..	914,217.14	18,898,545	906,182.36	18,732,452
Lead .... short tons..	110	10,450	432	49,248
Lime .... do....	67,476	535,157	73,941	601,557
Lithium minerals .... do....	21	252	....	(b)
Magnesite .... do....	3,933	15,221	7,805	23,415
Manganese ores .... long tons..	1	5	....	(b)
Mineral waters .... gallons sold..	1,934,784	675,214	1,487,975	520,515
Natural gas	....	133,696	....	134,560
Ocher .... short tons..	780	5,900	500	4,470
Petroleum .... barrels..	33,427,473	8,201,846	33,098,598	9,553,430
Platinum .... crude ounces (troy)..	....	3,320	....	(b)
Precious stones	....	....	....	121,600
Pyrite .... long tons..	61,748	247,712	52,926	236,867
Quicksilver .... flasks ..	24,635	886,081	20,310	730,808
Salt .... barrels..	664,099	188,330	806,788	291,528
Sand and gravel .... short tons..	141,636	62,985	228,050	103,300
Sand-lime brick	....	34,689	....	61,189
Silver (mines report) .... fine ounces (troy)..	1,076,174	650,009	1,220,641	817,830
Slate .... squares..	5,000	40,000	10,000	80,000
Stone	....	2,531,928	....	2,254,626
Other products	....	b 64,386	....	b 1,661,854
Total	....	43,406,258	....	50,037,409

a Estimated.
b Includes in 1905: Asbestos, gypsum, infusorial earth, metallic paint, talc, and tungsten. Includes in 1906: Arsenic, asbestos, fuller's earth, gypsum, infusorial earth and tripoli, litharge, lithium minerals, manganese ore, metallic paint, orange mineral, platinum, tungsten, red lead, white lead, zinc lead.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

COLORADO.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Bismuth........pounds..	2,288	$4,187	8,334	$12,500
Clay........short tons..	41,317	42,669	71,796	70,597
Clay products........	....	1,633,231	....	1,831,088
Coal........short tons..	8,826,429	10,810,978	10,111,218	12,735,616
Coke........do....	1,378,824	*a* 4,157,517	(*b*)	(*b*)
Ammonium sulphate........pounds..	243,756	*c* 9,289	....	*d* 880,028
Coal tar........gallons..	698,527	26,758	....	
Gas, illuminating........cubic feet..	496,695,079	556,917	....	
Gas coke........short tons..	35,089	140,673	....	
Copper........pounds..	9,404,830	1,457,749	7,427,253	1,433,460
Fluorspar........short tons..	1,156	8,200	....	(*e*)
Glass sand........do....	1,500	1,875	750	938
Gold (mines report)........fine ounces (troy)..	1,210,534.73	25,023,973	1,122,814.17	23,210,629
Iron ores........long tons..	133,471	398,700	14,078	22,525
Iron, pig........do....	....	(*f*)	....	(*b*)
Lead........short tons..	53,806	5,111,570	50,497	5,756,658
Lime........do....	10,115	48,459	6,595	32,020
Manganiferous iron ores........long tons..	....	....	32,400	97,600
Mineral waters........gallons sold..	903,600	130,623	829,850	116,366
Natural gas........	....	20,752	....	22,800
Petroleum........barrels..	376,238	337,606	327,582	262,675
Precious stones........	....	....	....	2,000
Sand and gravel........short tons..	21,295	12,870	47,456	19,589
Silver (mines report)........fine ounces (troy)..	11,499,307	6,945,581	12,216,830	8,185,276
Stone........	....	816,751	....	725,124
Uranium and vanadium........short tons..	4	*a* 375	....	(*b*)
Zinc........do....	6,599	778,682	32,456	3,959,632
Other products........	....	*b* 804,959	....	*b* 10,457,460
Total........	....	59,280,944	....	69,834,581

a Includes Utah.
b Includes in 1905: Cement, graphite, mica, sand-lime brick, and tungsten. Includes in 1906: Cement, coke, fuller's earth, graphite, gypsum, mica, pig iron, sand-lime brick, tantalum, tungsten, uranium, vanadium,
c Includes Washington.
d Estimated.
e Included under Kentucky.
f Included under miscellaneous.

CONNECTICUT.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay products........	....	*a* $1,608,578	....	*a* $1,747,205
Coal products:				
Ammonium sulphate........pounds..	....	(*b*)	....	(*b*)
Coal tar........gallons..	712,328	35,980	....	*c* 823,834
Gas, illuminating........cubic feet..	527,103,580	579,553	....	
Gas coke........short tons..	37,958	133,407	....	
Feldspar........do....	19,541	*d* 107,536	....	(*e*)
Flint........do....	....	(*f*)	....	(*e*)
Iron, pig........long tons..	12,521	*c* 220,000	....	(*e*)
Lime........short tons..	70,558	261,509	90,457	411,853
Mineral waters........gallons sold..	205,115	23,362	453,473	76,827
Precious stones........	....	....	....	200
Sand and gravel........short tons..	12,821	6,958	14,633	5,466
Stone........	....	1,014,064	....	1,386,540
Other products........	....	*e* 107,678	....	*e* 2,217,363
Total........	....	4,098,625	....	6,669,288

a Includes Rhode Island.
b Included under Rhode Island.
c Estimated.
d Includes Maine and New York.
e Includes in 1905: Clay, crystalline quartz, infusorial earth, and iron ores. Includes in 1906: Clay, feldspar, infusorial earth, iron ores, metallic paint, mica, pig iron, crystalline quartz, quartz (flint), sandstone.
f Included under Maryland.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

DELAWARE.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$227,064		$237,768
Coal products:				
Ammonium sulphate.....pounds		([a])		([a])
Coal tar.....gallons	76,606	2,725		[b] 84,360
Gas, illuminating.....cubic feet	60,690,000	61,226		
Gas coke.....short tons	4,128	12,740		
Sand and gravel.....do	160,881	65,181	84,871	35,191
Stone		178,428		146,346
Other products		[c] 215,580		[c] 310,461
Total		762,944		814,126

[a] Included under Maryland.
[b] Estimated.
[c] Includes in 1905: Clay, pigments (unclassified), and sand-lime brick. Includes in 1906: Clay, lithophone, sand-lime brick.

DISTRICT OF COLUMBIA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Clay products		$317,021		$335,139
Coal products:				
Ammonium sulphate.....pounds		([a])		([a])
Coal tar.....gallons		([a])		([a])
Gas, illuminating.....cubic feet		([a])		([a])
Gas coke.....short tons		([a])		([a])
Mineral waters.....gallons sold		([b])		
Other products		([b])		[c] 26,900
Total		317,021		362,039

[a] Included under Maryland. [b] Included under Miscellaneous.
[c] Includes in 1906: Mineral waters, pottery.

FLORIDA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Clay products		$329,738		$289,644
Coal products:				
Coal tar.....gallons		([a])		([a])
Gas, illuminating.....cubic feet		([a])		([a])
Gas coke.....short tons		([a])		([a])
Lime.....do	10,719	63,950	18,362	71,382
Mineral waters.....gallons sold	140,920	28,170	71,494	22,049
Phosphate rock.....long tons	1,194,106	4,251,845	1,304,505	5,585,578
Sand-lime brick				89,306
Stone		5,800		1,450
Other products		[b] 149,280		[b] 336,416
Total		4,828,783		6,395,825

[a] Included under Louisiana.
[b] Includes in 1905: Pottery, sand and gravel, and sand-lime brick. Includes in 1906: Clay, fuller's earth, pottery, and sand and gravel.

GEORGIA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Cement, natural.....barrels	89,167	$51,040	180,500	$98,075
Clay.....short tons	29,028	102,467	38,979	156,690
Clay products		2,119,746		2,400,624
Coal.....short tons	353,548	[a] 456,184	332,107	424,004
Coke.....do	70,593	224,260	70,280	277,921
Ammonium sulphate.....pounds		([b])		[c] 678,615
Coal tar.....gallons	712,799	24,604		
Gas, illuminating.....cubic feet	468,572,850	491,138		
Gas coke.....short tons	34,720	101,181		
Copper.....pounds			17,182	3,316
Glass sand.....short tons	4,500	4,050	6,000	6,000
Gold (mines report).....fine ounces (troy)	4,688	96,910	1,502.05	31,050
Iron ores.....long tons	200,842	296,561	411,230	734,780

[a] Includes North Carolina. [b] Included under Alabama. [c] Estimated.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

GEORGIA—Continued.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Iron, pig..........long tons..		(a)		(b)
Lime..........short tons..	16,200	$49,580	18,903	$72,840
Manganese ores..........long tons..	150	900		
Mineral waters..........gallons sold..	270,249	37,619	130,900	14,535
Ocher..........short tons..	4,209	43,481	5,550	58,350
Sand and gravel..........do....	80,503	37,203	329,797	111,816
Silver (mines report)........fine ounces (troy)..	1,040	628	599	402
Slate..........squares..	1,500	7,500	1,000	5,000
Stone..........		1,754,787		1,727,713
Other products..........		[b] 697,376		[b] 2,125,630
Total..........		6,597,215		8,927,361

[a] Included under Miscellaneous.
[b] Includes in 1905: Asbestos, bauxite, Portland cement, graphite, infusorial earth, iron ores, mica, pyrite, and talc. Includes in 1906: Asbestos, asphalt, bauxite, Portland cement, fuller's earth, graphite, infusorial earth, pig iron, pyrite, sand-lime brick, talc, and soapstone.

IDAHO.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Clay products..........		$212,780		(a)
Coal..........short tons..	5,882	[b] 17,846	5,365	$18,538
Coal tar..........gallons..		(c)		(c)
Gas, illuminating..........cubic feet..		(c)		(c)
Gas coke..........short tons..		(c)		(c)
Copper..........pounds..	7,321,585	1,134,846	8,578,046	1,655,563
Gold (mines report)........fine ounces (troy)..	52,033	1,075,618	55,587.73	1,149,100
Lead..........short tons..	94,076	8,937,125	117,117	13,351,338
Lime..........do....	6,694	44,733	5,932	39,840
Precious stones..........				400
Pumice..........short tons..		(d)		
Salt..........barrels..			1,574	1,867
Silver (mines report)........fine ounces (troy)..	8,679,093	5,242,172	9,018,815	6,042,606
Stone..........		37,870		24,969
Zinc..........short tons..		(e)	573	69,906
Other products..........		[a] 65,865		[a] 367,047
Total..........		16,768,855		22,721,174

[a] Includes in 1905: Clay, mineral waters, and salt. Includes in 1906: Antimony, clay, clay products, mica, mineral waters, phosphate rock, sand-lime brick.
[b] Includes Nevada.
[c] Included under Utah.
[d] Included under Nebraska.
[e] Included under Miscellaneous.

ILLINOIS.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Cement, natural..........barrels..	368,645	$116,549	365,843	$118,221
Cement, Portland..........do....	1,545,500	1,741,150	1,858,403	2,461,494
Clay..........short tons..	127,728	120,410	139,704	131,272
Clay products..........		12,361,786		12,634,181
Coal..........short tons..	38,434,363	40,577,592	41,480,104	44,763,062
Coke..........do....	10,307	27,681	268,693	1,205,462
Ammonium sulphate..........pounds..	312,926	22,956		[a] 2,720,641
Coal tar..........gallons..	2,415,023	49,714		
Gas, illuminating..........cubic feet..	1,768,186,332	1,912,868		
Gas coke..........short tons..	129,564	487,772		
Fluorspar..........do....	33,275	220,206	28,268	160,623
Glass sand..........do....	234,391	146,605	238,178	156,684
Iron, pig..........long tons..	2,034,483	[a] 37,040,000	2,156,866	[a] 47,128,000
Lead..........short tons..		(b)	572	65,208
Lime..........do....	98,907	421,589	121,546	534,118
Mineral waters..........gallons sold..	425,750	47,995	574,453	77,287
Natural gas..........		7,223		87,211
Petroleum..........barrels..	181,084	116,561	4,397,050	3,274,818
Sand and gravel..........short tons..	1,393,012	547,167	2,419,381	886,357
Stone..........		3,541,005		2,961,456
Zinc..........short tons..	46,606	5,499,508	282	34,404
Other products..........		[c] 59,230		[c] 1,787,807
Total..........		105,065,567		121,188,306

[a] Estimated.
[b] Included under Miscellaneous.
[c] Includes in 1905: Slag, cement, and sand-lime brick. Includes in 1906: Alum and aluminum sulphate, slag cement, infusorial earth, sand-lime brick, Venetian red, and white lead.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

INDIANA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Cement, natural.....barrels..	527,600	$211,040	600,000	$240,000
Cement, Portland.....do....	3,127,042	3,134,219	3,951,836	4,964,855
Clay.....short tons..	76,951	79,945	63,279	62,974
Clay products.....	.....	6,499,573	.....	7,158,234
Coal.....short tons..	11,895,252	12,492,255	12,092,560	13,116,261
Ammonium sulphate.....pounds..	33,769	22,630	.....	
Coal tar.....gallons..	1,712,397	44,198	.....	[a] 1,694,141
Gas, illuminating.....cubic feet..	1,216,172,974	1,169,947	.....	
Gas coke.....short tons..	90,927	303,354	.....	
Glass sand.....do....	1,640	2,169	38,940	29,259
Lime.....do....	106,408	366,866	114,819	353,648
Mineral waters.....gallons sold..	897,175	435,182	464,988	452,360
Natural gas.....	.....	3,094,134	.....	1,750,715
Oilstones.....	.....	([b])	.....	23,806
Petroleum.....barrels..	10,964,247	9,404,909	7,673,477	6,770,066
Pyrite.....long tons..	3,107	11,491	2,579	7,179
Sand and gravel.....short tons..	3,148,543	1,239,181	6,182,835	1,006,093
Sand-lime brick.....	.....	65,905	.....	86,880
Stone.....	.....	3,204,680	.....	3,756,305
Total.....	.....	41,781,678	.....	34,472,776

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

INDIAN TERRITORY.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Asphalt.....short tons..	2,936	$27,790	2,690	$18,461
Clay products.....	.....	374,235	.....	299,790
Coal.....short tons..	2,924,427	5,145,358	2,860,200	5,482,366
Coke.....do....	54,781	199,424	49,782	204,205
Coal tar.....gallons..	54,002	[a] 3,323	.....	
Gas, illuminating.....cubic feet..	52,194,000	[a] 55,792	.....	[b] 83,232
Gas coke.....short tons..	3,636	[a] 16,551	.....	
Lime.....do....	100	650	510	3,350
Mineral waters.....gallons sold..	.....	([c])	.....	([d])
Natural gas.....	.....	[a] 130,137	.....	.....
Petroleum.....barrels..	.....	([e])	.....	([f])
Stone.....	.....	9,510	.....	45,237
Other products.....	.....	.....	.....	[d] 3,805
Total.....	.....	5,962,770	.....	6,140,446

[a] Includes Oklahoma.
[b] Estimated.
[c] Included under Miscellaneous.
[d] Includes in 1906: Clay, mineral waters.
[e] Included under Kansas.
[f] Included under Oklahoma.

IOWA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Clay.....short tons..	.....	.....	2,005	$1,910
Clay products.....	.....	$3,392,122	.....	3,469,027
Coal.....short tons..	6,798,609	10,586,381	7,266,224	11,619,455
Coal tar.....gallons..	633,598	14,775	.....	
Gas, illuminating.....cubic feet..	534,747,650	633,557	.....	[a] 910,651
Gas coke.....short tons..	39,369	179,533	.....	
Gypsum.....do....	.....	589,055	.....	573,498
Lead.....do....	.....	([b])	270	30,780
Lime.....do....	19,360	76,904	17,497	78,366
Mineral waters.....gallons sold..	303,500	31,300	227,500	23,700
Sand and gravel.....short tons..	325,882	92,287	184,673	74,380
Sand-lime brick.....	.....	38,652	.....	38,255
Stone.....	.....	461,126	.....	499,416
Zinc.....short tons..	.....	.....	201	24,522
Other products.....	.....	[c] 2,336	.....	[c] 3,840
Total.....	.....	16,098,028	.....	17,347,800

[a] Estimated.
[b] Included under Miscellaneous.
[c] Includes in 1905: Clay, iron ores, and ocher. Includes in 1906: Ocher, shale, Venetian red.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

KANSAS.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Cement, natural........barrels..	230,686	[a] $110,750	[b] 3,020,862	$3,908,708
Clay products........	....	1,906,360	....	2,432,371
Coal........short tons..	6,423,979	9,350,542	6,024,775	8,979,553
Coke........do....	4,425	13,818	1,698	4,101
Coal tar........gallons..	205,690	10,898	....	
Gas, illuminating........cubic feet..	151,847,400	194,310	....	[c] 264,514
Gas coke........short tons..	9,749	35,260	....	
Gypsum........do....	....	150,402	....	247,572
Lead........do....	....	([d])	1,932	220,248
Lime........do....	2,795	17,242	1,560	10,217
Mineral waters........gallons sold..	213,050	47,708	305,957	89,807
Natural gas........	....	2,261,836	....	4,010,986
Petroleum........barrels..	12,013,495	[e] 6,546,398	....	([f])
Salt........do....	2,098,585	576,139	2,198,837	681,322
Sand and gravel........short tons..	70,988	21,552	293,918	66,762
Stone........	....	1,003,006	....	892,012
Zinc........short tons..	114,287	13,485,866	3,902	476,044
Other products........	....	[g] 2,349,861	....	[g] 299,859
Total........	....	38,081,948	....	22,584,076

[a] Includes Texas.
[b] Portland cement.
[c] Estimated.
[d] Included under Miscellaneous.
[e] Includes Indian Territory and Oklahoma.
[f] Included under Oklahoma.
[g] Includes in 1905: Portland cement, pottery, and sand-lime brick. Includes in 1906: Natural cement, emery, pottery, sand-lime brick, zinc lead, zinc white.

KENTUCKY.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Asphalt........short tons..	8,834	$66,420	4,172	$31,488
Barytes........do....	....	([a])	....	([a])
Cement, natural........barrels..	207,500	83,000	....	([b])
Clay........short tons..	43,536	57,090	45,910	59,780
Clay products........	....	2,406,350	....	2,592,423
Coal........short tons..	8,432,523	8,385,232	9,653,647	9,809,938
Coke........do....	79,487	159,659	74,064	169,846
Ammonium sulphate........pounds..	310,934	15,495	....	
Coal tar........gallons..	959,293	17,942	....	[d] 831,887
Gas, illuminating........cubic feet..	596,328,520	539,724	....	
Gas, coke........short tons..	56,328	183,100	....	
Fluorspar........do....	22,694	132,362	[c] 12,528	83,402
Glass sand........do....	739	480	2,400	2,040
Iron, pig........long tons..	63,735	[d] 1,120,000	98,127	[d] 2,077,000
Lead........short tons..	....	([e])	44	5,016
Lime........do....	9,556	28,393	9,784	28,081
Mineral waters........gallons sold..	383,750	42,415	547,605	76,141
Natural gas........	....	[f] 237,590	....	287,501
Petroleum........barrels..	[f] 1,217,337	[f] 943,211	[f] 1,213,548	[f] 1,031,629
Precious stones........	....	....	....	250
Sand and gravel........short tons..	727,131	282,464	584,477	291,096
Stone........	....	1,025,044	....	920,531
Zinc........short tons..	....	....	335	40,870
Other products........	....	[b] 45,840	....	[b] 419,978
Total........	....	15,771,811	....	18,758,897

[a] Included under Tennessee.
[b] Includes in 1905: Cement, iron ores, and sand-lime brick. Includes in 1906: Barytes, cement (Portland, natural, and slag), infusorial earth, iron ores, ocher, and sand-lime brick.
[c] Includes Colorado and Tennessee.
[d] Estimated.
[e] Included under Miscellaneous.
[f] Includes Tennessee.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

LOUISIANA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay products	....	$821,109	....	$900,697
Coal products:				
Coal tar ... gallons	87,226	a 5,710	....	b 135,313
Gas, illuminating ... cubic feet	67,703,000	a 90,989	....	
Gas coke ... short tons	6,180	a 26,313	....	
Mineral waters ... gallons sold	774,652	62,106	....	....
Natural gas	....	1,500	....	(c)
Petroleum ... barrels	8,910,416	1,601,325	9,077,528	3,557,838
Salt ... do	1,055,186	303,507	1,179,528	268,005
Sand and gravel ... short tons	350,669	189,962	941,734	448,449
Sulphur ... long tons	181,677	d 3,706,560	....	....
Other products	....	6,349	....	5,023,728
Total	....	6,815,430	....	10,334,030

a Includes Florida and Mississippi.
b Estimated.
c Included under Texas.
d Includes Nevada and Utah.

MAINE.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Clay products	....	$619,294	....	$680,370
Coal products:				
Ammonium sulphate ... pounds	....	(a)	....	(a)
Coal tar ... gallons	212,445	9,983	....	b 300,842
Gas, illuminating ... cubic feet	154,068,475	212,257	....	
Gas coke ... short tons	10,746	51,253	....	
Copper ... pounds	....	(c)	....	....
Feldspar ... short tons	....	(d)	....	(e)
Lime ... do	220,927	971,305	228,208	1,066,275
Mineral waters ... gallons sold	1,167,787	246,159	1,127,928	258,585
Precious stones	....	....	....	6,500
Slate	....	224,254	....	238,681
Stone	....	2,721,223	....	2,562,021
Other products	....	e 10,076	....	e 113,948
Total	....	5,065,804	....	5,227,222

a Included under New Hampshire.
b Estimated.
c Included under Miscellaneous.
d Included under Connecticut.
e Includes in 1905: Pottery, sand, and gravel. Includes in 1906: Feldspar, pottery, sand, and gravel.

MARYLAND.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Cement, natural ... barrels	55,324	$28,694	63,350	$32,675
Clay ... short tons	12,080	24,405	18,413	39,078
Clay products	....	2,249,367	....	2,136,539
Coal ... short tons	5,108,539	5,831,760	5,435,453	6,474,793
Ammonium sulphate ... pounds	2,234,627	a 434,385	....	f 2,697,773
Coal tar ... gallons	4,155,460	b 87,512	....	
Gas, illuminating ... cubic feet	1,753,770,009	b 596,358	....	
Gas coke ... short tons	406,764	1,334,266	....	
Feldspar ... do	15,878	c 118,621	10,229	34,507
Flint ... do	12,777	d 73,450	....	(e)
Glass sand ... do	17,899	20,108	10,000	14,000
Gold (mines report) ... fine ounces (troy)	717	14,821	....	....
Iron ores ... long tons	8,269	14,291	....	(e)
Iron, pig ... do	332,096	f 5,850,000	386,709	f 8,187,000
Lime ... short tons	134,431	360,247	127,863	350,460
Metallic paint and mortar colors ... do	1,174	3,812	....	(e)
Mineral waters ... gallons sold	456,214	44,627	593,671	58,334
Sand and gravel ... short tons	447,278	416,720	604,217	271,797

a Includes District of Columbia and Delaware.
b Includes District of Columbia.
c Includes Pennsylvania.
d Includes Pennsylvania and Connecticut.
e Includes in 1905: Slag cement, coke, sand-lime brick, and talc. Includes in 1906: Slag cement, coke, quartz (flint), infusorial earth, iron ores, metallic paint and mortar colors, sand-lime brick, and Venetian red.
f Estimated.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

MARYLAND—Continued.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Silver (mines report)......fine ounces (troy)..	93	$56		
Slate		151,215		$130,969
Stone		1,257,838		1,239,955
Talc and soapstone.....short tons..			2,956	23,310
Other products		a 1,135,704		a 1,248,704
Total		20,048,257		22,939,894

a Includes in 1905: Slag cement, coke, sand-lime brick, and talc. Includes in 1906: Slag cement, coke, quartz (flint), infusorial earth, iron ores, metallic paint and mortar colors, sand-lime brick, and Venetian red.

MASSACHUSETTS.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay.....short tons..			4,411	$6,442
Clay products		$2,050,457		2,172,733
Coal products:				
Ammonium sulphate.....pounds..	774,715	377,260		a 7,132,527
Coal tar.....gallons..	10,017,517	285,666		
Gas, illuminating.....cubic feet..	4,975,461,725	3,574,116		
Gas coke.....short tons..	670,542	2,247,074		
Copper.....pounds..			9,744	1,881
Glass sand.....short tons..	4,600	12,000	6,829	31,738
Iron, pig.....long tons..	3,466	a 60,000		(b)
Lime.....short tons..	84,380	395,326	119,267	563,100
Mineral waters.....gallons sold..	4,202,263	208,419	3,857,955	210,152
Precious stones				500
Sand and gravel.....short tons..	180,422	118,086	106,824	61,354
Stone		3,263,058		4,333,616
Other products		b 1,432,738		b 2,556,518
Total		14,024,200		16,770,561

a Estimated.
b Includes in 1905: Asbestos, clay, coke, emery, infusorial earth, iron ores, pyrite, salt, and talc. Includes in 1906: Alum and aluminum sulphate, asbestos, coke, corundum and emery, fuller's earth, iron ores, litharge, pig iron, pyrite, red lead, salt, talc and soapstone, Venetian red, and white lead.

MICHIGAN.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Bromine.....pounds..	1,192,758	a $178,914		(b)
Cement, Portland.....barrels..	2,773,283	2,921,507	3,747,525	$4,814,965
Clay.....short tons..	951	3,354	1,989	5,455
Clay products		1,765,707		1,844,477
Coal.....short tons..	1,473,211	2,512,697	1,346,338	2,427,404
Ammonium sulphate.....pounds..	2,654,323	271,333		c 4,736,349
Coal tar.....gallons..	5,958,602	116,809		
Gas, illuminating.....cubic feet..	3,263,603,059	2,325,377		
Gas coke.....short tons..	470,718	1,592,253		
Copper.....pounds..	230,287,992	35,694,639	229,695,730	44,790,667
Glass sand.....short tons..			600	3,000
Grindstones		111,500		(b)
Gypsum		634,434		753,878
Iron ores.....long tons..	10,885,902	23,367,233	11,822,874	31,145,087
Iron, pig.....do....	288,704	c 5,750,000	369,456	c 8,841,000
Lime.....short tons..	48,089	192,844	68,133	281,465
Mineral waters.....gallons sold..	2,684,800	277,188	902,528	73,357
Salt.....barrels..	9,492,173	1,851,332	9,936,802	2,018,760
Sand and gravel.....short tons..	414,509	210,609	597,189	194,699
Sand-lime brick		169,302		174,921
Silver (mines report)......fine ounces (troy)..	253,011	152,819	d 244,113	163,556
Stone		667,877		721,664
Other products		b 992,413		b 1,433,844
Total		81,760,141		104,424,548

a Includes Ohio and West Virginia.
b Includes in 1905: Asbestos, coke, graphite, petroleum, and whetstones. Includes in 1906: Aluminum salts, bromine, coke, graphite, grindstones, and whetstones.
c Estimated.
d From smelter reports.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

MINNESOTA.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay products		$1,499,386		$1,603,279
Coal products:				
Ammonium sulphate ... pounds..	771,900	59,724		[a] 1,679,821
Coal tar ... gallons..	2,111,083	54,823		
Gas, illuminating ... cubic feet..	834,691,210	842,599		
Gas coke ... short tons..	134,670	569,964		
Iron ores ... long tons..	21,735,182	35,895,001	25,364,077	51,799,256
Iron, pig ... do....		([b])		([c])
Lime ... short tons..	18,977	81,093	19,920	93,555
Mineral waters ... gallons sold..	7,681,650	132,970	8,621,979	175,677
Sand and gravel ... short tons..	109,576	71,375	145,020	77,941
Stone		1,331,949		1,543,817
Other products		[c] 766,491		[c] 3,892,104
Total		41,305,375		60,865,450

[a] Estimated.
[b] Included under Miscellaneous.
[c] Includes in 1905: Cement, coke, feldspar, pottery, and sand-lime brick. Includes in 1906: Natural cement, coke, corundum, feldspar, pig iron, pottery, and sand-lime brick.

MISSISSIPPI.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay products		$818,897		$851,080
Coal products:				
Coal tar ... gallons..		([a])		([a])
Gas, illuminating ... cubic feet..		([a])		([a])
Gas coke ... short tons..		([a])		([a])
Mineral waters ... gallons sold..	306,000	53,347	254,279	52,820
Sand and gravel ... short tons..	6,320	2,035	68,563	33,260
Sand-lime brick		([b])		
Other products				17,399
Total		874,279		954,559

[a] Included under Louisiana. [b] Included under Miscellaneous.

MISSOURI.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Barytes ... short tons..	26,761	$84,095	28,869	$93,479
Clay ... do....	172,724	322,425	165,258	365,793
Clay products		6,203,411		6,696,275
Coal ... short tons..	3,983,378	6,291,661	3,758,008	6,118,733
Coke ... do....	1,580	4,072		[a] 2,353,063
Ammonium sulphate ... pounds..	784,433	56,597		
Coal tar ... gallons..	2,486,575	86,515		
Gas, illuminating ... cubic feet..	1,672,955,701	1,556,117		
Gas coke ... short tons..	124,886	439,920		
Copper ... pounds..		([b])	54,347	10,489
Glass sand ... short tons..	123,467	66,401	101,862	65,393
Iron ores ... long tons..	113,012	161,878	80,910	158,109
Iron, pig ... do....		([b])		([c])
Lead ... short tons..		([b])	111,075	12,662,550
Lime ... do....	186,173	787,069	207,334	916,693
Mineral waters ... gallons sold..	470,750	77,480	618,400	96,545
Natural gas		7,390		7,210
Petroleum ... barrels..			[d] 3,500	4,890
Sand and gravel ... short tons..	1,961,873	668,153	2,962,796	970,985
Silver ... fine ounces (troy)..	[e] 12,900	7,869	[e] 31,268	20,950
Stone		2,446,429		2,159,294
Sublimed white lead ... short tons..			7,988	958,440
Zinc ... do....	11,844	1,397,592	130,348	15,902,456
Other products		[c] 2,378,694		[c] 5,934,970
Total		23,043,768		55,496,317

[a] Estimated.
[b] Included under Miscellaneous.
[c] Includes in 1905: Cement, grindstones, infusorial earth, petroleum, pigments (unclassified), and zinc white. Includes in 1906: Portland cement, grindstones, infusorial earth, litharge, pig iron, red lead, Venetian red, white lead, zinc lead, and zinc white.
[d] Includes Michigan.
[e] From smelter reports.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

MONTANA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay....short tons..	5,546	$33,983	1,615	$3,598
Clay products....	....	313,006	....	297,299
Coal....short tons..	1,643,832	2,823,350	1,829,921	3,240,357
Coke....do....	31,482	211,351	38,182	266,024
Coal tar....gallons..	....	(a)	....	(a)
Gas, illuminating....cubic feet..	....	(a)	....	(a)
Gas coke....short tons..	....	(a)	....	(a)
Copper....pounds..	314,750,582	48,786,340	294,701,252	56,877,341
Gold (mines report)....fine ounces (troy)..	213,913.75	4,794,083	216,188.56	4,469,014
Lead....short tons..	2,097	199,215	2,485	283,290
Lime....do....	4,073	22,436	4,745	30,098
Sand and gravel....do....	....	....	2,000	900
Silver (mines report)....fine ounces (troy)..	13,231,300	7,991,705	11,980,705	8,027,072
Stone....	....	274,669	....	292,549
Zinc....short tons..	....	(b)	1,415	172,630
Other products....	....	[c] 50,911	....	[c] 166,395
Total....	....	65,501,049	....	74,126,567

[a] Included under Nevada.
[b] Included under Miscellaneous.
[c] Includes in 1905: Abrasive corundum, grindstones, gypsum, iron ores, mineral waters, molybdenum, pottery, and tungsten. Includes in 1906: Arsenic, grindstones, gypsum, iron ores, mineral waters, molybdenum, pottery, precious stones, and tungsten.

NEBRASKA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Clay products....	....	$1,006,743	....	$990,708
Coal products:				
Coal tar....gallons..	82,393	2,426	....	....
Gas, illuminating....cubic feet..	65,553,100	83,563	....	
Gas coke....short tons..	4,916	26,135	....	[a] 123,336
Pumice....do....	1,832	[b] 5,540	....	
Sand and gravel....do....	12,900	8,200	177,417	38,308
Sand-lime brick....	....	(c)	....	....
Stone....	....	225,239	....	283,280
Other products....	....	....	....	[d] 617,468
Total....	....	1,357,846	....	2,053,100

[a] Estimated.
[b] Includes Idaho and South Dakota.
[c] Included under Miscellaneous.
[d] Includes in 1906: Litharge, mineral waters, pumice, red lead, sand-lime brick, and white lead.

NEVADA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Coal....short tons..	....	(a)	800	$5,700
Coal tar....gallons..	89,226	[b] $3,496	....	
Gas, illuminating....cubic feet..	62,522,700	[b] 114,953	....	[c] 159,276
Gas coke....short tons..	4,017	[b] 26,348	....	
Copper....pounds..	413,292	64,060	1,090,635	210,493
Gold (mines report)....fine ounces (troy)..	254,927.51	5,269,819	506,520.31	10,470,704
Lead....short tons..	2,096	199,025	1,669	190,266
Lime....do....	....	....	150	1,600
Salt....barrels..	....	....	11,249	6,420
Silver (mines report)....fine ounces (troy)..	6,482,081	3,915,177	6,770,612	4,536,310
Stone....	....	1,500	....	5,000
Sulphur....long tons..	....	(d)	....	(e)
Zinc....short tons..	....	....	1,768	215,696
Other products....	....	[e] 279,007	....	[e] 189,198
Total....	....	9,873,385	....	15,990,663

[a] Included under Idaho.
[b] Includes Montana and New Mexico.
[c] Estimated.
[d] Included under Louisiana.
[e] Includes in 1905: Clay products, graphite, gypsum, iron ores, and salt. Includes in 1906: Antimony, clay products, graphite, gypsum, iron ores, sulphur, tungsten.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

NEW HAMPSHIRE.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay products		$554,734		$726,051
Coal products:				
Ammonium sulphate ..... pounds	69,586	[a] 3,578		[c] 381,873
Coal tar ..... gallons	265,556	[b] 13,177		
Gas, illuminating ..... cubic feet	190,765,514	[b] 255,540		
Gas coke ..... short tons	14,095	[b] 74,863		
Mica				9,884
Mineral waters ..... gallons sold	813,050	197,350	781,500	230,650
Stone		838,371		818,131
Other products		[d] 91,025		[d] 81,338
Total		2,028,638		2,247,927

[a] Includes Maine.
[b] Includes Vermont.
[c] Estimated.
[d] Includes in 1905: Mica, pottery, and whetstones. Includes in 1906: Pottery, precious stones, whetstones.

NEW JERSEY.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Cement, Portland ..... barrels	3,654,777	$2,775,768	3,423,648	$4,445,364
Clay ..... short tons	440,645	616,459	470,174	680,999
Clay products		16,699,525		17,362,269
Coal products:				
Ammonium sulphate ..... pounds	1,165,550	96,752		[a] 2,651,728
Coal tar ..... gallons	2,774,725	84,243		
Gas, illuminating ..... cubic feet	1,483,032,012	1,585,683		
Gas coke ..... short tons	191,824	643,984		
Glass sand ..... do	65,673	54,005	102,658	83,031
Iron ores ..... long tons	526,271	1,269,374	542,518	1,570,578
Iron, pig ..... do	311,039	[a] 5,150,000	379,390	[a] 7,542,000
Lime ..... short tons	40,659	168,775	42,714	187,978
Marls ..... do	38,026	[b] 16,494	19,104	7,341
Mineral waters ..... gallons sold	394,060	45,397	585,215	237,137
Sand and gravel ..... short tons	1,236,870	749,344	1,516,804	875,284
Slate		5,360		
Stone		1,276,781		1,394,393
Zinc ..... short tons		([c])	11,206	1,367,132
Other products		[d] 628,177		[d] 1,449,463
Total		31,842,121		39,854,697

[a] Estimated.
[b] Includes Virginia.
[c] Included under Miscellaneous.
[d] Includes in 1905: Slag cement, coke, metallic paint, pigments (unclassified), pyrite, sand-lime brick, talc. Includes in 1906: Slag cement, coke, lithophone, quartz (flint), sand-lime brick, talc and soapstone, white lead.

NEW MEXICO.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay products		$141,722		$152,599
Coal ..... short tons	1,649,933	2,190,231	1,964,713	2,638,986
Coke ..... do	89,638	253,229	147,747	442,712
Gas, illuminating ..... cubic feet		([a])		([a])
Gas coke ..... short tons		([a])		([a])
Copper ..... pounds	5,334,192	826,800	7,099,842	1,370,270
Gold (mines report) ..... fine ounces (troy)	15,359.56	317,510	14,174.80	293,019
Lead ..... short tons	1,170	111,055	640	72,960
Lime ..... do	400	2,625	1,790	9,975
Mineral waters ..... gallons sold	75,500	16,020	94,000	17,700
Precious stones				16,000
Sand and gravel ..... short tons			1,250	1,500
Silver (mines report) ..... fine ounces (troy)	369,192	222,992	491,127	329,055
Stone		110,922		168,567
Zinc ..... short tons		([b])	555	67,710
Other products		[c] 189,008		[c] 224,197
Total		4,382,114		5,805,250

[a] Included under Nevada.
[b] Included under Miscellaneous.
[c] Includes in 1905: Gypsum, iron ores, mica, and salt. Includes in 1906: Clay, gypsum, iron ores, mica, salt, tungsten.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

NEW YORK.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Cement, natural........barrels..	1,926,837	$1,332,809	1,515,866	$1,055,785
Portland........do....	2,111,411	2,044,253	2,414,362	2,725,744
Clay........short tons..	8,056	18,161	6,864	9,933
Clay products........	....	14,486,347	....	13,876,607
Coal products:				
Ammonium sulphate........pounds..	2,787,317	171,946	....	d 7,465,935
Coal tar........gallons..	7,349,569	189,866	....	
Gas, illuminating........cubic feet..	5,004,667,394	5,090,057	....	
Gas coke........short tons..	423,167	1,335,345	....	
Feldspar........do....	....	(a)	....	(c)
Flint........do....	....	(b)	....	(c)
Glass sand........do....	3,165	3,115	1,500	1,200
Gypsum........	....	771,138	....	749,896
Iron ores........long tons..	1,139,937	3,197,919	1,041,992	2,635,639
Iron, pig........do....	1,198,068	d 19,940,000	1,552,659	d 31,022,000
Lime........short tons..	114,876	490,845	114,620	519,855
Metallic paint and mortar colors........do....	7,159	76,990	7,106	79,060
Millstones........	....	25,915	....	28,848
Mineral waters........gallons sold..	5,619,878	652,680	6,481,074	893,476
Natural gas........	....	623,251	....	672,795
Petroleum........barrels..	1,117,582	1,557,630	1,243,517	1,995,377
Pyrite........long tons..	11,935	39,883	25,616	76,516
Salt........barrels..	8,359,121	2,167,931	8,978,630	2,098,686
Sand and gravel........short tons..	3,587,590	1,703,431	4,077,985	1,371,969
Sand-lime brick........	....	123,104	....	191,321
Slate........	....	66,646	....	72,360
Stone........	....	5,364,222	....	5,596,053
Talc, fibrous........short tons..	56,500	445,000	61,672	557,200
Other products........	....	c 3,137,803	....	c 19,174,650
Total........	....	65,056,287	....	92,870,905

a Included under Connecticut.
b Included under North Carolina.
c Includes in 1905: Aluminum, slag cement, coke, emery, abrasive garnet, graphite, infusorial earth, shale, and sienna. Includes in 1906: Aluminum, aluminum salts, slag cement, coke, emery, feldspar, fuller's earth, abrasive garnet, graphite, infusorial earth, litharge, orange mineral, quartz (flint), red lead, sandstone, shale, sienna, and white lead.
d Estimated.

NORTH CAROLINA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Barytes........short tons..	5,519	$21,545	(a)	(a)
Clay........do....	11,095	86,141	12,010	$90,358
Clay products........	....	1,020,161	....	1,182,338
Coal........short tons..	....	(a)	....	....
Coal tar........gallons..	74,503	4,355	....	b 131,580
Gas, illuminating........cubic feet..	58,848,230	86,011	....	
Gas coke........short tons..	5,373	29,253	....	
Copper........pounds..	....	(c)	582,209	112,366
Flint........short tons..	38,368	d 30,659	....	(e)
Gold (mines report)........fine ounces (troy)...	6,080	125,685	3,973.16	82,131
Iron ores........long tons..	56,282	73,540	56,057	75,638
Lime........short tons..	1,792	7,980	5,896	41,468
Mica........	....	88,275	....	217,696
Millstones........	....	2,522	....	....
Mineral waters........gallons sold..	181,000	33,744	156,352	31,413
Monazite and zircon........pounds..	1,352,418	f 163,908	698,375	125,758
Precious stones........	....	....	....	5,000
Sand-lime brick........	....	29,103	....	32,975
Silver (mines report)........fine ounces (troy)..	20,230	12,219	30,769	20,615
Stone........	....	585,561	....	812,961
Talc and soapstone........short tons..	(a)	(a)	4,009	66,729
Other products........	....	e 158,941	....	e 33,821
Total........	....	2,486,063	....	3,062,847

a Included under Georgia.
b Estimated.
c Included under Miscellaneous.
d Includes New York.
e Includes in 1905: Abrasive corundum and garnet, graphite, iron ores, sand and gravel, and talc. Includes in 1906: Barytes, graphite, quartz (flint), millstones, sand, and gravel.
f Includes South Carolina and South Dakota.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

NORTH DAKOTA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$232,432		$269,873
Coal ... short tons	317,542	424,778	305,689	451,382
Coal tar ... gallons		(a)		(a)
Gas, illuminating ... cubic feet		(a)		(a)
Gas coke ... short tons		(a)		(a)
Stone		1,055		44
Other products		[b] 7,215		[b] 10,506
Total		665,480		731,805

[a] Included under Utah.
[b] Includes in 1905: Cement, clay, and mineral waters. Includes in 1906: Natural cement, clay, and mineral waters.

OHIO.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Bromine ... pounds		(a)		(b)
Cement, Portland ... barrels	1,312,977	$1,390,481	1,422,901	$1,709,918
Clay ... short tons	239,718	217,302	248,995	251,301
Clay products		28,303,039		31,014,165
Coal ... short tons	25,552,950	26,486,740	27,731,640	30,346,580
Coke ... do	277,130	970,897	293,994	1,013,248
Ammonium sulphate ... pounds	1,117,271	88,243		
Coal tar ... gallons	8,479,198	270,325		[c] 5,594,184
Gas, illuminating ... cubic feet	4,728,777,755	3,280,672		
Gas coke ... short tons	497,208	1,446,382		
Glass sand ... do	76,460	79,999	71,329	71,246
Grindstones and pulpstones		644,315		644,720
Iron ores ... long tons	19,989	26,624	17,384	29,706
Iron, pig ... do	4,586,110	[c] 75,530,000	5,327,133	[c] 105,244,000
Lime ... short tons	327,373	1,056,721	331,972	1,100,133
Metallic paint and mortar colors ... do	1,589	20,360	(a)	(a)
Mineral waters ... gallons sold	943,114	117,733	1,790,767	164,007
Natural gas		5,721,462		7,145,809
Oilstones and whetstones				46,042
Petroleum ... barrels	16,346,660	17,054,877	14,787,763	16,997,000
Pyrite ... long tons	8,944	32,770	4,732	14,439
Salt ... barrels	2,526,558	565,946	3,236,785	789,237
Sand and gravel ... short tons	2,205,379	1,033,763	2,352,945	1,183,196
Sand-lime brick		14,058		10,184
Stone		4,595,265		4,451,683
Other products		[b] 255,736		[b] 2,156,132
Total		169,203,710		209,976,930

[a] Included under Michigan.
[b] Includes in 1905: Cement, gypsum, and oilstones. Includes in 1906: Aluminum salts, bromine, gypsum, litharge, natural cement, metallic paint and mortar colors, orange mineral, red lead, slag cement, and white lead.
[c] Estimated.

OKLAHOMA.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay products		$222,064		$241,111
Coal products:				
Coal tar ... gallons		(a)		(a)
Gas, illuminating ... cubic feet		(a)		(a)
Gas coke ... short tons		(a)		(a)
Lime ... do	400	4,000	120	1,500
Natural gas		(a)		259,862
Petroleum ... barrels		(b)	[c] 21,718,648	[c] 9,615,198
Salt ... do	(a)	(a)	9,893	4,965
Stone		195,246		186,454
Other products		[d] 202,023		[d] 377,150
Total		623,333		10,686,240

[a] Included under Indian Territory.
[b] Included under Kansas.
[c] Includes Indian Territory and Kansas.
[d] Includes in 1905: Gypsum, mineral waters, salt, and sand and gravel. Includes in 1906: Gypsum, mineral waters, and sand and gravel.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

OREGON.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay products	....	$380,575	....	$506,192
Coal .... short tons..	109,641	282,495	79,731	212,338
Coal tar .... gallons..	21,452	2,145	....	
Gas, illuminating .... cubic feet..	18,131,200	39,675	....	[a] 55,842
Gas coke .... short tons..	1,327	8,946	....	
Copper .... pounds..	....	([b])	545,859	105,351
Gold (mines report) .... fine ounces (troy)..	67,978.23	1,405,235	66,123.79	1,366,900
Lead .... short tons..	....	([b])	....	....
Lime .... do....	7,886	74,745	3,934	32,388
Mineral waters .... gallons sold..	33,085	8,107	30,850	12,523
Platinum .... fine ounces (troy)..	....	2,000	....	....
Quicksilver .... flasks..	43	1,677	3	109
Sand and gravel .... short tons..	....	....	246,250	107,644
Silver (mines report) .... ounces..	90,636	54,744	79,346	53,162
Stone	....	95,159	....	92,391
Other products	....	[c] 86,470	....	[c] 95,566
Total	....	2,441,973	....	2,640,406

[a] Estimated.
[b] Included under Miscellaneous.
[c] Includes in 1905: Gypsum, nickel ore, pottery, and sand-lime brick. Includes in 1906: Clay, gypsum, nickel and cobalt, platinum, and pottery.

PENNSYLVANIA.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Cement:				
Natural .... barrels..	748,057	$306,555	744,403	$560,534
Portland .... do....	13,813,487	11,195,940	18,645,015	18,598,439
Clay .... short tons..	235,510	406,388	386,038	572,331
Clay products	....	19,124,553	....	21,774,611
Coal:				
Anthracite .... long tons..	69,339,152	141,879,000	63,645,010	131,917,694
Bituminous .... short tons..	118,413,637	113,390,507	129,293,206	130,290,651
Coke .... do....	20,573,736	42,253,178	23,060,511	54,184,531
Ammonium sulphate .... pounds..	5,880,172	620,068	....	
Coal tar .... gallons..	14,249,781	319,201	....	[c] 7,822,548
Gas, illuminating .... cubic feet..	3,910,669,305	2,268,505	....	
Gas coke .... short tons..	1,374,815	3,903,634	....	
Feldspar .... do....	....	([a])	18,467	132,230
Flint .... do....	....	([a])	....	([b])
Glass sand .... do....	361,829	482,937	342,967	510,910
Iron ores .... long tons..	808,717	1,060,162	949,429	1,246,267
Iron, pig .... do....	10,579,127	[c] 177,090,000	11,247,869	[c] 225,970,000
Lime .... short tons..	620,018	1,672,267	624,060	1,857,754
Metallic paint and mortar colors .... do....	8,596	123,570	11,021	136,086
Millstones	....	1,351	....	2,624
Mineral waters .... gallons sold..	1,322,594	194,113	1,506,286	280,054
Natural gas	....	19,197,336	....	18,558,245
Ocher .... short tons..	7,789	72,360	8,597	79,244
Petroleum .... barrels..	10,437,195	14,653,278	10,256,893	16,596,943
Sand and gravel .... short tons..	3,666,975	1,753,372	4,889,908	1,969,901
Sand-lime brick	....	63,226	....	62,921
Slate	....	3,491,905	....	3,522,149
Stone	....	7,956,177	....	8,804,776
Umber .... short tons..	....	9,704	....	10,000
Other products	....	[b] 6,339,386	....	[b] 11,952,337
Total	....	569,828,673	....	657,413,780

[a] Included under Maryland.
[b] Includes in 1905: Aluminum, slag cement, abrasive garnet, graphite, pigments (unclassified), crystalline quartz, salt, shale, sienna, talc, and zinc white. Includes in 1906: Aluminum, aluminum salts, bromine, slag cement, abrasive garnet, graphite, litharge, lithophone, orange mineral, crystalline quartz, quartz (flint), red lead, salt, shale, sienna, talc, Venetian red, white lead, zinc white.
[c] Estimated.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

RHODE ISLAND.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay products		(a)		(b)
Coal products:				
Ammonium sulphate ..... pounds	262,786	c $8,868		
Coal tar ..... gallons	710,069	20,400		
Gas, illuminating ..... cubic feet	490,466,400	548,633		d $784,210
Gas coke ..... short tons	34,868	135,018		
Graphite		(e)	(b)	(b)
Lime ..... short tons	6,461	42,743	7,003	54,569
Mineral waters ..... gallons sold	210,830	15,469	220,770	16,161
Stone		556,664		623,490
Other products				b 237,179
Total		1,327,795		1,715,609

a Included under Connecticut.
b Includes in 1906: Clay products, graphite, and talc.
c Includes Connecticut.
d Estimated.
e Included under Miscellaneous.

SOUTH CAROLINA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay ..... short tons	45,595	$146,790	44,665	$175,351
Clay products		749,835		830,481
Coal products:				
Coal tar ..... gallons	158,361	5,315		
Gas, illuminating ..... cubic feet	116,931,170	159,709		a 228,817
Gas coke ..... short tons	11,823	42,992		
Gold (mines report) ..... fine ounces (troy)	4,601	95,111	3,819.63	78,959
Lime ..... short tons	7,955	34,440	7,134	34,719
Mineral waters ..... gallons sold	858,830	78,837	1,458,494	348,744
Monazite ..... pounds		(b)	148,900	26,802
Phosphate rock ..... long tons	270,225	878,169	223,675	817,068
Silver (mines report) ..... fine ounces (troy)	111	67	92	62
Stone		297,284		258,398
Other products		c 5,908		707
Total		2,494,457		2,800,108

a Estimated.
b Included under North Carolina.
c Includes in 1905: Sand and gravel and sand-lime brick.

SOUTH DAKOTA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay products		$58,271		$58,175
Columbite		(a)		
Gold (mines report) ..... fine ounces (troy)	338,116.70	6,989,492	330,956.06	6,841,469
Lead ..... short tons		(b)		
Lime ..... do	4,165	26,308	3,666	23,930
Natural gas		15,200		15,400
Precious stones				4,000
Pumice ..... short tons		(c)		
Silver (mines report) ..... fine ounces (troy)	182,749	110,381	150,875	101,086
Stone		200,061		145,966
Other products		d 171,860		d 319,881
Total		7,571,573		7,509,907

a Included under North Carolina.
b Included under Miscellaneous.
c Included under Nebraska.
d Includes in 1905: Cement, clay, copper, gypsum, mica, mineral waters, pyrite, sand-lime brick, and tungsten. Includes in 1906: Portland cement, clay, gypsum, lithium minerals, mica, mineral waters, sand-lime brick, and tantalum.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

TENNESSEE.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Barytes........short tons..	a 9,487	$15,325	5,247	$8,782
Clay........do....	67,531	94,201	58,938	104,397
Clay products........	....	1,493,279	....	1,620,226
Coal........short tons..	5,766,690	6,577,881	6,259,275	7,667,415
Coke........do....	468,092	1,184,442	483,428	1,350,856
Ammonium sulphate........pounds..	91,794	5,135	....	
Coal tar........gallons..	721,411	29,663	....	
Gas, illuminating........cubic feet..	430,175,200	434,718	....	d 665,836
Gas coke........short tons..	39,159	135,790	....	
Copper........pounds..	....	(b)	17,809,442	3,437,222
Fluorspar........short tons..	260	1,720	....	(c)
Gold (mines report)........fine ounces (troy)..	211	4,362	234.06	4,838
Iron ores........long tons..	734,770	918,850	370,734	1,307,433
Iron, pig........do....	372,692	d 5,260,000	426,874	d 7,251,000
Lead........short tons..	....	....	11	1,254
Lime........do....	75,667	252,908	83,047	307,165
Manganese ores........long tons..	20	100	30	300
Metallic paints and mortar colors..short tons..	5,035	36,380	....	(e)
Mineral waters........gallons sold..	1,254,018	135,861	411,698	58,471
Natural gas........	....	(c)	....	300
Petroleum........barrels..	....	(c)	....	(c)
Phosphate rock........long tons..	482,859	1,633,389	547,677	2,147,991
Sand and gravel........short tons..	414,478	157,594	632,006	259,063
Sand-lime brick........	....	(b)	....	(e)
Silver (mines report)........fine ounces (troy)..	95,522	57,695	55,931	37,474
Stone........	....	992,566	....	1,131,909
Zinc........short tons..	....	(b)	124	15,128
Other products........	....	....	....	e 67,210
Total........	....	19,441,859	....	27,444,570

a Includes small production from Kentucky.
b Included under Miscellaneous.
c Included under Kentucky.
d Estimated.
e Includes in 1906: Metallic paint and mortar colors, sand-lime brick, and Venetian red.

TEXAS.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Asphalt........	....	....	24,900	$306,750
Clay products........	....	$1,718,945	....	1,969,598
Coal........short tons..	1,200,684	1,968,558	1,312,873	2,178,901
Coal tar........gallons..	236,341	15,140	....	
Gas, illuminating........cubic feet..	166,917,672	253,566	....	a 355,560
Gas coke........short tons..	11,984	54,531	....	
Copper........pounds..	....	....	51,377	9,916
Gold (mines report)........fine ounces (troy)..	12	248	b 77	1,592
Iron ores........long tons..	....	(c)	36,660	36,660
Iron, pig........do....	....	(d)	....	(c)
Lead........short tons..	....	(d)	....	....
Lime........do....	31,984	142,470	41,183	192,527
Mineral waters........gallons sold..	1,526,970	144,421	1,045,315	122,085
Natural gas........	....	....	....	e 150,695
Petroleum........barrels..	28,136,189	7,552,262	12,567,897	6,565,578
Quicksilver........flasks..	4,723	173,362	4,761	178,829
Salt........barrels..	444,832	142,993	360,733	170,559
Sand and gravel........short tons..	363,085	146,462	314,110	159,367
Silver (mines report)........fine ounces (troy)..	387,506	234,054	301,772	202,187
Stone........	....	427,321	....	518,719
Zinc........short tons..	....	....	8	976
Other products........	....	c 778,013	....	c 1,630,538
Total........	....	13,752,346	....	14,751,037

a Estimated.
b From smelter reports.
c Includes in 1905: Cement, clay, gypsum, iron ores, natural gas, and sand-lime brick. Includes in 1906: Natural cement, Portland cement, clay, gypsum, pig iron, and sand-lime brick.
d Included under Miscellaneous.
e Includes Alabama and Louisiana.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

UTAH.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Asphalt ... short tons..	11,421	$92,540	12,947	$159,960
Clay ... do....			4,713	11,416
Clay products ...		544,578		634,444
Coal ... short tons..	1,332,372	1,793,510	1,772,551	2,408,381
Coke ... do....		([a])		([b])
Coal tar ... gallons..	85,458	[c] 6,830		
Gas, illuminating ... cubic feet..	108,204,812	[c] 166,705		[d] 128,103
Gas coke ... short tons..	7,642	[c] 42,923		
Copper ... pounds..	58,153,393	9,013,776	50,329,119	9,713,520
Gold (mines report) ... fine ounces (troy)..	248,692	5,140,920	252,439.42	5,218,386
Lead ... short tons..	42,746	4,160,870	56,260	6,413,640
Lime ... do....	12,765	69,089	17,461	86,518
Manganese ores ... long tons..			800	10,000
Precious stones ...				2,500
Quicksilver ... flasks..	1,050	42,000	1,164	48,888
Salt ... barrels..	177,342	135,465	262,212	169,635
Silver (mines report) ... fine ounces (troy)..	11,036,471	6,666,028	11,550,634	7,738,925
Stone ...		290,728		292,745
Sulphur ... long tons..		([e])		([b])
Uranium and vanadium ... short tons..		([a])		
Zinc ... do....		([f])	2,449	298,778
Other products ...		[b] 281,837		[b] 1,832,652
Total ...		28,447,799		34,998,856

[a] Included under Colorado.
[b] Includes in 1905: Cement, gypsum, iron ores, pottery, and sand and gravel. Includes in 1906: Antimony, Portland cement, coke, gypsum, iron ores, mineral waters, sand and gravel, and sulphur.
[c] Includes Idaho, North Dakota, and Wyoming.
[d] Estimated.
[e] Included under Louisiana.
[f] Included under Miscellaneous.

VERMONT.

Product.	1905. Quantity.	1905. Value.	1906. Quantity.	1906. Value.
Clay ... short tons..		([a])	5,392	$37,325
Clay products ...		$112,967		112,368
Coal products:				
Coal tar ... gallons..		([b])		([b])
Gas, illuminating ... cubic feet..		([b])		([b])
Gas coke ... short tons..		([b])		([b])
Copper ... pounds..		([c])	11,694	2,257
Lime ... short tons..	39,620	188,921	32,755	167,393
Mineral waters ... gallons sold..	73,000	20,550	77,500	22,150
Sand and gravel ... short tons..	86,527	10,535	81,587	11,612
Silver (mines report) ... fine ounces (troy)..			1,323	886
Slate ...		1,352,541		1,441,330
Stone ...		6,993,765		7,526,466
Talc and soapstone ... short tons..		([a])	10,413	101,057
Other products ...		[a] 118,555		[a] 29,660
Total ...		8,797,834		9,452,504

[a] Includes in 1905: Clay, ocher, talc, and whetstones. Includes in 1906: Metallic paint, ocher, whetstones.
[b] Included under New Hampshire.
[c] Included under Miscellaneous.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

VIRGINIA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Arsenic....pounds..		(a)		
Barytes....short tons..	6,468	$27,838	11,775	$45,336
Clay....do....			2,903	24,354
Clay products....		1,994,578		1,966,078
Coal....short tons..	4,275,271	3,777,325	4,254,879	4,183,991
Coke....do....	1,499,481	2,869,452	1,577,659	3,611,659
Ammonium sulphate....pounds..		(b)		
Coal tar....gallons..	691,530	21,152		c 685,738
Gas, illuminating....cubic feet..	420,420,478	485,368		
Gas coke....short tons..	32,422	116,879		
Copper....pounds..		(a)		
Gold (mines report)....fine ounces (troy)..	241	4,982	717.50	14,832
Iron ores....long tons..		(d)	828,081	1,579,817
Iron, pig....do....	510,210	c 7,540,000	483,525	c 8,591,000
Lead....short tons..		(a)		
Lime....do....	114,221	396,434	104,486	382,083
Manganese ores....long tons..	3,947	35,209	6,028	77,522
Marl....short tons..		(e)		
Millstones....		8,186		15,611
Mineral waters....gallons sold..	2,340,287	549,102	1,997,207	418,908
Precious stones....				500
Pyrite....long tons..	123,183	426,008	128,794	431,388
Sand and gravel....short tons..	351,115	154,580	335,178	121,951
Silver (mines report)....fine ounces (troy)..	177	107	250	168
Slate....		146,786		172,857
Stone....		667,050		606,343
Talc and soapstone....short tons..		(d)	23,624	590,800
Zinc....do....			1,143	139,446
Other products....		d 2,530,950		d 990,432
Total....		21,751,986		24,650,814

a Included under Miscellaneous.
b Included under West Virginia.
c Estimated.
d Includes in 1905: Asbestos, cement, gypsum, iron ores, metallic paint, ocher, pottery, salt, sand-lime brick, talc, and titanium. Includes in 1906: Asbestos, natural cement, Portland cement, gypsum, mica, ocher, pottery, quartz (flint), salt, sand-lime brick, titanium.
e Included under New Jersey.

WASHINGTON.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Arsenic....pounds..		(a)		
Clay products....		$1,175,032		$1,499,884
Coal....short tons..	2,864,926	5,141,258	3,276,184	5,908,434
Coke....do....	53,137	251,717	45,642	226,977
Ammonium sulphate....pounds..		(b)		
Coal tar....gallons..	465,380	32,268		c 660,443
Gas, illuminating....cubic feet..	359,180,276	459,103		
Gas coke....short tons..	28,006	109,032		
Copper....pounds..	223,328	34,616	290,823	56,129
Gold (mines report)....fine ounces (troy)..	19,595.63	405,078	10,722.22	221,648
Lead....short tons..	53	5,035	46	5,244
Lime....do....	27,935	160,985	59,094	347,924
Mineral waters....gallons sold..	30,000	10,101	39,500	10,800
Sand and gravel....short tons..			293,571	144,725
Silver (mines report)....fine ounces (troy)..	125,376	75,727	45,878	30,738
Stone....		919,110		738,652
Zinc....short tons..			7	854
Other products....		d 11,482		d 83,691
Total....		8,790,544		9,936,143

a Included under Miscellaneous.
b Included under Colorado.
c Estimated.
d Includes in 1905: Sand and gravel, sand-lime brick, and talc. Includes in 1906: Antimony, arsenic, clay, marble, molybdenum, platinum, tungsten.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

WEST VIRGINIA.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Bromine ..... pounds	.....	(a)	.....	(b)
Clay ..... short tons	81,880	$52,640	54,207	$36,377
Clay products	.....	2,018,795	.....	2,783,312
Coal ..... short tons	37,791,580	32,341,790	43,290,350	41,051,939
Coke ..... do	3,400,593	6,548,205	3,713,514	8,192,956
Ammonium sulphate ..... pounds	1,002,058	c 86,530	.....	d 720,934
Coal tar ..... gallons	1,766,066	50,542	.....	
Gas, illuminating ..... cubic feet	129,935,260	102,855	.....	
Gas coke ..... short tons	119,369	415,468	.....	
Glass sand ..... do	155,052	225,734	158,093	227,225
Grindstones	.....	.....	.....	21,304
Iron, pig ..... long tons	298,179	d 5,250,000	304,534	d 6,447,000
Lime ..... short tons	104,156	255,337	98,447	257,333
Mineral waters ..... gallons sold	90,728	50,063	122,880	57,460
Natural gas	.....	10,075,804	.....	13,735,343
Petroleum ..... barrels	11,578,110	16,132,631	10,120,935	16,170,293
Salt ..... do	202,151	74,063	200,055	57,584
Sand and gravel ..... short tons	135,049	86,161	236,765	113,149
Stone	.....	842,627	.....	741,971
Zinc ..... short tons	.....	(e)	.....	.....
Other products	.....	b 122,131	.....	b 80,408
Total	.....	74,731,376	.....	90,694,588

a Included under Michigan.
b Includes in 1905: Cement, grindstones, and iron ores. Includes in 1906: Bromine, Portland cement, iron ores.
c Includes Virginia.
d Estimated.
e Included under Miscellaneous.

WISCONSIN.

Product.	1905 Quantity.	1905 Value.	1906 Quantity.	1906 Value.
Cement, natural ..... barrels	139,128	$63,737	.....	(a)
Clay products	.....	1,382,115	.....	$1,227,342
Coal products:				
Ammonium sulphate ..... pounds	1,727,733	121,464	.....	b 3,352,287
Coal tar ..... gallons	1,905,217	94,305	.....	
Gas, illuminating ..... cubic feet	2,126,338,477	1,579,659	.....	
Gas coke ..... short tons	293,759	1,252,106	.....	
Iron ores ..... long tons	859,283	1,718,890	848,133	2,033,217
Iron, pig ..... do	.....	b 5,510,000	.....	(a)
Lead ..... short tons	.....	(c)	1,753	199,842
Lime ..... do	214,872	726,071	225,633	769,808
Mineral waters ..... gallons sold	6,656,834	1,454,715	8,252,718	2,422,694
Sand and gravel ..... short tons	181,946	96,288	301,610	171,474
Sand-lime brick	.....	.....	.....	36,850
Stone	.....	1,791,447	.....	1,871,945
Zinc ..... short tons	.....	(c)	11,057	1,348,954
Other products	.....	a 1,013,814	.....	a 8,371,362
Total	.....	16,804,611	.....	21,805,775

a Includes in 1905: Cement, clay, coke, graphite, metallic paint, crystalline quartz, sand-lime brick. Includes in 1906: Natural cement, clay, coke, graphite, metallic paint and mortar colors, pig iron, crystalline quartz, zinc white.
b Estimated.
c Included under Miscellaneous.

Output and value, by States and Territories, of the mineral products of the United States in the calendar years 1905 and 1906—Continued.

WYOMING.

Product.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Clay.....short tons..			719	$3,986
Clay products		$34,556		74,321
Coal.....short tons..	5,602,021	7,336,951	6,133,994	8,013,528
Coal tar.....gallons..		(a)		(a)
Gas, illuminating.....cubic feet..		(a)		(a)
Gas coke.....short tons..		(a)		(a)
Copper.....pounds..	2,530,531	392,232	106,177	20,492
Gold (mines report).....fine ounces (troy)..	1,293.81	26,745	315.46	6,521
Gypsum		71,560		(b)
Lime.....short tons..	262	3,099	396	4,265
Petroleum.....barrels..	8,454	51,545	c 7,000	49,000
Precious stones				1,000
Silver (mines report).....fine ounces (troy)..	3,655	2,208	136	91
Stone		59,431		80,098
Other products		b 678,875		b 810,547
Total		8,657,202		9,063,849

a Included under Utah.
b Includes in 1905: Asbestos, clay, coke, grindstones, iron ores, mineral waters, natural gas, and sand and gravel. Includes in 1906: Asbestos, coke, grindstones, gypsum, iron ores, mineral waters, sand and gravel, and sulphur.
c Estimated.

MISCELLANEOUS PRODUCTS.

METALLIC.				
Antimony		$705,787		
Copper		2,345,919		
Iron, pig		8,460,000		
Lead		9,890,640		$280,212
Zinc		2,892,534		
Total		24,294,880		280,212
NONMETALLIC.				
Alum and aluminum sulphate, arsenic		1,985,441		
Fuller's earth		214,497		
Gas, coke, tar, ammonia, graphite, oilstones, and mineral waters		39,163		36,996
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		24,061,202		36,996
Grand total		48,356,082		317,208

IRON ORES, PIG IRON, AND STEEL.

By Edwin C. Eckel.

ACKNOWLEDGMENTS.

The data on iron-ore production which form the basis of the following report are collected directly by the United States Geological Survey, requests for statistics being sent to every producing mine in the country. As both the promptness of publication and the final value of the report depend chiefly on the manner in which these inquiries are answered, it is a pleasure to acknowledge the practically universal cordiality and completeness with which the mine owners and managers of the country have replied. The writer must also acknowledge his indebtedness to Miss J. B. Clagett, of this Office, who has had charge, under his direction, of the receipt, comparison, and tabulation of the individual reports.

In connection with the data on the United States iron-ore industry during 1906 it seems desirable to present a brief summary of the principal facts relative to the American pig-iron and steel industries during the same period. Unlike the iron-ore statistics, which are collected directly by the United States Geological Survey, the pig-iron and steel statistics are collected by a private agency, the American Iron and Steel Association. Through the courtesy of that association and of its secretary, Mr. James M. Swank, these statistics are available for the present publication. They have been rearranged slightly from the form in which they are given in the reports of the association. For any comments on these statistics, however, the present writer is solely responsible.

INTRODUCTION.

The year 1906 witnessed a steady growth in production in all branches of the iron industry, from ore to finished products, previous records being broken in production of ore, pig iron, and steel. Coincident with increase in production came increase in prices, which rose steadily from the beginning to the end of the year, with the exception of a slight depression in June. These movements in output and price must be regarded as continuations of the growth shown during 1905, and their relations to the past history of the iron industry can be best noted on comparison of the records of the industry for a number of years preceding.

This recent remarkable growth in the American iron industry is strikingly brought out in fig. 1, which shows graphically the annual production of iron ores, pig iron, and steel for the years 1870 to 1906, inclusive. The figures on which this diagram are based are official, those for iron-ore production being collected directly by the United States Geological Survey, while those for pig iron and steel are collected by the American Iron and Steel Association. The curves bring out clearly the great falling off in pro-

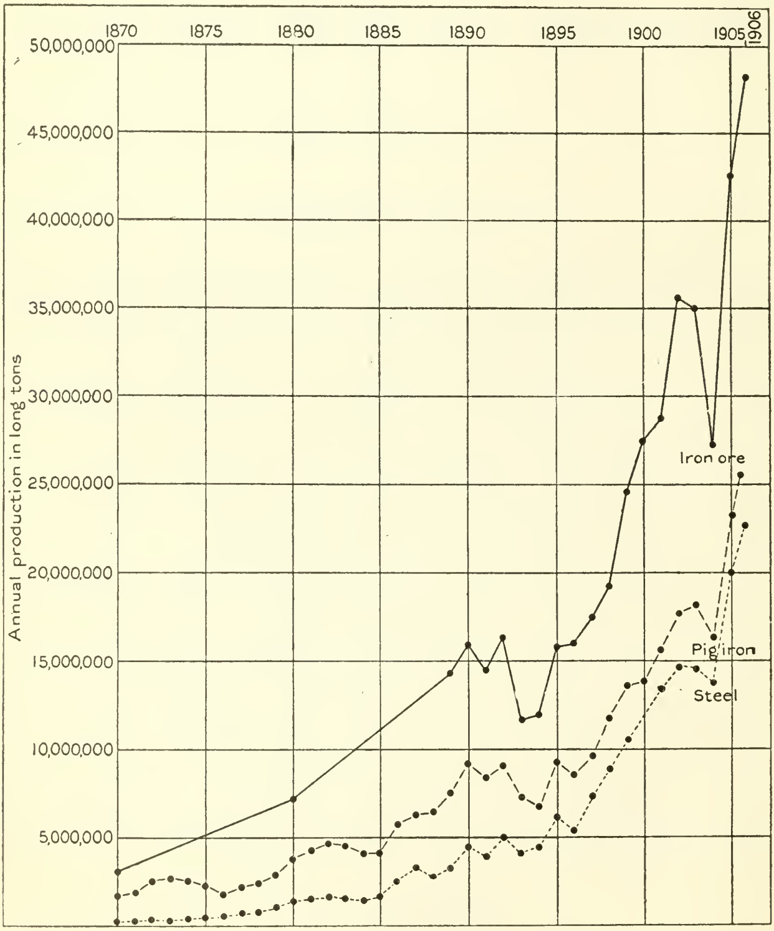

Fig. 1.—Curve showing the American production of iron ore, pig iron, and steel, 1870–1906.

duction in 1904 and the equally sharp upward movement of 1905 and 1906.

The chief factors in keeping prices down to a reasonable level have been, curiously enough, the great iron and steel producing corporations. Their attitude in this matter is not, of course, dictated by altruistic motives, but it affords a refreshing contrast to the method of procedure which a few years ago would have been considered to be the immediate consequence of the consolidation of interests in any industry. Realizing that steady sales at reasonably high profits are in the end better than a runaway market with its consequent great fluctuations in both prices and sales, all efforts have been made to steady the iron market so far as is possible, and until within a very recent period this policy was markedly successful. Toward the very close of the year, however, prices in several lines rose more sharply than is generally considered advisable, and it is doubtful as to how far control would be possible in 1907 in case generally prosperous business conditions should maintain a high demand for iron and steel products. It is known, moreover, that heavy increases in production will be possible during the latter half of 1907 and in 1908, and the probabilities are therefore in favor of lower rather than of higher prices in the near future.

IRON-ORE PRODUCTION OF THE UNITED STATES.

PRODUCTION, BY STATES.

The iron-ore production of the United States in 1906 amounted to 47,749,728 long tons, valued at $100,597,106. As compared with 1905, the most productive previous year, this was an increase of 12.28 per cent in tonnage and of 33.83 per cent in value. The production for 1905 and 1906, by States, is given in the following table:

Quantity and value of iron ore produced in the United States, 1905 and 1906, by States.

State.	1905.		1906.		Increase (+) or decrease (−) in 1906.		Percentage of increase or decrease in 1906.	
	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.
Alabama	3,782,831	$4,257,155	3,995,098	$5,123,539	+ 212,267	+ $866,384	+ 5.61	+ 20.35
Arkansas and Texas	27,668	39,510	a 36,660	36,660	+ 8,992	− 2,850	+ 32.50	− 7.21
Colorado	b 133,471	398,700	14,078	22,525	− 119,393	− 376,175	− 89.45	− 94.35
Connecticut and Massachusetts	25,931	77,278	31,343	94,129	+ 5,412	+ 16,851	+ 20.87	+ 21.81
Georgia	200,842	296,561	411,230	734,780	+ 210,388	+ 438,219	+104.75	+147.77
Kentucky, Maryland, and West Virginia	44,969	59,766	46,940	58,175	+ 1,971	− 1,591	+ 4.38	− 2.66
Michigan	10,885,902	23,367,233	11,822,874	31,145,087	+ 936,972	+ 7,777,854	+ 8.61	+ 33.29
Minnesota	21,735,182	35,895,001	25,364,077	51,799,256	+3,628,895	+15,904,255	+ 16.70	+ 44.31
Missouri	c 113,112	162,028	80,910	158,109	− 32,202	− 3,919	− 28.47	− 2.42
Montana, Nevada, New Mexico, Utah, and Wyoming	690,631	1,090,585	792,190	946,551	+ 101,559	− 144,034	+ 14.71	− 13.21
New Jersey	526,271	1,269,374	542,518	1,570,578	+ 16,247	+ 301,204	+ 3.09	+ 23.73
New York	1,139,937	3,197,919	1,041,992	2,635,639	− 97,945	− 562,280	− 8.59	− 17.58
North Carolina	56,282	73,540	56,057	75,638	− 225	+ 2,098	− .40	+ 2.85
Ohio	19,989	26,624	17,384	29,706	− 2,605	+ 3,082	− 13.03	+ 11.58
Pennsylvania	808,717	1,060,162	949,429	1,246,267	+ 140,712	+ 186,105	+ 17.40	+ 17.55
Tennessee	734,770	918,850	870,734	1,307,433	+ 135,964	+ 388,583	+ 18.50	+ 42.29
Virginia	740,345	1,256,428	828,081	1,579,817	+ 87,736	+ 323,389	+ 11.85	+ 25.74
Wisconsin	859,283	1,718,890	848,133	2,033,217	− 11,150	+ 314,327	− 1.30	+ 18.29
Total	42,526,133	75,165,604	47,749,728	100,597,106	+5,223,595	+25,431,502	+ 12.28	+ 33.83

a Production of Texas alone.
b Includes the manganiferous and silver manganiferous iron ores.
c Includes a small production from Iowa.

RANK OF STATES AS ORE PRODUCERS.

In the following two tables the various iron-ore producing States are arranged in rank according to their production in 1905 and 1906, respectively. On comparison of the tables it will be seen that no material change in this respect has taken place among the leading

States. A decrease during 1906 in the production of Wisconsin, which ranked fifth in 1905, coincident with a rather marked increase in the output of Pennsylvania and Tennessee, has permitted Pennsylvania to assume fifth place and Tennessee sixth. Virginia also is passed by Tennessee. Georgia, though making no gain in rank, reports a production during 1906 double the output of 1905.

Rank of iron-ore producing States in 1905 and 1906, with quantity and value of product and percentage of each.

1905.

Rank.	State.	Production.		Rank.	State.	Value.	
		Quantity, in long tons.	Percentage of total production.			Amount.	Percentage of total.
1	Minnesota	21,735,182	51.11	1	Minnesota	$35,895,001	47.76
2	Michigan	10,885,902	25.60	2	Michigan	23,367,233	31.09
3	Alabama	3,782,831	8.90	3	Alabama	4,257,155	5.66
4	New York	1,139,937	2.68	4	New York	3,197,919	4.25
5	Wisconsin	859,283	2.02	5	Wisconsin	1,718,890	2.29
6	Pennsylvania	808,717	1.90	6	New Jersey	1,269,374	1.69
7	Virginia	740,345	1.74	7	Virginia	1,256,428	1.67
8	Tennessee	734,770	1.73	8	Montana, Nevada, New Mexico, Utah, and Wyoming	1,090,585	1.45
9	Montana, Nevada, New Mexico, Utah, and Wyoming	690,631	1.62	9	Pennsylvania	1,060,162	1.41
10	New Jersey	526,271	1.24	10	Tennessee	918,850	1.22
11	Georgia	200,842	.47	11	Colorado	398,700	.53
12	Colorado	133,471	.31	12	Georgia	296,561	.39
13	Missouri	[a] 113,112	.27	13	Missouri	162,028	.22
14	North Carolina	56,282	.13	14	Connecticut and Massachusetts	77,278	.10
15	Kentucky, Maryland, and West Virginia	44,969	.11	15	North Carolina	73,540	.10
16	Arkansas and Texas	27,668	.06	16	Kentucky, Maryland, and West Virginia	59,766	.08
17	Connecticut and Massachusetts	25,931	.06	17	Arkansas and Texas	39,510	.05
18	Ohio	19,989	.05	18	Ohio	26,624	.04
	Total	42,526,133	100.00		Total	75,165,604	100.00

1906.

Rank.	State.	Quantity, in long tons.	Percentage of total production.	Rank.	State.	Amount.	Percentage of total.
1	Minnesota	25,364,077	53.12	1	Minnesota	$51,799,256	51.49
2	Michigan	11,822,874	24.76	2	Michigan	31,145,087	30.96
3	Alabama	3,995,098	8.37	3	Alabama	5,123,539	5.09
4	New York	1,041,992	2.18	4	New York	2,635,639	2.62
5	Pennsylvania	949,429	1.99	5	Wisconsin	2,033,217	2.02
6	Tennessee	870,734	1.82	6	Virginia	1,579,817	1.57
7	Wisconsin	848,133	1.78	7	New Jersey	1,570,578	1.56
8	Virginia	828,081	1.73	8	Tennessee	1,307,433	1.30
9	Montana, Nevada, New Mexico, Utah, and Wyoming	792,190	1.66	9	Pennsylvania	1,246,267	1.24
10	New Jersey	542,518	1.14	10	Montana, Nevada, New Mexico, Utah, and Wyoming	946,551	.94
11	Georgia	411,230	.86	11	Georgia	734,780	.73
12	Missouri	80,910	.17	12	Missouri	158,109	.16
13	North Carolina	56,057	.12	13	Connecticut and Massachusetts	94,129	.09
14	Kentucky, Maryland, and West Virginia	46,940	.10	14	North Carolina	75,638	.08
15	Arkansas and Texas	[b] 36,660	.07	15	Kentucky, Maryland, and West Virginia	58,175	.06
16	Connecticut and Massachusetts	31,343	.06	16	Arkansas and Texas	36,660	.04
17	Ohio	17,384	.04	17	Ohio	29,706	.03
18	Colorado	14,078	.03	18	Colorado	22,525	.02
	Total	47,749,728	100.00		Total	100,597,106	100.00

[a] Includes a small production from Iowa. [b] Texas alone.

VARIETIES OF IRON ORE PRODUCED.

The iron minerals which are used as ores of that metal fall, when considered from the chemical point of view, into two classes—oxides and carbonates. The latter are relatively very unimportant in the United States, furnishing less than one twenty-fifth of 1 per cent of the total output. The important group of oxides, moreover, is separable on both commercial and scientific grounds into three subgroups, the ores of which differ in composition, grade, and geologic associations.

The final grouping used in this report is, therefore, as follows, the varieties being named in order of their present productive importance:

1. *Red hematite:* Including all the anhydrous sesquioxides known locally as red hematite, specular ore, fossil ore, oolitic ore, etc.
2. *Brown hematite:* Including limonite, gothite, and other hydrous sesquioxides known locally as brown iron ores, bog ores, etc.
3. *Magnetite:* Including the magnetic oxides.
4. *Carbonate:* Including the iron carbonates of various types.

Production of iron ore in the United States in 1905 and 1906, by States and varieties, in long tons.

1905.

State.	Brown hematite.	Red hematite.	Magnetite.	Carbonate.	Total quantity.	Total value.
Alabama	781,561	[a] 3,001,270			3,782,831	$4,257,155
Arkansas and Texas	27,668				27,668	39,510
Colorado	131,317	2,154			133,471	398,700
Connecticut and Massachusetts	25,931				25,931	77,278
Georgia	155,434	45,408			200,842	296,561
Kentucky, Maryland, and West Virginia	17,959	25,000		2,010	44,969	59,766
Michigan		10,885,902			10,885,902	23,367,233
Minnesota		21,735,182			21,735,182	35,895,001
Missouri	[b] 34,366	78,746			113,112	162,028
Montana, Nevada, New Mexico, Utah, and Wyoming	14,174	557,619	118,838		690,631	1,090,585
New Jersey			526,271		526,271	1,269,374
New York	9,266	80,020	1,050,651		1,139,937	5,197,919
North Carolina			56,282		56,282	73,540
Ohio				19,989	19,989	26,624
Pennsylvania	166,435	4,425	637,857		808,717	1,060,162
Tennessee	461,774	272,996			734,770	918,850
Virginia	704,470	35,357	518		740,345	1,256,428
Wisconsin	16,307	842,976			859,283	1,718,890
Total	2,546,662	37,567,055	2,390,417	21,999	42,526,133	75,165,604

1906.

State.	Brown hematite.	Red hematite.	Magnetite.	Carbonate.	Total quantity.	Total value.
Alabama	821,301	3,173,797			3,995,098	$5,123,539
Arkansas and Texas	[c] 36,660				36,660	36,660
Colorado	14,078				14,078	22,525
Connecticut and Massachusetts	31,343				31,343	94,129
Georgia	305,624	105,606			411,230	734,780
Kentucky, Maryland, and West Virginia	18,895	27,433		612	46,940	58,175
Michigan		11,822,874			11,822,874	31,145,087
Minnesota		25,364,077			25,364,077	51,799,256
Missouri	41,805	39,105			80,910	158,109
Montana, Nevada, New Mexico, Utah, and Wyoming		[d] 620,635	171,555		[e] 792,190	946,551
New Jersey	20,611		521,907		542,518	1,570,578
New York	1,000	128,385	912,607		1,041,992	2,635,039
North Carolina			56,057		56,057	75,638
Ohio				17,384	17,384	29,706
Pennsylvania	134,027	8,854	806,548		949,429	1,246,267
Tennessee	590,763	279,971			870,734	1,307,433
Virginia	735,204	92,257	620		828,081	1,579,817
Wisconsin	29,752	818,381			848,133	2,033,217
Total	2,781,063	42,481,375	2,469,294	17,996	47,749,728	100,597,106

[a] Includes 26,857 tons of "gray hematites," or magnetic ores.
[b] Includes a small production from Iowa.
[c] Texas alone.
[d] Includes a small quantity of brown hematite.
[e] Includes some ore used as smelter flux.

Production of iron ores in the United States, by varieties, 1889–1906, in long tons.

Year.	Brown hematite.	Red hematite.	Magnetite.	Carbonate.	Total.
1889	2,523,087	9,056,288	2,506,415	432,251	14,518,041
1890	2,559,938	10,527,650	2,570,838	377,617	16,036,043
1891	2,757,564	9,327,398	2,317,108	189,108	14,591,178
1892	2,485,101	11,646,619	1,971,965	192,981	16,296,666
1893	1,849,272	8,272,637	1,330,886	134,834	11,587,629
1894	1,472,748	9,347,434	972,219	87,278	11,879,679
1895	2,102,358	12,513,995	1,268,222	73,039	15,957,614
1896	2,126,212	12,576,288	1,211,526	91,423	16,005,449
1897	1,961,954	14,413,318	1,059,479	83,295	17,518,046
1898	1,989,681	16,150,684	1,237,978	55,373	19,433,716
1899	2,869,785	20,004,399	1,727,430	81,559	24,683,173
1900	3,231,089	22,708,274	1,537,551	76,247	27,553,161
1901	3,016,715	24,006,025	1,813,076	51,663	28,887,479
1902	3,305,484	30,532,149	1,688,860	27,642	35,554,135
1903	3,080,399	30,328,654	1,575,422	34,833	35,019,308
1904	2,146,795	23,839,477	1,638,846	19,212	27,644,330
1905	2,546,662	37,567,055	2,390,417	21,999	42,526,133
1906	2,781,063	42,481,375	2,469,294	17,996	47,749,728
Total	44,805,907	345,299,719	31,287,532	2,048,350	423,441,508
Percentage of totals for 18 years	10.6	81.5	7.4	0.5	....
Percentage of total for 1906	5.8	89.0	5.2	....	....

VALUE OF IRON ORE PER TON.

The following table presents data on the value per ton of the different varieties of iron ore in the various producing States. The values given are intended to represent value at the mouth of the mine, and are taken directly from the replies of the producers. It is probably unnecessary to caution the reader that any such table must be accepted as merely a fair approximation to the truth. The element of inaccuracy arises from conditions in the iron-ore business and can not be readily overcome. By far the bulk of the iron ore produced in the United States is mined directly by pig-iron producers for use in their own furnaces, and the valuation which they place on such ore is therefore entirely a matter of accounting. In some cases the reports made to the Survey evidently include merely actual mining costs; in others they contain an allowance for sinking fund; and in still other instances the values given are obviously merely convenient prices to use in charging costs against the blast furnaces.

It is to be noted, however, that the errors are almost entirely in one direction—that of undervaluing the ore rather than of overvaluing it. If all of the American iron ore were to be bought by iron furnaces in open market from an entirely distinct set of iron miners, the average prices paid would probably be considerably in excess of those now reported.

Average value per long ton of iron ore in the United States in 1906, by States and varieties.

State.	Brown hematite.	Red hematite.	Magnetite.	Carbonate.
Alabama	$1.62	$1.19		
Arkansas and Texas	[a] 1.00			
Colorado	1.60			
Connecticut and Massachusetts	3.00			
Georgia	1.86	1.57		
Kentucky, Maryland, and West Virginia	1.52	1.01		$3.00
Michigan		2.63		
Minnesota		2.04		
Missouri	2.01	1.90		
Montana, Nevada, New Mexico, Utah, and Wyoming		1.14	$1.39	
New Jersey	2.46		2.91	
New York	4.00	2.40	2.55	
North Carolina			1.35	
Ohio				1.71
Pennsylvania	2.33	2.42	1.14	
Tennessee	1.62	1.26		
Virginia	1.90	1.94	3.08	
Wisconsin	2.17	2.41		
Total average	1.78	2.13	2.05	1.75

[a] Texas alone.

PRINCIPAL IRON MINES OF THE UNITED STATES.

During 1906, 158 mines produced over 50,000 long tons of iron ore each, the maximum production of any one mine being 2,531,251 tons from the Mountain Iron, of Minnesota. Permission has been obtained from the owners to publish the names and output of 135 of these large producers, and this information is presented in the following table:

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1906.

Name of mine.	State.	Variety of ore.[a]	Quantity.
Mountain Iron	Minnesota		2,531,251
Morris	do		1,809,377
Hull Rust	do		1,690,311
Fayal	do		1,624,243
Burt	do		1,375,729
Mahoning	do		1,275,203
Red Mountain Group	Alabama		1,270,721
Adams	Minnesota		1,210,514
Stevenson	do		1,014,604
Chapin	Michigan		921,209
Biwabik	Minnesota		809,299
Cornwall Ore Bank Company	Pennsylvania	Magnetite	804,848
Pioneer	Minnesota		767,911
Lake Superior	Michigan		742,427
Spruce	Minnesota		660,195
Sunrise	Wyoming		590,201
Cleveland Lake	Michigan		567,904
Monroe-Tener	Minnesota		498,480
Newport	Michigan		497,465
Pewabic	do		482,020
Penn Iron Mining Company	do		420,079
Aragon	do		416,215
Savoy-Sibley	Minnesota		377,917
Chisholm	do		376,144
Albany	do		356,219
Hartford	Michigan		349,871
Higgins	Minnesota		341,099
Ashland	Michigan		338,158
Great Western (including Lincoln)	do		321,080
Tobin and Genesee	do		315,031
Chandler	Minnesota		314,995
Queen	Michigan		310,596

[a] Red hematite except when specified. Some of the Michigan mines produce magnetite in subordinate quantities.

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1906—Continued.

Name of mine.	State.	Variety of ore.	Quantity.
Leetonia	Minnesota		309,354
Lyon Mountain	New York	Magnetite	301,903
Lincoln	Minnesota		300,000
Bristol	Michigan		298,700
Hawkins	Minnesota		295,107
Clark	do		281,707
Rust	do		280,566
Lake Angeline	Michigan		280,000
Hull	Minnesota		274,754
Utica	do		272,134
Glen	do		271,918
Cliff's Shaft	Michigan		269,845
Yates	Minnesota		265,289
Old Bed	New York	Magnetite	264,527
Leonard	Minnesota		254,453
Negaunee	Michigan		249,403
Miller	Minnesota		243,339
Sellers	do		231,342
Myers	do		225,257
Commodore	do		217,843
Iroquois	do		211,745
Odanah Iron Company	Wisconsin		202,302
Zenith	Minnesota		198,359
Clifford	Michigan		195,871
Cyprus	Minnesota		192,190
Tilden	Michigan		183,447
Baltic	do		180,626
La Rue	Minnesota		179,811
Princeton	Michigan		178,524
Genoa	Minnesota		176,391
Florence	Wisconsin		174,204
Croxton	Minnesota		173,864
Republic	Michigan		166,574
Austin	do		166,145
Agnew	Minnesota		163,260
Cardiff	Tennessee	Brown hematite	163,163
Minorca	Minnesota		162,939
Fierro	New Mexico		161,555
Duluth	Minnesota		158,346
Mikado	Michigan		156,093
Elba	Minnesota		152,564
Troy	do		147,421
Salisbury	Michigan		147,417
Montreal	Wisconsin		142,960
Laura	Minnesota		141,000
Brotherton	Michigan		139,368
Harmony	New York	Magnetite	138,222
Riverton Group	Michigan		138,083
Soudan	Minnesota		135,004
Crosby	do		131,925
Bessemer	do		121,545
Corsica	do		118,852
Crystal Falls	Michigan		118,286
Oriskany	Virginia	Brown hematite	116,520
Greeley	Alabama	do	114,204
Ironton	Michigan		112,790
Colby	do		111,771
Jordan	Minnesota		110,768
Port Henry No. 21	New York	Magnetite	110,411
Malta	Minnesota		110,307
Hemlock	Michigan		109,378
Songo	Alabama		109,336
Mayas	Minnesota		108,000
Vivian	Michigan		107,271
Mohawk	Minnesota		106,482
Pinkney	Tennessee	Brown hematite	103,000
Dunn	Michigan		102,384
Richards	New Jersey	Magnetite	100,632
Loretto	Michigan		97,980
Mansfield	do		96,160
Holland	Minnesota		94,275
Brunt	do		94,162
Nanaimo	Michigan		93,569
Wharton	New Jersey	Magnetite	93,172
Richmond	Michigan		89,563
Lamont	do		88,172
Atlantic	Wisconsin		86,383
Caspian	Michigan		81,711
Sunday Lake	do		81,554

*Iron-ore mines of the United States that produced more than 50,000 long tons each in 1906—*Continued.

Name of mine.	State.	Variety of ore.	Quantity.
Mannie	Tennessee	Brown hematite	80,194
Pettit	Minnesota		79,619
Victoria	do		77,813
Moro	Michigan		74,932
Illinois	Wisconsin		74,469
Pearce	Minnesota		73,255
Rossie	New York		65,920
Cambria	Michigan		65,432
Susquehanna	Minnesota		64,000
Cass	do		63,419
Marrow	do		62,667
Iron Ridge	Wisconsin		62,276
Hurd	New Jersey	Magnetite	61,797
Alexander	Minnesota		61,582
Wood and De Camp	New Jersey	Magnetite	60,121
Kinney	Minnesota		57,690
Ottawa	Wisconsin		57,335
Cranberry	North Carolina	Magnetite	56,057
Yale	Michigan		55,173
Embree Iron Company	Tennessee	Brown hematite	53,515
Helen-Bess	Alabama		53,388
La Belle	Minnesota		53,266
Anvil	Michigan		52,136
Rorer	Virginia	Brown hematite	50,263
Total (135 mines)			40,233,087
Unspecified (23 mines) [a]			3,274,106
Grand total (158 mines)			43,507,193

[a] Includes the product of 23 mines producing over 50,000 long tons each, operated by 12 companies, which object to the publication of individual statistics.

STOCKS OF ORE AT MINES.

The stock of ore on hand at mines on December 31, 1906, amounted to 3,281,789 long tons, a decrease of 13.92 per cent from the stock held on December 31, 1905—3,812,281 long tons, which in turn was a decrease of 18.31 per cent from the quantity in stock on December 31, 1904. The stock in 1906 represented about 6.8 per cent of the total output of the year.

Stock of iron ore on hand at the mines December 31, 1906, by States, in long tons.

State.	Quantity.	State.	Quantity.
Alabama	24,034	Pennsylvania	11,365
Georgia	2,061	Tennessee	36,230
Maryland	225	Texas	6,000
Massachusetts	3,300	Virginia	460
Michigan	1,991,074	Wisconsin	96,444
Minnesota	996,902		
Missouri	2,950	Total	3,281,789
Montana and New Mexico	1,900		
New Jersey	5,608	Total stock, 1905	3,812,281
New York	87,663	Per cent of decrease, 1906	13.92
Ohio	15,573		

Stock of iron ore on hand December 31, 1905 and 1906, in principal producing States, in long tons.

State.	1905. Quantity.	1906. Quantity.
Alabama	177,119	24,034
Michigan	2,097,156	1,991,074
Minnesota	1,088,501	996,902
New Jersey	28,139	5,608
New York	50,428	87,663
Pennsylvania	20,497	11,365
Tennessee	24,130	36,230
Wisconsin	116,777	96,444
Total	3,602,747	3,249,320

APPARENT ANNUAL ORE CONSUMPTION.

The following table includes data on certain factors from which an approximate estimate of our annual ore consumption is deduced. The result is of course merely an approximation, for no data are available on certain factors which should enter into the final result. The elements accounted for in the table and estimate are (1) domestic iron-ore production; (2) stock of ore at mines; (3) imports of ore; (4) exports of ore; (5) stocks of ore at lake ports; (6) zinc residuum production.

Apparent consumption of iron ore for all purposes, 1889–1906, in 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	6,438,967	90,289	43,433,138
1906	47,749,728	3,281,789	1,060,390	265,240	6,252,455	93,461	49,355,343

COMPARATIVE PRODUCTION OF IRON ORE AND PIG IRON.

Detailed data on the pig-iron production of the United States are presented on later pages of this report, but in the following table an interesting comparison is made between the annual production of iron ore and of pig iron.

Production of iron ore and pig iron in the United States, 1889–1906, in 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	1906	47,749,728	25,307,191

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

IRON-ORE RESERVES OF THE UNITED STATES.

About two years ago, in response to a request from the Swedish Parliament, an eminent Swedish geologist prepared a report on the iron-ore reserves of the world. The report itself attracted little notice in the United States, even among those directly interested in the iron industry. Early in 1906, however, a summary of the report was forwarded by the American consul at Paris, and the wide circulation given to consular reports in America resulted in drawing considerable attention to the matter in both the daily and the technical press.

The character of the report in the form in which it reached the American public is fairly indicated by the following extracts:

It will surprise a great many to learn that we are likely to run short in iron inside of a single century if we keep up the present rate of consumption. As a matter of fact we are more likely to increase the consumption than we are to reduce it. The world has only 10,000,000,000 tons of iron ore available. Of these Germany has twice as many tons as the United States. Russia and France each have 400,000,000 tons more than this country. * * * Assuming therefore as true the claim of geological science that the extent of workable iron-ore beds is known to within a margin of possible error not exceeding 5 per cent, the Swedish report, which is based upon the most authoritative information, has naturally attracted world-wide attention. * * * The present output of ore and the amount of ore actually consumed by each is as follows, in tons:

Country.	Workable deposits.	Annual output.	Annual consumption.
United States	1,100,000,000	35,000,000	35,000,000
Great Britain	1,000,000,000	14,000,000	20,000,000
Germany	2,200,000,000	21,000,000	24,000,000
Spain	500,000,000	8,000,000	1,000,000
Russia and Finland	1,500,000,000	4,000,000	6,000,000
France	1,500,000,000	6,000,000	8,000,000
Sweden	1,000,000,000	4,000,000	1,000,000
Austria-Hungary	1,200,000,000	3,000,000	4,000,000
Other countries		5,000,000	1,000,000
Total	10,000,000,000	100,000,000	100,000,000

While it is probable that the foregoing statement does not take into adequate account the undeveloped ore deposits of Utah and Alabama, its teachings are nevertheless obvious and impressive. Of the world's workable iron-ore deposits, as at present known, the United States possesses only about one-ninth, and at the present rate of consumption the entire supply will be exhausted within the present century.

It must be admitted that an official statement such as this might fairly cause alarm to those unacquainted with the facts of the case and that the daily press can not be blamed for taking the matter very seriously. As a matter of fact, however, the figures given can not be accepted as reliable, and it seems desirable to present a more careful statement of the case. The original Swedish report did not do justice to the American iron-ore deposits, and in the consular translation this injustice was accentuated rather than lessened.

Before taking up the subject of American iron-ore reserves in general it may be well to dispose of one statement in the quotation: "Assuming therefore as true the claim of geological science that the extent of workable iron-ore beds is known to within a margin of possible error not exceeding 5 per cent * * *." This assumption appears to be entirely gratuitous. No mining geologist of any experience would make such a claim, except for very small or unusually uniform ore bodies. Elsewhere, in discussing the Clinton or red ores of Alabama, the writer has said: "The amount of Clinton ore in any area can probably be determined by a geologist within 5 or 10 per cent, and estimates of red-ore reserves can therefore be made by competent men with a degree of accuracy impossible in dealing with the magnetites, hematites, or brown ores of other districts." The Clinton ore it must be remembered is an exceptionally easy ore to estimate because it occurs in bedded form and is fairly uniform over considerable distances both vertically and horizontally. In dealing with irregularly shaped ore bodies an estimate which came within 25 per cent of the actual quantity might well be considered remarkably accurate. When, however, the estimate covers not a single area or deposit, but the total iron ore contained in a State or nation, the case is very different, for the possibility of error in such an estimate is enormous. As will be shown below, the Swedish report on iron-ore reserves probably contains an error of something over 1,000 per cent in its estimate of American ore tonnage.

The Lake Superior district, at present the leading American producer, has been explored more thoroughly than any other ore field in the United States, but estimates as to total tonnage range within rather wide limits. At present the totals commonly quoted vary from 1,500,000,000 to 2,000,000,000 tons, of which the United States Steel Corporation is commonly supposed to control over three-fourths. This supply is being drawn on to meet a constantly increasing annual demand, and it is conceded that before 1915 the district will probably be called upon to ship over 50,000,000 tons of ore a year. It is obvious that at such a rate the Lake Superior ores can hardly be expected to last beyond the year 1950, and it is equally obvious that long before that date the value of good workable deposits of iron ore, both there and elsewhere in the United States, will have increased immensely. During the past year ore lands in the Lake district have been sold at a valuation of $1 per ton of ore in the ground, though the average valuation is still of course considerably below that price.

In the Rocky Mountain and Pacific States a few large iron-ore deposits are known to exist, and many others are reported, but any attempt at an estimate of total tonnage would be, with only our present knowledge of the subject, merely the wildest sort of guessing.

A more promising field lies in the older Eastern States. It is probable that careful exploratory work will develop magnetic iron ores in New York, New Jersey, and Pennsylvania in quantities far in excess of anything usually considered possible in those States. Here also close estimates are impossible.

With regard to the southern iron ores the case is very different. Here the work which the Geological Survey has carried on during the last three years and which was planned so as to obtain data on the quantity of ore available, gives a fairly secure basis for tonnage estimates. It is safe, therefore, to submit the following figures as representing minimum values for the workable iron-ore reserves above the 1,000-foot level of certain Southern States, with the caution that further exploratory work in the South will probably greatly increase rather than decrease these estimates:

		Red ore.	Brown ore.
Alabama	long tons..	1,000,000,000	75,000,000
Georgia	do....	200,000,000	125,000,000
Tennessee	do....	600,000,000	225,000,000
Virginia	do....	50,000,000	300,000,000
Total	do....	1,850,000,000	725,000,000

This gives a total estimated reserve, for the red and brown ores of the four States noted, of over 2,500,000,000 tons. If to this we add the ores occurring at deeper levels in the States named, and also the red and brown ores of Maryland, West Virginia, and Kentucky, and the magnetic ores of the other Southern States, it is probably fair to assume that the total southern ore reserve will amount to very nearly 10,000,000,000 tons, or five times that credited to the Lake Superior district. Much of this ore is of course unworkable at the present day, but all of it should be counted on in any estimate of total ore reserves.

In considering these figures it will be well to bear in mind that the southern red ores will average from 33 to 43 per cent metallic iron, but that they carry so much lime as to be almost or quite self-fluxing. The brown ores, as washed, will range from 40 to 50 per cent metallic iron. It may be further added that the estimates as to red-ore tonnage are probably much more accurate than those relative to brown ores.

To sum up the matter—in place of the 1,100,000,000 tons credited by the Swedish geologist, it is probably safe to say that the United States has from ten to twenty times that reserve of iron ore.

The present rate at which our ore is being mined is as follows:

1903	tons..	35,019,308
1904	do....	27,644,330
1905	do....	42,526,133
1906	do....	47,749,728

Assuming that the demand for iron ore during the present century may range from 50,000,000 to 100,000,000 tons per year, the Lake Superior district would last for from twenty-five to fifty years more, if it supplied the entire United States. But counting on the known reserves elsewhere in the United States the ore will last for a much longer period, though, of course, it must necessarily show a gradual but steady increase in value and in cost of mining, along with an equally steady decrease in grade. No attempt is here made to consider a very important factor in the problem—the extent to which Cuban, Haytian, and other high-grade foreign ores may be imported in the near future.

OCCURRENCE AND PRODUCTION OF IRON ORE IN THE VARIOUS STATES AND DISTRICTS.

THE IRON DISTRICTS OF THE UNITED STATES.

Iron ore is mined for blast-furnace use in only 26 States of the Union, though it occurs in almost every State and Territory. For convenience in description, it is advisable to group the producing States in four natural districts defined by geographic and trade considerations:

1. The Lake Superior district, including Michigan, Minnesota, and Wisconsin.
2. The southern district, including Alabama, Georgia, North Carolina, Tennessee, the Virginias, Maryland, Kentucky, Arkansas, Missouri, and Texas.
3. The northern district, including New England, New York, New Jersey, Pennsylvania, Ohio, and Iowa.
4. The western district, including the producing States of Colorado, Utah, Wyoming, Arizona, and New Mexico.

The present relative importance of these four districts as iron-ore producers is well brought out by the following table, which gives the output of each district in long tons for 1905 and 1906, and the percentage of the total American output produced by each district in those years. It will be seen that the Lake district is preeminently the greatest, producing approximately four-fifths of the total, as against one-seventh from the southern district, one-twentieth from the northern, and one-sixtieth from the western districts.

Iron-ore production of the four districts in 1905 and 1906.

	1905.		1906.	
	Quantity, in long tons.	Percentage of total.	Quantity, in long tons.	Percentage of total.
Lake Superior	33,480,367	78.73	38,035,084	79.66
Southern	5,700,819	13.41	6,325,710	13.24
Northern	2,520,845	5.93	2,582,666	5.41
Western	824,102	1.93	806,268	1.69
Total	42,526,133	100.00	47,749,728	100.00

LAKE SUPERIOR DISTRICT.

The Lake Superior district, which for convenience is here considered to be exactly coextensive with the States of Minnesota, Michigan, and Wisconsin, produced during 1906 over 38 million tons of iron ore, equivalent to about 80 per cent of the entire American output. It is at present by far the most important iron district, not only in the United States but in the world.

Lake Superior iron ranges.—The bulk of the production of the American portion of the Lake Superior district is from five distinct areas or "ranges," located in Michigan, Wisconsin, and Minnesota. The essential facts concerning these five principal ranges, together with less important ranges in Canada or elsewhere in the district, are embodied in tabular form as follows:

Lake Superior iron-ore ranges.

Range.	Location.	Opened.	Production, 1889-1906, in long tons.
Marquette	Michigan	1854	54,091,441
Menominee	Michigan and Wisconsin	1872	50,308,316
Gogebic	do	1884	47,532,521
Vermilion	Minnesota	1884	24,064,820
Mesabi	do	1892	123,513,206
Michipicoten	Canada	1900	*a* 1,090,939
Baraboo	Wisconsin	1903	....
Sudbury	Canada	1906	....

a Production of 1906 not included.

Production of Lake Superior districts by ranges.—Details concerning the production of the five principal ranges are presented in the following tables. It will be seen that the Mesabi range in 1906 produced slightly over three-fifths of the entire Lake Superior output, and that its ratio of increase over 1905 was also the greatest. The two Minnesota ranges together produced almost exactly two-thirds of the entire Lake Superior production—an amount over one-half the entire production of the United States.

Production of iron ore in the Lake Superior region in 1905–6, by ranges.

Range.	1905.	1906.	Increase (+) or decrease (−) in 1906.	Percentage of increase or decrease, 1906.	Percentage of total production in Lake Superior region.
	Long tons.	*Long tons.*	*Long tons.*		
Marquette (Michigan)	3,772,645	4,070,914	+ 298,269	+ 7.91	10.75
Menominee (Michigan and Wisconsin)	4,472,630	4,962,357	+ 489,727	+10.95	13.10
Gogebic (Michigan and Wiscons n)	3,344,551	3,484,023	+ 139,472	+ 4.17	9.20
Vermilion (Minnesota)	1,578,626	1,794,186	+ 215,560	+13.65	4.74
Mesabi (Minnesota)	20,156,566	23,564,891	+3,408,325	+16.91	62.21
Total	33,325,018	37,876,371	+4,551,353	+13.66	100.00

Production of Lake Superior iron ore, 1889–1906, by ranges, in long tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Total.
1889	2,631,026	1,876,157	2,147,923	864,508	....	7,519,614
1890	2,863,848	2,274,192	2,914,081	891,910	....	8,944,031
1891	2,778,482	1,856,124	2,041,754	945,105	....	7,621,465
1892	2,848,552	2,402,195	3,058,176	1,226,220	29,245	9,564,388
1893	2,064,827	1,563,049	1,466,815	815,735	684,194	6,594,620
1894	1,935,379	1,255,255	1,523,451	1,055,229	1,913,234	7,682,548
1895	1,982,080	1,794,970	2,625,475	1,027,103	2,839,350	10,268,978
1896	2,418,846	1,763,235	2,100,398	1,200,907	3,082,973	10,566,359
1897	2,673,785	1,767,220	2,163,088	1,381,278	4,220,151	12,205,522
1898	2,987,930	2,275,664	2,552,205	1,125,538	4,837,971	13,779,308
1899	3,634,596	3,281,422	2,725,648	1,643,984	6,517,305	17,802,955
1900	3,945,068	3,680,738	3,104,033	1,675,949	8,158,450	20,564,238
1901	3,597,089	3,697,408	3,041,869	1,805,996	9,303,541	21,445,903
1902	3,734,712	4,421,250	3,683,792	2,057,532	13,080,118	26,977,404
1903	3,686,214	4,093,320	3,422,341	1,918,584	13,452,812	26,573,271
1904	2,465,448	2,871,130	2,132,898	1,056,430	11,672,405	20,198,311
1905	3,772,645	4,472,630	3,344,551	1,578,626	20,156,566	33,325,018
1906	4,070,914	4,962,357	3,484,023	1,794,186	23,564,891	37,876,371
Total	54,091,441	50,308,316	47,532,521	24,064,820	123,513,206	299,510,304

Shipments and receipts of Lake Superior ore.—During 1906 over 38,500,000 long tons of iron ore were shipped from the Lake Superior district. Of this total over 37,500,000 tons were shipped by water down the Lakes, the remaining 1,000,000 tons being all-rail shipments. Of these shipments, 32,000,000 tons reached Lake Erie ports, the remainder being received at Chicago, Milwaukee, and other places. Details concerning these shipments and receipts are presented in the following tables, which are taken from the Iron Trade Review:

Shipments of Lake Superior iron ore, 1901–1906, in long tons.

Shipping port.	1901.	1902.	1903.	1904.	1905.	1906.
Two Harbors	5,018,197	5,605,185	5,120,656	4,566,542	7,779,850	8,180,125
Escanaba	4,022,668	5,413,704	4,277,561	3,644,267	5,307,938	5,851,050
Duluth	3,437,955	5,598,408	5,356,473	4,649,611	8,807,559	11,220,218
Ashland	2,886,252	3,553,919	2,823,119	2,288,400	3,485,344	3,388,106
Marquette	2,354,284	2,595,010	2,007,346	1,907,301	2,977,828	2,791,033
Superior	2,321,077	4,180,568	3,978,579	4,169,990	5,118,385	6,083,057
Gladstone	117,089	92,375	85,816	553	....	....
Total	20,157,522	27,039,169	23,649,550	21,226,664	33,476,904	37,513,589
All-rail shipments	431,715	531,952	640,328	548,253	876,552	1,008,650
Grand total	20,589,237	27,571,121	24,289,878	21,774,917	34,353,456	38,522,239

Iron-ore receipts at Lake Erie ports, 1901–1906, in long tons.

Port.	1901.	1902.	1903.	1904.	1905.	1906.
Ashtabula, Ohio	3,981,170	4,796,805	4,242,160	3,639,250	6,373,779	6,833,352
Cleveland, Ohio	3,831,060	4,873,318	4,434,160	3,572,228	5,854,745	6,604,661
Conneaut, Ohio	3,181,019	4,300,301	3,903,937	4,083,655	5,327,552	5,432,370
Buffalo and Tonawanda, N. Y.	1,475,386	2,256,798	2,149,901	2,433,601	3,774,928	4,928,331
Erie, Pa	1,379,377	1,717,268	1,257,798	1,284,778	2,112,476	1,986,539
Fairport, Ohio	1,181,776	1,538,744	1,434,342	1,157,858	2,008,621	1,861,498
Toledo, Ohio	798,298	1,037,571	652,305	508,793	1,006,855	1,423,741
Lorain, Ohio	721,662	1,442,417	990,490	972,931	1,605,823	2,191,965
Huron, Ohio	431,311	520,646	486,106	231,364	825,278	778,453
Sandusky, Ohio	33,017	165,556	130,532	48,356	51,202	35,847
Total	17,014,076	22,649,424	19,681,731	17,932,814	28,941,259	32,076,757

Stocks of iron ore at Lake Erie ports.—The two following tables, taken from the Iron Trade Review, contain data as to the stocks on hand at Lake Erie ports on December 1, 1906, and May 1, 1907, respectively. It will be noted that although the stocks on December 1, 1906, were lower than on the same date in 1905, the quantity remaining in stock on May 1, 1907, was greater than in 1906.

Stocks of iron ore at lower lake ports, December 1, 1901–1906, in long tons.

Port.	At close of navigation, December 1—					
	1901.	1902.	1903.	1904.	1905.	1906.
Ashtabula, Ohio	1,769,145	1,967,136	1,911,911	1,403,575	1,589,951	1,631,312
Cleveland, Ohio	1,378,060	1,500,604	1,337,750	1,237,033	1,330,619	1,224,606
Fairport, Ohio	710,590	924,236	845,946	660,420	759,961	590,783
Erie, Pa	470,718	722,966	657,409	583,439	564,961	552,631
Lorain, Ohio	195,863	328,304	288,581	299,504	271,695	336,321
Conneaut, Ohio	604,106	673,679	591,364	684,487	976,976	1,057,424
Toledo, Ohio	254,196	310,023	106,710	318,573	368,024	281,000
Huron, Ohio	231,501	232,764	253,249	182,495	208,023	245,499
Buffalo, N. Y	198,100	319,367	282,890	318,739	315,780	315,412
Sandusky, Ohio	47,384	95,175	95,275	75,134	52,977	17,467
Total	5,859,663	7,074,254	6,371,085	5,763,399	6,438,967	6,252,455

Stocks of iron ore at lower lake ports, May 1, 1902–1907, in long tons.

Port.	At opening of navigation, May 1—					
	1902.	1903.	1904.	1905.	1906.	1907.
Ashtabula, Ohio	924,742	1,073,967	1,559,028	623,451	462,564	568,485
Cleveland, Ohio	624,865	829,347	968,508	513,559	350,382	447,573
Fairport, Ohio	472,325	555,709	579,677	390,869	266,162	154,246
Erie, Pa	223,972	426,744	474,275	236,414	169,488	189,276
Lorain, Ohio	96,992	190,311	237,404	165,586	140,452	176,300
Conneaut, Ohio	152,891	125,400	128,018	96,295	148,528	139,853
Toledo, Ohio	111,511	126,331	160,216	71,642	52,550	147,397
Huron, Ohio	129,635	147,817	208,008	68,100	80,738	98,106
Buffalo, N. Y	73,861	60,241	150,106	61,271	90,906	50,313
Sandusky, Ohio	37,400	56,500	68,863	44,444	29,320	5,439
Total	2,848,194	3,592,367	4,534,103	2,271,631	1,791,090	1,976,988

Prices of Lake Superior iron ores, 1906–7.—The prices established in the fall of 1906 for 1907 deliveries of Lake Superior iron ores at lower lake ports showed an increase of 75 cents per ton on Bessemer ores and 50 cents on non-Bessemers. Along with this increase in price, however, was a decrease of over 1 per cent in the iron content of the basis ore, the Bessemer base being reduced from 56.7 per cent to 55 per cent, and the non-Bessemer from 52.8 per cent to 51.5 per cent. This reduction in iron content amounts to a further increase in price, so that the actual rise is about 92 cents per ton for Bessemer ores and 63 cents per ton for non-Bessemers. A comparison of prices for the four principal types in 1906 and 1907 is therefore as follows:

Prices per long ton of Lake Superior iron ores at lower lake ports, 1906–7.

	1906.	1907.	
		New basis.	Reduced to 1906 basis.
Old Range:			
Bessemer	$4.25	$5.00	$5.17
Non-Bessemer	3.70	4.20	4.33
Mesabi:			
Bessemer	4.00	4.75	4.92
Non-Bessemer	3.50	4.00	4.13

Grade and character of Lake Superior iron ores.—The bulk of the Lake Superior iron ore is red hematite, though small quantities of magnetite are furnished by the Marquette Range. In places this hematite carries a considerable percentage of combined water, so that a small portion of the output might fairly be placed in the brown hematite class. In the present report, however, all of the Lake Superior ores are grouped as red hematites.

The average grade of the ores shipped from the Lake Superior district is decreasing quite steadily, the falling off in the past five years probably amounting to a decrease of 1 per cent in iron content per year.

The cargo analyses of a representative group of these ores, as shipped in 1906, will be found in the following table, selected from those published by the Lake Superior Iron Ore Association. The analyses given are for ores in natural condition.

Average cargo analyses of Lake Superior iron ores of the season 1906.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
GOGEBIC RANGE.										
Ashland	53.40	0.040	6.54	0.240	2.75	0.222	0.231	0.008	2.45	11.00
Brotherton	53.04	.025	12.61	.263	.96	.145	.109	.007	.64	9.18
Cary Bessemer	50.87	.051	9.41	2.02	.90	.200	.291	.006	4.60	9.00
Norrie	55.28	.035	3.91	.35	....	....	....	....	....	11.45
MARQUETTE RANGE.										
Abbotsford, lump	63.86	0.034	5.31	....	....	....	....	....	....	0.96
Bessie	48.95	.409	13.72	....	....	....	....	....	....	2.47
Cliffs, lump	61.19	.113	5.87	0.308	2.48	0.796	0.776	0.021	0.68	.50
Palmer	46.68	.051	21.10	....	....	....	....	....	....	1.41
Richmond	41.75	.040	32.82	.09	.93	.24	.35	.004	1.85	4.03
Salisbury	52.06	.110	6.62	.516	2.00	.50	.44	.010	2.07	12.50
MENOMINEE RANGE.										
Baltic	50.94	0.469	4.81	0.225	3.00	1.37	1.42	0.035	5.26	10.00
Calumet	39.85	.028	31.26	.180	2.34	.85	1.41	.008	1.82	5.00
Florence	49.43	.279	5.78	.200	3.21	1.27	2.37	.116	4.24	10.46
Saginaw	50.35	.029	16.19	.160	1.88	.25	1.65	.015	1.15	6.24
BARABOO RANGE.										
Illinois	47.89	0.041	14.80	0.160	1.51	0.29	0.15	....	1.82	12.13
MESABI RANGE.										
Biwabik	56.42	0.040	3.40	0.417	1.60	0.45	0.24	0.007	3.90	9.34
Larkin	49.42	.023	13.41	1.43	1.16	.19	.25	.022	2.75	10.00
Mahoning	58.32	.044	1.93	.25	1.12	.49	.05	.011	2.92	10.14
Shenango	53.73	.040	4.32	.66	2.16	.19	.10	.010	4.13	12.14
Shilling	52.45	.063	4.42	.52	1.38	.32	.09	.025	6.27	12.30
Troy	49.29	.035	9.58	.83	2.49	.28	.61	.170	5.34	14.00
VERMILION.										
Chandler	59.77	0.040	5.29	0.098	....	....	....	....	....	5.40
Pilot, lump	65.68	.029	2.10	.096	....	....	....	....	....	2.30
Savoy	60.71	.041	3.89	.093	....	....	....	....	....	5.71

The exploratory work of 1906 was confined to closer drilling and more detailed examination of known districts, to exploration of extensions of these districts, and to deeper level work in the Michigan ranges. The last was perhaps the most promising field of endeavor.

It would perhaps be hazardous to say that all of the large high-grade deposits of iron ore in the Lake Superior district are now definitely known and located. The fact remains, however, that explorations on the new ranges—Baraboo, Cuyuna, and the Canadian group—during the past few years have been with few exceptions distinctly disappointing. In the Coleraine region, on the western end of the Mesabi, large quantities of ore have been developed by drilling, but the bulk of these ores is low grade and very sandy. Careful washing improves them remarkably, however, and they can be counted on to form part of the supply of the near future.

The Great Northern ore lease.—The principal development of the year in the Lake Superior iron region, the leasing of the Great Northern or Hill ore lands to the United States Steel Corporation, was, in its initial stage, financial rather than industrial. It would be difficult to overestimate the importance of this step in its relation to the future of the Lake Superior iron-ore industry, and, in fact, to the American iron trade in general. Its most immediate effects were to appreciably strengthen the Steel Corporation's ore reserves, to remove the possibility of any serious future competition based on Lake Superior ores, and to increase the royalty scale for undeveloped Lake Superior ores. The Steel Corporation is now currently credited with controlling something between two-thirds and three-fourths of the entire Lake Superior iron-ore supply. As the Geological Survey reports on the Lake districts contain nothing on which to base tonnage estimates, there is no ready means of checking up this current belief. Whatever the exact percentage may be, it is certain that the recent acquisition removed from the market the largest holding of ore lands known to remain in the district. The principal features of the lease are as follows: The royalty to be paid for the ore is, at the start, $1.65 per long ton for ore containing 59 per cent metallic iron, delivered in docks at the head of Lake Superior. If the ore grades higher or lower than 59 per cent, the royalty is to be increased or decreased according to a fixed scale. This royalty is for ore to be shipped during 1907, and the base price is to be increased 3.4 cents per ton for each succeeding year. The minimum to be mined and shipped is 750,000 tons in 1907, and this minimum increases by 750,000 tons per year until it reaches 8,250,000 tons a year, after which it remains constant. The lease will continue until the ore is exhausted, unless on January 1, 1915, the lessee decides to terminate it. The royalty includes a payment to the Great Northern Railway Company of 80 cents per ton for transportation charges from the mines to the head of the lake. The actual royalty to be paid for the ore, therefore, is 85 cents per long ton in 1907, 88.4 cents per ton in 1908, and so on. It is believed that the bulk of this ore will fall considerably below the requirement of 59 per cent metallic iron taken as the base for royalties. Widely variant estimates have been published as to the ore tonnage covered by this lease. Mr. T. F. Cole, in testifying before a Minnesota legislature committee, is reported to have said that on the Hill lands approximately 175,000,000 tons of ore had been disclosed by exploratory work. On the assumption that as much more remains entirely untested, the lease would cover something like 350,000,000 tons of ore.

PUBLICATIONS ON THE LAKE SUPERIOR DISTRICT.

The following list gives the titles of the various reports issued by the United States Geological Survey, which cover the geology and iron resources of this region:

Bayley, W. S. The Menominee Iron-Bearing District of Michigan. Monograph XLVI, U. S. Geol. Survey. 513 pp. 1904.

Clements, J. M. The Vermilion Iron-Bearing District of Minnesota. Monograph XLV, U. S. Geol. Survey. 463 pp. 1903.

Clements, J. M., Smyth, H. L., Bayley, W. S., and Van Hise, C. R. The Crystal Falls Iron-Bearing District of Michigan. Monograph XXXVI, U. S. Geol. Survey. 512 pp. 1899.

Irving, R. D., and Van Hise, C. R. The Penokee Iron-Bearing Series of Michigan and Wisconsin. Monograph XIX, U. S. Geol. Survey. 534 pp. 1892.

Leith, C. K. The Mesabi Iron-Bearing District of Minnesota. Monograph XLIII, U. S. Geol. Survey. 316 pp. 1903.

Van Hise, C. R. The iron-ore deposits of the Lake Superior region. In Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 3, pp. 305–434. 1901.

Van Hise, C. R., Bayley, W. S., and Smyth, H. L. The Marquette Iron-Bearing District of Michigan, with Atlas. Monograph XXVIII, U. S. Geol. Survey. 608 pp. 1897.

SOUTHERN DISTRICT.

As noted in an earlier table of this report, the southern district now produces slightly over 13 per cent of the entire iron-ore output of the United States. Of late years this percentage has shown no particular tendency to increase, having been stationary or declining since 1896.

The South is practically unsupplied with ores below the Bessemer limit in phosphorus. Considering the region as a whole, it may be said that its present ore supply is of two types—(1) red hematite of rather low iron content (35–40 per cent), but frequently containing sufficient lime to be self-fluxing; (2) brown hematites, ranging from 38 to 52 per cent iron, usually high in silica. Neither of these types is characteristically low in phosphorus, and during the prevalence of the Bessemer idea the general use of southern irons was for the foundry. With the rapid rise of the basic open-hearth process, however, much of the southern product now goes into steel making, and this proportion seems likely to increase rapidly. In addition to the two classes of ore above noted as supplying the bulk of the present southern output, large deposits of magnetic ores, though not extensively worked at present, are known to exist.

Alabama.—Commercial, geographical, and geological differences permit the separation of the iron ores of Alabama into six groups:

1. The Clinton, red, or fossil ores of the Birmingham district, including ores occurring in the territory tributary to Birmingham from Springfield south through Birmingham to the southernmost outcrop of red ore.

2. The red ores of northern Alabama, including ores in territory tributary to Chattanooga, Attalla, and Gadsden.

3. The gray hematites of Talladega and adjoining counties in eastern Alabama.

4. The brown ores of the Russellville district in northwestern Alabama.

5. The brown ores of the Woodstock district, mostly in eastern Tuscaloosa County.

6. The brown ores of eastern Alabama, occurring in a belt extending from the Georgia State line, near Rock Run, southwestward through the Coosa Valley country to near Brierfield.

Of these six areas the Birmingham district contains the principal reserves of red ore in the South, while the Russellville district is perhaps the most promising of the Alabama brown-ore regions so far as possibilities of future extension are concerned.

In the spring of 1907 it was reported that the Champion brown-ore mines, located a few miles north of Oneonta, were to be reopened and worked by the Tennessee Coal, Iron and Railroad Company. These mines, currently believed to be among the richest in the State, are owned jointly by the Tennessee and the Sloss-Sheffield companies and have been idle for a number of years, owing to disagreement between the owners. It is stated that 35 cents per ton is to be paid as royalty for ore extracted by the Tennessee Company under the present agreement.

During 1906 the Potter ore lands in the Birmingham district were purchased by the Republic and the Tennessee companies jointly. Though the Potter tract is estimated to contain only about one-fifth as much ore as was involved in the Hill lease, it is of interest as a matter of comparison to note that the southern companies secured their ore for practically 1 cent per ton.

Georgia.—The present iron-ore production of Georgia is confined to a relatively small area in the northwestern corner of the State, and there is little prospect that this productive area will be materially extended in the near future. The ores now worked are (1) brown hematites, associated chiefly with Lower Silurian and Cambrian limestones, and (2) red hematites—the well-known Clinton ores. The latter do not reach the extreme development, either as to length of outcrop or thickness of bed, which is notable in Alabama. The Georgia brown ores, on the other hand, occur in extensive and important deposits. Magnetic ores are known to occur in the Piedmont district of Georgia, but so far they have not been carefully prospected. Those seen by the present writer were too small to warrant consideration as a source of furnace supply, but it is possible that workable deposits will yet be found in this district.

The formation of the Southern Steel Company and its subsequent rapid expansion will probably have an important influence on the future of the Georgia iron industry, and in particular will cause more rapid development in the Cartersville district. Changes of ownership in the Etna district may also materially increase the Georgia output.

Maryland.—Two distinct sources of ore have been worked to supply the Maryland iron industry, and a third group of promising deposits is as yet untouched. The worked ores have been derived from (1) deposits of brown hematite in the Coastal Plain region, associated with Cretaceous sands and clays, and (2) deposits of brown hematite in the valley regions, associated with Lower Silurian and Cambrian limestones. The third class mentioned, which gives promise of future value, includes a series of deposits of red hematite and magnetite occurring in the Blue Ridge region and associated with schists and gneisses.

In this connection it may be well to note that the present large production of pig iron and steel in Maryland is not based to any important extent on local ores, but on ores imported from Cuba and Spain.

North Carolina and South Carolina.—The Carolinas are of interest as possible future producers of iron ores rather than as serious factors in the industry of to-day, for only one important mining operation is located within their limits.

Though deposits of brown hematite are known to occur at various points in North and South Carolina, the ores to which attention must be paid in future are the magnetic ores of the western portions of both States. At the Cranberry mines in North Carolina these ores have already been handled in considerable quantity. Similar lenses of magnetite are known to be both frequent and extensive elsewhere in the Carolinas.

Tennessee.—The iron production of Tennessee is derived from three sources, the deposits worked chiefly falling in one of the following classes: (1) Red or Clinton hematites of the western side of the valley of East Tennessee; (2) brown hematites from the valley itself, and (3) brown hematites from Lawrence and other counties in middle Tennessee. None of these groups of deposits appear to have reached or even approached their maximum possible development.

Texas, Arkansas, and Missouri.—The three southwestern States here grouped are of little present importance as iron producers and offer little hope for the future. The most promising ore deposits of the region are those which occur in Texas. Here, in the northeastern counties, extensive though thin beds of brown hematite are found, while in Llano and adjoining counties magnetic ores of good grade but unknown extent have been located.

Virginia.—Considered from either an industrial or a geologic point of view, the iron ores of Virginia fall into 6 groups:

1. Magnetites and specular hematites of the Blue Ridge and Piedmont districts.
2. Red hematites (Clinton ores, "fossil ores," "oolitic ores") of the foothills of the Allegheny Mountains.
3. Brown hematites (Oriskany ores) of the Goshen-Longdale-Oriskany district, mostly in Augusta, Bath, Botetourt, Alleghany, and Craig counties.
4. Brown hematites of the New River-Cripple Creek district, mostly in Wythe and Pulaski counties.
5. Brown hematites of the Roanoke, Shenandoah, and Page valleys.
6. Brown hematites ("gossan ores") of Carroll and Floyd counties.

Of these classes of ores, the Oriskany brown ores are at present the most important. Together with the magnetites the Oriskany ores also give most promise of future supply.

West Virginia.—The only kind of iron ore occurring in workable quantity in West Virginia is brown hematite, for the red Clinton hematites of the State are thin and the carbonate ores of the coal regions can not be considered as serious possibilities. The brown hematites occur in two regions, the deposits of the two differing in character and relations. The ores of the Shenandoah Valley area of Jefferson and Berkeley counties are now mined on a small scale and are associated with Cambrian and Ordovician limestones and shales. In the Allegheny foothills a different series of iron-ore deposits occur, entirely comparable to the Oriskany ores noted in the description of Virginia. These ores are as yet but slightly developed, but give promise of being of high importance in the near future.

PUBLICATIONS ON SOUTHERN IRON ORES.

BURCHARD, E. F. The iron ores of the Brookwood district, Alabama: Bull. U. S. Geol. Survey No. 260, pp. 321–334. 1905.

——— The Clinton or red ores of the Birmingham district, Alabama: Bull. U. S. Geol. Survey No. 315, pp. 130–151. 1907.

——— The brown iron ores of the Russellville district, Alabama: Bull. U. S. Geol- Survey No. 315, pp. 152–160. 1907.

ECKEL, E. C. Iron ores of northeastern Texas: Bull. U. S. Geol. Survey No. 260, pp. 348–353. 1905.

——— The iron industry of Texas: Iron Age, vol. 76, pp. 478–479. 1905.

——— The Clinton or red ores of northern Alabama: Bull. U. S. Geol. Survey No. 285, pp. 172–179. 1906.

——— The Oriskany and Clinton iron ores of Virginia: Bull U. S. Geol. Survey No. 285, pp. 183–189. 1906.

GRASTY, J. S. The gray ores of Alabama: Manufacturers' Record, vol. 50, pp. 550–553. 1906.

HAYES, C. W., and ECKEL, E. C. Iron ores of the Cartersville district, Georgia: Bull. U. S. Geol. Survey No. 213, pp. 233–242. 1903.

HOLDEN, R. J. The brown ores of the New River-Cripple Creek district, Virginia: Bull. U. S. Geol. Survey, No. 285, pp. 190–193. 1906.

KEITH, A. Iron-ore deposits of the Cranberry district, North Carolina-Tenness e: Bull. U. S. Geol. Survey No. 213, pp. 243–246. 1903.

KINDLE, E. M. The iron ores of Bath County, Ky.: Bull. U. S. Geol. Survey No. 285, pp. 180–182. 1906.

MCCALLIE, S. W. Preliminary report on the iron ores of Georgia: Bull. No. 10, Georgia Geol. Survey, p. 190. 1900.

NITZE, H. B. C. Iron ores of North Carolina: Bull. No. 1, North Carolina Geol. Survey, 239 pp. 1893.

PORTER, J. J. The Virginia iron industry: Manufacturers' Record, vol. 51, pp. 717–719, 749–752, 788–790. 1907.

SMITH, P. S. The gray iron ores of Talladega County, Ala.: Bull. U. S. Geol. Survey No. 315, pp. 161–184. 1907.

NORTHERN DISTRICT.

The northern, or more properly the northeastern, district now produces not quite 6 per cent of the total American output of iron ore, despite the fact that its reserves of ore would probably compare favorably as to both quantity and quality with those of the Lake Superior district.

New England.—The only iron ores of New England which require consideration at present are those occurring in the extreme western portion of the area. In Vermont, western Massachusetts, and northwestern Connecticut a series of brown hematite deposits are found associated with Lower Silurian and Cambrian limestones.

New Jersey.—By far the most important iron ores of New Jersey are the magnetites which occur associated with gneisses and crystalline limestones in the highland portion of the State. Several deposits of red hematites and one of brown ore are or have been worked; but the bulk of the State's production of ore has always been of the magnetic type.

New York.—The iron ores of New York occur in five groups, distinct geographically and geologically:

1. Magnetites of the Hudson highlands.
2. Magnetites of the Adirondacks.
3. Red hematites of the western Adirondacks.
4. Red hematites (Clinton ores) of central New York.
5. Brown hematites of southeastern New York.

The first three groups are by far the most important, either as present producers or as probable sources of future supply.

Ohio.—The only iron ores at present mined in Ohio are carbonates, associated with the coal rocks of the eastern and southeastern portions of the State. These ores, formerly the basis of a considerable local industry, are now mined on a small scale. Though occurring as carbonates originally much of the material extracted has been hydrated in part to brown hematite. Analyses of typical ores after calcination follow:

Analyses of calcined carbonate ores, Ohio.

	1.	2.
Iron (Fe)	44.80	44.50
Manganese (Mn)	0.70	0.62
Sulphur (S)	0.67	0.80
Phosphorus (P)	0.195	0.57
Silica (SiO_2)	18.50	23.00
Alumina (Al_2O_3)	5.75	4.45
Lime (CaO)	6.45	5.90
Magnesia (MgO)	1.95	2.55

1. "Ohio block ore." Scioto County, Ohio. Calcined ore.
2. New Castle Mine, Pine Grove, Lawrence County, Ohio. Calcined ore.

Pennsylvania.—Many kinds of ore have at different times been mined in Pennsylvania, but at present only three classes are sufficiently important or promising to require notice here. These are:

1. Magnetites of southeastern Pennsylvania.
2. Brown hematites of the valley region of southeastern Pennsylvania.
3. Red hematites (Clinton ores) of east-central Pennsylvania.

Of these the third class has been important in the past and is little worked at present; but it may again be of importance in the future. The other two classes are the present source of most of the Pennsylvania production of iron ore.

WESTERN IRON DISTRICT.

The western district, which includes the Rocky Mountain and the Pacific coast States, now produces less than 2 per cent of the total American output of iron ore. The relatively slow growth of the iron-mining industry in this district is due to the fact that at present only one furnace company is operating within its limits—the Colorado Fuel and Iron Company. The recent reopening of the works at Irondale, Wash., will probably have little effect on the iron-mining industry of the district, for the ores used at this charcoal furnace will mostly be shipped in from Texada Island, British Columbia.

PUBLICATIONS ON WESTERN IRON ORES.

The following list includes the more important recent publications relative to the iron ores of the western United States:

Ball, S. H. The Hartville iron-ore range, Wyoming: Bull. U. S. Geol. Survey, No. 315, pp. 190–205. 1907.

——— Titaniferous iron ore of Iron Mountain, Wyoming: Bull. U. S. Geol. Survey, No. 315, pp. 206–212. 1907.

Boutwell, J. M. Iron ores in the Uintah Mountains, Utah: Bull. U. S. Geol. Survey, No. 225, pp. 221–228. 1904.

Diller, J. S. Iron ores of the Redding quadrangle, California: Bull. U. S. Geol. Survey, No. 213, pp. 219–220. 1903.

Leith, C. K. Iron ores in southern Utah: Bull. U. S. Geol. Survey, No. 225, pp. 229–237. 1904.

——— Iron ores of the western United States and British Columbia: Bull. U. S. Geol. Survey, No. 285, pp. 194–200. 1906.

FOREIGN TRADE IN IRON ORE.

Below are presented data on the imports and exports of iron ore into and from the United States, with a table on the world's production of iron ore.

IMPORTS.

During 1906 the United States imported slightly more than 1,000,000 long tons of iron ore, over three-fifths of which were from Cuba. Spain, Newfoundland, and Ontario, in the order named, were the next most important sources of supply. Norway, the East Indies, and British India were, for the first time, noticeable in this regard.

The table following shows the imports of iron ore, by countries, from 1903 to 1906, inclusive:

Quantity and value of iron ores imported into the United States, 1903–1906, by countries, in long tons.

Country.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cuba	613,585	$1,501,480	364,630	$822,413	539,935	$1,437,900	639,362	$2,178,997
Spain	94,720	196,139	36,810	89,218	191,861	366,436	171,870	418,922
French Africa	7,830	14,586						
Greece			2,500	2,535			48,630	61,560
Newfoundland and Labrador	[a] 86,730	86,680	5,400	5,400	5,600	5,600	[a] 125,395	125,395
United Kingdom	6,843	31,868	173	2,093	408	2,396	231	1,955
British Columbia	525	789						
Germany	207	1,820	2	70	1	42	1,084	8,949
Netherlands			1	10			50	474
Quebec, Ontario, etc.	169,681	424,440	77,887	177,966	104,096	240,303	57,890	100,125
Belgium	300	2,964	210	1,671	400	3,370	400	6,662
France				8				
Norway							9,278	37,240
East Indies—British India							6,200	27,155
Other countries	19	242			3,350	6,114		
Total	980,440	2,261,008	487,613	1,101,384	845,651	2,062,161	1,060,390	2,967,434

[a] Newfoundland only.

EXPORTS.

As compared with our annual production, the export trade in iron ore is relatively unimportant, the total exports during the last three years averaging less than a quarter of a million tons annually.

Exports of iron ore, 1903–1906.

1903	long tons	80,611	$255,728	1905	long tons	208,017	$530,457
1904	do	213,865	458,823	1906	do	265,240	771,839

CUBAN PRODUCTION.

As the most important source of our foreign supply is Cuba, data on the Cuban production of iron ore for a series of years are presented in the following table:

Shipments of iron ore from mines in the Province of Oriente (Santiago), 1901–1906, in long tons.

Year.	Juragua Iron Co. (Limited).	Spanish-American Iron Co.	Cuban Steel Ore Co.	Total.
1901	199,764	334,833	17,651	552,248
1902	221,039	455,105	23,590	699,734
1903	155,898	467,723		623,621
1904	31,162	356,111		387,273
1905	139,828	421,331		561,159
1906	133,379	507,195		640,574

The total shipments from 1884, the year of first shipment, to 1906, inclusive, amounted to 7,963,219 long tons, of which 88,091 tons went to foreign ports.

Early in 1907 the Pennsylvania Steel Company announced that steps would be taken to develop the great brown hematite deposits of the Mayari district, Cuba. These deposits were first located by Messrs. Hayes and Spencer, of the United States Geological Survey, and were described in an official report published in 1901.[a] It seems probable that they will be of great future importance to the American iron industry.

WORLD'S PRODUCTION OF IRON ORE.

The latest obtainable figures for the iron-ore production of the more important producing countries are given in the following table:

World's production of iron ore in 1904 and 1905, by countries.

Country.	1904.	1905.
United States	27.644,330	42,526,133
Germany and Luxemburg	22,047,393	23,444,073
Great Britain	13,774,282	14,590,703
Spain	7,964,748	9,077,245
France	7,022,841	7,395,400
Russia	5,950,000	6,050,000
Sweden	4,084,647	4,365,967
Austria-Hungary	3,380,795	3,697,679
Canada, Newfoundland	701,416	963,543
Cuba	387,273	561,159
Algeria	468,737	568,609

[a] Hayes, C. Willard, Vaughan, T. Wayland, and Spencer, Arthur C. Report on a Geological Reconnoissance of Cuba, made under the Direction of Gen. Leonard Wood, Military Governor, 1901.

World's production of iron ore in 1904 and 1905, by countries—Continued.

Country.	1904.	1905.
Greece	422,159	465,622
Italy	409,460	366,616
Belgium	206,730	176,620
China	120,000	123,000
India	71,608	102,120
Japan	80,000	100,000
Norway	45,328	46,582
Australia	11,679	11,184
Portugal	12,488	3,200

Of the figures in this table, those for the United States, Great Britain, Cuba, Canada, and Australia are in long tons; for other countries in metric tons. The figures for the ore production of Russia, China, and Japan have been estimated from the known pig-iron outputs of those countries, and are therefore merely approximations.

THE IRON AND STEEL INDUSTRY OF THE UNITED STATES.

As noted in the introduction to this report, the data on pig-iron and steel production presented in the following tables are those collected and published by Mr. J. M. Swank, secretary of the American Iron and Steel Association. For the comments on these figures, however, the present writer is solely responsible.

PRODUCTION OF PIG IRON.

Owing to the delay in publication of this report, it is fortunately possible to give not only the pig-iron production of the United States, by States, for 1905 and 1906, but to include the figures for the first half of 1907, which were published on August 1, 1907, by Mr. Swank. The following table contains these data:

Total production of pig iron, 1905–1907, by States.

	Blast furnaces.				Production, including spiegeleisen and ferromanganese, in long tons.		
	In blast June 30, 1906.	December 31, 1906.			1905.	1906.	First half of 1907.
		In.	Out.	Total.			
Pennsylvania	130	132	23	155	10,579,127	11,247,869	5,964,884
Ohio	53	57	7	64	4,586,110	5,327,133	2,815,174
Illinois	20	22	0	22	2,034,483	2,156,866	1,263,258
Alabama	26	31	16	47	1,604,062	1,674,848	861,771
New York	18	17	8	25	1,198,068	1,552,659	859,125
Virginia	14	14	11	25	510,210	483,525	260,912
Tennessee	14	13	8	21	372,692	426,874	193,371
Colorado	4	5	0	5	407,774	413,040	220,209
Missouri	2	2	0	2			
Maryland	4	4	1	5	332,096	386,709	221,145
New Jersey	8	9	2	11	311,039	379,390	195,245
Wisconsin	5	6	0	6	351,415	373,323	160,045
Minnesota	1	1	0	1			
Michigan	10	12	0	12	288,704	369,456	197,330
West Virginia	3	3	1	4	298,179	304,534	151,643
Kentucky	4	5	4	9	63,735	98,127	79,013
Georgia	3	2	2	4	38,699	92,599	26,173
Texas	1	1	3	4			
Connecticut	2	3	0	3	15,987	20,239	8,746
Massachusetts	1	1	1	2			
Total	323	340	[a] 87	[a] 427	22,992,380	25,307,191	13,478,044

[a] Not including 1 idle stack each in North Carolina and Oregon.

From this table it will be seen that the production of 1906 showed an increase of more than 10 per cent over that of 1905—itself a record year—and that the 1907 output bid fair to show a marked gain over 1906. This tendency to increase was checked, however, in July and August, and it is now doubtful whether the total for 1907 will show much gain over 1906.

PRODUCTION OF PIG IRON BY KINDS.

In the following table the pig-iron production for 1905 and 1906 is classified by kinds or grades. It will be noted that the great increase in total pig-iron production of 1906 over 1905 was due entirely to an increase in the output of steel-making irons, for foundry irons showed an actual decrease in 1906. It might also be said that basic pig showed almost twice as much increase, proportionately, as did Bessemer and other acid pigs.

Production of pig iron 1905–6, by kinds, in long tons.

Kind.	1905.	1906.
Bessemer Low-phosphorus	12,407,116	13,840,518
Basic	4,105,179	5,018,674
Forge and foundry	5,837,174	5,714,492
Charcoal	352,928	433,007
Spiegeleisen	227,797	244,980
Ferromanganese	62,186	55,520
Total	22,992,380	25,307,191

PRODUCTION OF STEEL.

The steel statistics for 1906 showed a great increase in total output over 1905, the production of 1906 being 23,246,251 tons as compared with 19,912,751 tons in 1905, an increase of 3,333,500 tons.

The feature of most interest, however, is not the total output, but the relative productions of Bessemer and open-hearth steels. These are given in the following tables, published by Mr. J. M. Swank in the Bulletin of the American Iron and Steel Association.

BESSEMER INGOTS AND CASTINGS.

The total production of Bessemer steel ingots and castings in 1906 was 12,275,253 long tons, against 10,941,375 tons in 1905, an increase of 1,333,878 tons, or over 12.1 per cent. The following table gives the production of Bessemer steel ingots and castings in the last six years:

Production of Bessemer steel ingots and castings in 1906.

1901	long tons	8,713,302	1904	long tons	7,859,140
1902	do	9,138,363	1905	do	10,941,375
1903	do	8,592,829	1906	do	12,275,253

Below is given, by States, the production of Bessemer ingots and castings since 1903:

Production of Bessemer ingots and castings, 1903–1906, by States, in long tons.

State.	1903.	1904.	1905.	1906.
Pennsylvania	3,909,436	3,464,650	4,491,445	4,826,725
Ohio	2,330,134	2,050,115	3,131,149	3,769,913
Illinois	1,366,569	1,257,190	1,651,250	1,685,056
Other States	986,690	1,087,185	1,667,531	1,993,559
Total	8,592,829	7,859,140	10,941,375	12,275,253

OPEN-HEARTH INGOTS AND CASTINGS.

The total production of open-hearth steel ingots and direct castings in the United States in 1906 was 10,970,998 gross tons, against 8,971,376 tons in 1905, an increase of 1,999,622 tons, or over 22.2 per cent. The following table gives the total production of open-hearth steel ingots and castings, by States, since 1903:

Production of open-hearth steel ingots and castings, 1903–1906, by States, in long tons.

State.	1903.	1904.	1905.	1906.
New England	169,209	195,901	239,282	251,047
New York and New Jersey	104,598	165,986	348,072	553,186
Pennsylvania	4,442,730	4,306,498	6,471,818	7,710,949
Illinois	422,919	358,215	617,625	884,472
Ohio	369,349	480,906	687,392	816,483
Other States	321,106	400,660	607,187	754,861
Total	5,829,911	5,908,166	8,971,376	10,970,998

The following table gives the production, by States, of both basic and acid open-hearth steel ingots and castings in 1906:

Production of basic and acid open-hearth steel ingots and castings in 1906, by States, in long tons.

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	184,307	66,740	251,047
New York and New Jersey	520,422	32,764	553,186
Pennsylvania	6,605,912	1,105,037	7,710,949
Illinois	878,548	5,924	884,472
Ohio	755,936	60,547	816,483
Other States	704,260	50,601	754,861
Total	9,649,385	1,321,613	10,970,998

THE PROGRESS OF BASIC STEEL.

In the following table are given the annual production of Bessemer and open-hearth steel from 1891 to 1906, inclusive:

Production of Bessemer and open-hearth steel, 1891–1906, in long tons.

Year.	Bessemer.	Open-hearth.
1891	3,247,417	579,753
1892	4,168,435	669,889
1893	3,215,686	737,890
1894	3,571,313	784,936
1895	4,909,128	1,137,182
1896	3,919,906	1,298,700
1897	5,475,315	1,608,671
1898	6,609,017	2,230,292
1899	7,586,354	2,947,316
1900	6,684,770	3,398,135
1901	8,713,302	4,656,309
1902	9,138,363	5,687,729
1903	8,592,829	5,829,911
1904	7,859,140	5,908,166
1905	10,941,375	8,971,376
1906	12,275,253	10,970,998

Looking at the matter casually, the impressive fact would seem to be the retrogression of the Bessemer process relative to the open-hearth. When the details are examined, however, it will be seen that what is taking place is a retrogression of all acid processes relative to basic processes. In the United States this fact is masked because we have no production of basic Bessemer steel and a comparatively small output of acid open-hearth.

The following tables, reproduced from the Iron Age, emphasize the relative decline of the acid processes in the 3 leading steel-making countries. It is to be borne in mind that this shift from the acid toward the basic steels is due, primarily, to the decreasing supply of the low-phosphorus ores required by both the acid Bessemer and the acid open-hearth processes. Long tons are used for the United States and Great Britain, and metric tons for Germany.

Bessemer and open-hearth steel production of the United States, Germany, and Great Britain in 1906.

	United States.	Germany.	Great Britain.	Increase over 1905.
Acid Bessemer	12,275,253	407,688	1,307,149	1,249,498
Basic Bessemer	....	6,772,804	600,189	591,310
Acid open hearth	1,321,613	230,668	3,378,691	526,884
Basic open hearth	9,649,385	3,534,612	1,176,245	2,662,686
Castings	Incl. above.	189,313	Incl. above.	....
Totals	23,246,251	11,135,085	6,462,274	....
Total 1905	19,912,751	10,066,553	5,889,460	....

Acid and basic steel production, 1902–1906, in United States, Germany, and Great Britain.

UNITED STATES.

	Acid steel.	Basic steel.
1902	10,329,559	4,496,533
1903	9,687,827	4,734,913
1904	8,660,939	5,106,367
1905	12,097,023	7,815,728
1906	13,596,866	9,649,385

GERMANY.

	Acid steel.	Basic steel.
1902	517,996	7,262,686
1903	613,399	8,188,116
1904	554,288	8,223,189
1905	655,495	9,290,296
1906	715,952	10,419,133

GREAT BRITAIN.

	Acid steel.	Basic steel.
1902	3,833,888	1,075,179
1903	3,930,189	1,103,912
1904	3,712,506	1,314,373
1905	4,439,067	1,373,215
1906	4,685,840	1,776,434

TOTAL.

	Acid steel.	Basic steel.
1902	14,681,443	12,834,398
1903	14,231,415	14,026,941
1904	12,927,733	14,643,929
1905	17,191,585	18,479,239
1906	18,998,658	21,844,952

THE PRODUCTIVE STATUS OF THE UNITED STATES STEEL CORPORATION.

During 1906 considerable public interest was attracted to a discussion in a leading iron-trade journal regarding the definition of the loosely used terms "trust" and "monopoly." The particular application of the question was to the United States Steel Corporation, and figures collected by Mr. J. M. Swank were presented to show the proportion of various iron and steel products controlled by that company. These figures are given in the following table:

Table showing iron and steel products of the United States and the proportion of each controlled by the United States Steel Corporation in 1905.

	By United States Steel Corporation.	By independent companies.	Total shipments and production.	Percentage United States Steel Corporation.			
				1905.	1904.	1903.	1902.
Shipments of iron ore from the lake region..........long tons..	19,251,872	15,101,584	34,353,456	56.0	53.8	58.8	60.4
Total production of iron ore.......do....	18,486,556	24,039,577	42,526,133	43.5	38.0	43.8	45.1
Production of coke...........short tons..	12,242,909	19,988,220	32,231,129	37.9	36.6	34.2	37.4
Iron and steel actually produced:							
Bessemer, basic, foundry, and other kinds of pig iron........long tons..	9,951,891	12,746,513	22,698,404	43.8	44.3	39.9	44.3
Spiegeleisen, ferromanganese, ferrophosphorus, and ferrobessemer, long tons..........	220,257	73,719	293,976	74.9	70.5	81.0	81.0
Total pig iron, including spiegeleisen, etc..............long tons..	10,172,148	12,820,232	22,992,380	44.2	44.6	40.4	44.7

Table showing iron and steel products of the United States and the proportion of each controlled by the United States Steel Corporation in 1905—Continued.

	By United States Steel Corporation.	By independent companies.	Total shipments and production.	Percentage United States Steel Corporation.			
				1905.	1904.	1903.	1902.
Bessemer steel ingots and castings, long tons	7,379,188	3,562,187	10,941,375	67.4	69.0	72.0	73.9
Open hearth steel ingots and castings, long tons	4,616,051	4,355,325	8,971,376	51.4	50.4	51.0	52.4
Total steel ingots and castings, long tons	11,995,239	7,917,512	19,912,751	60.2	61.0	63.5	65.7
Bessemer steel rails long tons	1,713,610	1,478,737	3,192,347	53.6	57.2	65.6	65.4
Structural shapes do	908,096	752,423	1,660,519	54.6	55.1	60.3	57.9
Plates and sheets, excluding nail plate, long tons	2,028,429	1,503,801	3,532,230	57.4	58.0	59.9	59.4
Wire rods long tons	1,265,707	542,981	1,808,688	69.9	71.3	73.1	71.5
Bars, skelp, nail plate, open hearth, and iron rails, etc long tons	2,063,113	4,583,118	6,646,231	31.0	28.6	29.8	31.1
Total finished rolled products, long tons	7,978,955	8,861,060	16,840,015	47.3	47.8	51.2	50.8
Wire nails, kegs of 100 pounds	7,175,418	3,679,474	10,854,892	66.1	67.0	70.6	64.8

It will be seen from these figures that the Steel Corporation produces somewhat less than half the pig iron of the country, and that its iron ore and coke output are proportionately still less. In steel and in most finished products its percentage is considerably higher, but in no case does it reach 70 per cent of the total American output. It may further be noted that in most lines the corporation has fallen off in percentage of production, though this tendency will probably be checked within a year or so when its present plans for new construction begin to show effect.

The real strength of the Steel Corporation lies not in its present control of production, but in the fact that its holdings of iron-ore lands in the Lake Superior district are so complete as to prevent any possibility of competition in that line. These holdings are variously estimated as representing from 75 to 85 per cent of the total iron-ore tonnage of the Lake Superior district, and so long as no other ore districts are taken into consideration it is obvious that the ore supply of the independent interests is not large enough to last for many years. In an earlier section of this report data were presented relative to other American ore districts which seem to show that an ore scarcity in the Lake Superior region need not necessarily be taken as meaning the end of competition.

SOUTHERN IRON CONDITIONS.

Prominent among the districts which offer hope for the future, when the better of the Lake Superior ore deposits are exhausted, is that which includes the Southeastern States from Virginia to Alabama.

In one respect the past year has been disappointing, when the conditions of the iron industry in the South are considered, for 1906 showed no material advance over 1905 so far as the production of either iron ore or pig iron were concerned. This is not a new thing, however, for contrary to the general impression the development of southern iron resources has not kept pace with that of the rest of the country.

The relative importance of the southern iron industry as compared with that of the entire United States is shown in the following table:

Proportionate iron production of South, 1854–1907, in long tons.

Year.	Production of United States.	Production of Southern States.	Percentage of total, Southern States.
1854	724,833	86,949	11.99
1880	4,295,414	265,526	6.18
1885	4,529,869	626,523	13.83
1890	10,307,028	1,642,930	15.94
1891	8,279,870	1,499,284	18.01
1892	9,157,000	1,636,243	17.87
1893	7,124,502	1,333,935	18.72
1894	6,657,388	1,182,044	17.75
1895	9,446,308	1,549,204	16.40
1896	8,623,127	1,646,410	19.09
1897	9,652,680	1,586,737	16.44
1898	11,773,934	1,700,053	14.44
1899	13,620,703	1,938,219	14.23
1900	13,789,242	2,147,840	15.58
1901	15,878,354	2,109,081	13.28
1902	17,821,307	2,548,340	14.30
1903	18,009,252	2,713,496	15.07
1904	16,497,033	2,178,927	13.21
1905	22,992,380	2,589,398	11.26
1906	25,307,191	2,775,973	10.97
1907 [a]	13,478,044	1,421,240	10.54

[a] First half of year.

While the South produced in 1854 almost exactly 12 per cent of the American total, in 1880 her production had fallen to barely over 6 per cent. From this year on a relatively rapid increase in southern output carried the percentage to 18 in 1891, to 18.72 in 1893, and finally to a maximum of 19.09 per cent in 1896. Since 1896, though the southern output has increased quite regularly, the increase is small compared with that shown by other sections. The result is that the southern output is steadily becoming of less relative importance, the percentage having fallen off until during the first half of 1907 it was barely over 10.5 per cent—considerably less than in 1854.

The decrease in relative output, though very gradual, has unfortunately been very steady, having encountered no serious reversal of direction since 1896 and no reversal at all since 1903. So far as can be estimated now from the new furnaces known to be in course of construction, there is no probability that the present trend will be changed in the near future. Unless business conditions should change materially, the southern iron output of 1908 and 1909 will probably not amount to more than 9 per cent of the total American production.

The system of mining the red ores of the Birmingham district is not one which permits a rapid increase in output to meet a suddenly enlarged demand, and few southern companies have ever spent much money in intelligent prospecting or development work. Transportation conditions, too, were unfavorable in 1906, the inadequacy of the car supply during the last two years being almost incredible.

During the last decade the wages of common laborers in Alabama have more than doubled, and along with the increase in wages is an increase in the general inefficiency of much of this labor. The principal problems before the southern iron manufacturer are, in fact, connected with labor supply, and within the year serious efforts have been made both to divert white immigration into this district and to supply the more pressing immediate needs by introducing Italian and Mexican labor. This latter step, though it may help in present needs, is of doubtful wisdom, for it seems calculated to add another race problem to the one with which the South has always struggled.

As was pointed out a year ago, the profits of southern iron making at present go largely to the railroads which carry the pig iron to northern markets. This condition will disappear as the steel-making capacity of the South is increased; and one of the most encouraging signs at the present day is the extent to which new steel plants are being planned and constructed.

A summary of the matter might be that three conditions must be observed before there can be hope for any great increase in the southern iron industry relative to the remainder of the American trade:

(1) The labor supply must be increased and its quality improved.

(2) Development work in the mines should be carried on during periods of depression, so that the mines can respond quickly to any suddenly increased demands.

(3) The output of steel-making irons should be increased, and provision should be made not only for their conversion into steel, but for their local manufacture into finished products.

Progress is now being made along all three of these lines. Within two years it is probable that the steel-making capacity of the South will be more than doubled. Several companies are making intelligently directed attempts so to develop their large ore reserves that they will be able to meet readily the demands of the furnaces in times of extra pressure. The labor question, though still not by any means in a satisfactory condition, has been taken up during the last year or so with particular care, and there are reasons to hope that the next boom in iron will find Birmingham at least with a fairly good labor supply.

RECENT TECHNOLOGIC ADVANCES.

Of processes affecting the iron industry the three which have received most attention during the last few years are probably the Gayley dry blast, electric smelting, and nodulizing. The first of these is in successful operation at a number of furnaces and is now hardly subject to discussion as a new or untried process. With the other two the case is different, and some space may profitably be devoted to a brief discussion of their probable status in the iron industry.

Electric smelting.—There is of course nothing particularly novel in the idea of producing iron or steel in the electric furnace, though some recent experimenters appear to ignore this fact and to consider the mere electrolytic production of metal to be the mark of success. The real point is to produce metal in the electric furnace cheaper than in the blast furnace, and concerning this possibility a great deal of discussion has taken place, often in a purely academic fashion, without much experimental basis. During the past two years, however, a number of experimental plants have been operated in various parts of America and Europe, and our knowledge of the problem is fast assuming a definite shape. Recent exhaustive discussion of the subject by Haanel, Harbord, Kershaw, and others seems to warrant the following conclusions:

(1) Under the conditions which obtain in most of the settled portions of the world neither pig iron nor ordinary structural steels can be produced in the electric furnace at a cost to compete with the blast furnace.

(2) Under exceptional conditions, where ample water power can be very cheaply developed in the immediate vicinity of the ores and when fuel is very dear, pig iron and steel can be produced profitably in the electric furnace. Harbord estimates that with electrical energy costing $10 per electrical horsepower year and with coke at $7 per ton the two methods are about on an equality.

(3) Electric smelting may be practicable in the case of titaniferous ores or of other ores difficult to treat in the blast furnace if the resulting product possesses any properties which would counterbalance the increased cost.

(4) Electric smelting methods can be profitably applied to the manufacture of crucible steel or of other high-grade special steels and ferro-alloys.

It will be seen, therefore, that there is little prospect that electric smelting will have much influence on the general development of the iron and steel industries until fuel supplies become much scantier than they are at present. Considerably more practical results to the industry can be expected from the process next to be considered, though it bears on an entirely different phase of the iron manufacturers' problems.

Nodulizing.—In all furnaces, and particularly in those running on soft or fine ores, a very appreciable quantity of iron ore is carried out by the blast. This ore dust, which may amount to 5 per cent or more of the furnace charge (equivalent to from 25 to 50 tons per day per furnace), is usually trapped before entering the stoves, so that it can be removed and stored. Its fineness, however, precludes its direct use in the furnace, and hitherto the only method of utilizing it involved the preparation of briquettes. The "nodulizing" process does away with certain difficulties inherent in any regular briquetting process and seems likely to come into general use as a means for economically handling flue dust. It is of service also in other fields, for it can handle the finer material produced during magnetic concentration, and it renders available certain sulphurous products (blue billy, sulphury ores, etc.) which have hitherto been treated with difficulty.

The principal novel point in connection with this process is that it employs rotary furnaces closely similar to the rotary kilns now so familiar in the Portland-cement industry. These kilns are set slightly inclined; the fine ore is fed in at the upper end and travels toward the lower end as the kiln revolves slowly. Fuel is sprayed in at the lower end, so that a high temperature is produced there. So far the process is exactly similar to that employed in cement practice. The point of difference lies in the fact that a hydrocarbon or other binder is dropped or sprayed into the ore as it is fed into the upper end of the kiln. As the materials slowly pass downward the binder mats the ore into little masses or nodules. Farther down in the kiln the greater heat causes the tar to combine with the sulphur, if the latter be present, and the two are largely volatilized. Still closer to the discharge end practically all of the binder has disappeared, but the ore nodules, now free from sulphur, still cohere, owing to incipient fusion of their particles, for the heat here approximates to 2,000° F.

It will be seen that this "nodulizing" accomplishes both the consolidation and the desulphurizing of the material, and that its chief advantage, as compared with the older briquetting and roasting processes, arises from the fact that the rotary kiln is an extremely effective labor-saving device.

MANGANESE ORES.

By Edwin C. Eckel.

INTRODUCTION.

The year 1906 witnessed a rather marked revival of the American manganese industry, the output exceeding that of 1905, 1904, and 1903, and closely approaching the production of 1902. Nothing like the outputs of the period from 1884 to 1901 was, however, made in 1906. The temporary revival of the industry was marked by increased interest in prospecting and opening up new manganese properties and in reopening old mines. It was also, unfortunately, accompanied by the exploitation of many manganese mining companies of doubtful character, the manganese-ore industry being of a nature to lend itself readily to promotions of this type.

The manganese industry of the United States has never been established on a sound basis. Even during the period of greatest production not more than two or three manganese mines were operated in business-like fashion. The bulk of the product has come from small workings, operated irregularly and inefficiently by individuals with little technical ability and less capital. Manganese deposits are, as a rule, very irregular in form, and are likely to show very rapid variations in grade of ore. It is consequently difficult to work them efficiently on a small scale, for in order to be able to ship high-grade ore steadily a good concentrating plant is necessary, and such a plant can not be built or operated simply to handle the output from one or two small pits.

PRODUCTION.

The ores included under this head are relatively pure manganese ores, carrying 40 per cent or more of metallic manganese. Ores carrying less than this percentage of manganese, with relatively high iron, are reported on a later page under the heading of manganiferous iron ore.

During 1906. the production of manganese ores amounted to 6,921 long tons, valued at $88,132, an increase of 2,803 tons, or 68.1 per cent, in quantity, and of $51,918, or 143.4 per cent, in value over the production of 1905, which was 4,118 long tons, valued at $36,214. All of this increase is due to large reported increases in the output of Virginia and Utah, for no other States produced any notable quantity of manganese in 1906.

In the table on the following page are given the quantity and value and the average price per ton of the manganese produced in the United States from 1904 to 1906, inclusive:

Production of manganese ores in the United States, 1904–1906, by States.

State.	1904.			1905.			1906.		
	Quantity, long tons.	Value.	Average price per ton.	Quantity, long tons.	Value.	Average price per ton.	Quantity, long tons.	Value.	Average price per ton.
Arkansas							62	$290	$4.68
California	60	$900	$15.00	1	[a] $5	$5.00	1	20	20.00
Georgia				150	[a] 900	6.00			
Tennessee				[a] 20	[a] 100	5.00	30	300	10.00
Utah	32	160	5.00				800	10,000	12.50
Virginia	3,054	28,406	9.30	[b] 3,947	35,209	8.92	6,028	77,522	12.86
Total	3,146	29,466	9.37	4,118	36,214	8.80	6,921	88,132	12.73

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

In the following table are given the quantity and value of manganese ore produced in the United States from 1880 to 1906, inclusive:

Production of manganese ores in the United States, 1880–1906, in long tons.

Year.	Arkansas.	Georgia.	Virginia.	Other States.	Total production.	Total value.
1880		1,800	3,661	300	5,761	$86,415
1881	100	1,200	3,295	300	4,895	73,425
1882	175	1,000	2,982	375	4,532	67,980
1883	400		5,355	400	6,155	92,325
1884	800		8,980	400	10,180	122,160
1885	1,483	2,580	18,745	450	23,258	190,281
1886	3,316	6,041	20,567	269	30,193	277,636
1887	5,651	9,024	19,835	14	34,524	333,844
1888	4,312	5,568	17,646	1,672	29,198	279,571
1889	2,528	5,208	14,616	1,845	24,197	240,559
1890	5,339	749	12,699	6,897	25,684	219,050
1891	1,650	3,575	16,248	1,943	23,416	239,129
1892	6,708	826	6,079		13,613	129,586
1893	2,020	724	4,092	882	7,718	66,614
1894	1,934	1,277	1,797	1,300	6,308	53,635
1895	2,991	3,856	1,715	985	9,547	71,769
1896	3,421	4,085	2,018	564	10,088	90,727
1897	3,240	3,332	3,650	886	11,108	95,505
1898	2,662	6,689	5,662	944	15,957	129,185
1899	356	3,089	6,228	262	9,935	82,278
1900	145	3,447	7,881	298	11,771	100,289
1901	91	4,074	4,275	3,555	11,995	116,722
1902	82	3,500	3,041	854	7,477	60,911
1903		500	1,801	524	2,825	25,335
1904			3,054	92	3,146	29,466
1905		150	3,947	21	4,118	36,214
1906	62		6,028	831	6,921	88,132
Total	49,466	72,294	205,897	26,863	354,520	3,398,743

USES.

The principal uses of manganese ores may be conveniently classified as follows: (1) metallurgical, in connection chiefly with the iron and steel industries; (2) chemical, in connection with the manufacture of chlorine, of oxygen, of potassium permanganate, etc.

In addition, minor uses for manganese are found in the glass, pottery, brick, and paint industries.

When manganese ores are used for metallurgical purposes their value depends upon (*a*) the percentage of metallic manganese present in the ore and (*b*) the relative absence of such undesirable elements as phosphorus, sulphur, etc. The ores used in the chemical industries are valued on an entirely different basis, for here the chief use for manganese ore is as a supplier of oxygen, and the value of the ore depends upon the percentage of manganese peroxide present in the ore. The result of this difference in utilization is that many ores suitable for metallurgical purposes are absolutely worthless in the chemical industries.

PRICES.

The ruling prices for manganese ores during 1906, as established by the Carnegie Steel Company, were governed by the following schedule:

Schedule of prices which will be paid per ton of 2,240 pounds for domestic manganese ore: Delivered at Lucy Furnaces, Pittsburg, Pa., Edgar Thomson Furnaces, Bessemer, Pa., or South Works, Illinois Steel Company, South Chicago, Ill.

Prices are based on ores 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.

Percentage of metallic manganese in ore.	Price per unit, in cents.	
	Manganese.	Iron.
Over 49	30	6
46 to 49	29	6
43 to 46	28	6
40 to 43	27	6

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.

The prices quoted covered only the ores used in the steel industry. Manganese ores for chemical uses are valued on an entirely different basis.

MANGANIFEROUS IRON ORES.

In addition to the output of relatively high-grade manganese ores covered by the preceding table, there is in Arkansas and Colorado a very important production of iron ores carrying 20 to 40 per cent of manganese. These ores have hitherto been reported among the iron ores, though their output was repeated under manganese. As this method of procedure seems likely to cause confusion, the output of highly manganiferous iron ores for 1906 is reported in this place only. The table on the following page shows that ores of this class amounted to 41,300 long tons, valued at $122,400:

Production of manganiferous iron ores in the United States, 1904–1906, in long tons.

State.	1904.				1905.			
	Percentage of manganese.	Quantity.	Value.	Average value per ton.	Percentage of manganese.	Quantity.	Value.	Average value per ton.
Arkansas	28	600	$1,200	$2.00	28	3,321	$6,642	$2.00
Colorado	15–32	17,074	54,104	3.17	14–41	45,837	110,497	2.41
Total	15–32	17,674	55,304	3.13	14–41	49,158	117,139	2.38

State.	1906.			
	Percentage of manganese.	Quantity.	Value.	Average value per ton.
Arkansas	20–25	8,900	$24,800	$2.79
Colorado	26–36	32,400	97,600	3.01
Total	20–36	41,300	122,400	2.96

Lake Superior manganiferous iron ores.—A large proportion of the iron ores of the Lake Superior district carry sufficient manganese to be notable, but as the output of these ores has been included in the iron-ore report it is not reported separately here. These Lake Superior ores carry from 1 to 8 per cent manganese, and can not therefore be grouped satisfactorily with either the pure manganese ores or with the highly manganiferous iron ores of Arkansas and Colorado. A fair assumption would be that during 1906 the Lake Superior district produced about 1,000,000 long tons of this very low-manganese iron ore, and that its average manganese content was about 4 per cent

A fairly typical example of the Lake Superior manganiferous ores is afforded by the following analysis from Oglebay, Norton & Co.'s 1907 list. It is of the "Ottawa manganese" ore, from the Ottawa mine, Gogebic district.

Analysis of manganiferous iron ore, Michigan.

	Dried at 212° F.	Natural state.
Metallic iron	53.44	48.10
Manganese	6.25	5.63
Phosphorus	.064	.058
Sulphur	.006	.005
Silica	6.71	6.04
Alumina	1.49	1.34
Lime	.15	.14
Magnesia	.20	.18
Loss on ignition	5.27	4.74
Moisture	None.	10.00

MANGANIFEROUS RESIDUUM FROM ZINC ROASTING.

The material classed under this head is a residual product from certain zinc oxide works using New Jersey ores. The crude ore as shipped to the zinc oxide plant consists of a mixture of franklinite and willemite, the former being predominant. After roasting off the bulk of the zinc in the zinc oxide plant, the residue is a mass of manganese and iron oxides.

The following table gives the quantity and value of this product, together with the average price per ton from 1901 to 1906, inclusive:

Production of manganiferous zinc residuum in the United States, 1901–1906, in long tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
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
1903	73,264	73,264	1.00	1906	93,461	93,461	1.00

IMPORTS.

The quantity of manganese ores imported into the United States during 1906 amounted to 221,260 long tons, valued at $1,696,043, which is a decrease compared with the 1905 imports, although a substantial increase over 1904.

The comparatively small domestic production of manganese ore makes the importations of this product into this country a most important factor, as the demand for ferromanganese and spiegeleisen increases with the growth of the steel industry.

India easily leads in the quantity of manganese exported in 1906 with 154,180 long tons, valued at $939,984, as compared with 101,030 tons, valued at $501,423, in 1905, and 10,200 tons, valued at $58,635, in 1904. Brazil ranks second, and Russia, Cuba, Germany, Japan, Belgium, United Kingdom, and Canada follow in the order named.

The following table, prepared from information furnished by the Bureau of Statistics of the Department of Commerce and Labor, gives the imports of manganese ores into the United States, by countries, from 1904 to 1906, inclusive:

Imports of manganese ores into the United States during the years 1904–1906, by countries, in long tons.

Country.	1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Brazil	66,875	$589,089	114,670	$1,058,478	30,260	$300,466
Russia	11,959	98,002	24,650	202,774	13,805	109,814
British India	10,200	58,635	101,030	501,423	154,180	939,984
Cuba	16,239	80,974	6,489	35,049	11,701	117,050
Japan	996	12,651	1,329	13,950	2,000	21,664
Germany	1,031	33,365	2,336	54,150	4,386	112,511
United Kingdom	993	22,533	1,298	30,555	1,330	37,711
Canada	118	3,887	7	575	112	1,125
Spain			50	708		
Belgium	108	2,456	80	1,762	1,710	30,377
All other countries			5,094	52,983	1,776	25,341
Total	108,519	901,592	257,033	1,952,407	221,260	1,696,043

Most of the shipments came through the ports of Baltimore and Philadelphia, the records showing that out of the total imports of 221,260 long tons 120,051 tons were received at Baltimore and 93,590 tons at Philadelphia.

In the following table are given the quantity and value of the manganese ores imported from 1904 to 1906, inclusive, by customs districts:

Manganese ores imported into the United States during the calendar years 1904–1906, by customs districts, in long tons.

Customs districts.	1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Philadelphia, Pa	33,651	$294,408	117,591	$822,525	93,590	$682,485
Baltimore, Md	49,876	422,453	126,018	993,163	120,051	860,112
New York, N. Y	4,833	65,450	5,954	90,942	6,802	136,037
Newport News, Va	83	2,102				
Chicago, Ill	184	6,140	20	496	239	10,096
Boston, Mass	3	195	4	127	5	209
New Orleans, La			199	1,822	411	3,675
Pensacola, Fla			650	4,284		
Mobile, Ala	19,844	109,564	6,489	35,049		
Huron, Mich	1	63				
All others	44	1,217	108	3,999	162	3,429
Total	108,519	901,592	257,033	1,952,407	221,260	1,696,043

In 1906 the United States produced 6,921 long tons of manganese, or only 3.1 per cent compared with the imports.

The following table gives, merely for comparison, the relative quantity and value of the domestic production of manganese ores and the quantity and value of the imported ores from 1901 to 1906, inclusive, and the total for eighteen years:

Relative quantities and values of domestic and imported manganese ores, 1901–1906, in long tons.

Year.	Domestic production.		Imports.	
	Quantity.	Value.	Quantity.	Value.
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
1906	6,921	88,132	221,260	1,696,043
Total for 18 years (1889–1906)	205,824	1,875,106	2,169,818	18,856,582

WORLD'S PRODUCTION OF MANGANESE ORES.

In the following table is given the production of manganese ores in the principal countries for the latest years for which statistics are available. The unit used is either the long or the metric ton, except in the case of Canada, where the short ton is used.

World's production of manganese ores.

Country.	Year.	Quantity.	Country.	Year.	Quantity.
North America:		*Tons.*	Europe—Continued.		*Tons.*
United States	1906	6,921	Portugal	1903	30
Canada [a]	1906	93	Russia	1905	426,813
Cuba	1906	18,688	Spain	1905	26,020
South America:			Sweden	1905	1,992
Brazil [a]	1905	233,950	Turkey [a]	1905	28,600
Chile	1905	1,324	Norway	1904	22
Europe:			Asia:		
Austria	1905	13,788	India	1905	253,896
Bosnia and Herzegovina	1905	4,129	Japan	1905	11,162
Hungary	1905	9,943	Java	1905	1,600
France	1905	6,751	Oceania:		
Germany	1905	51,463	Queensland	1905	1,517
Greece	1905	8,171	New Zealand	1905	55
Italy	1905	5,384			

[a] Exports.

FERROMANGANESE AND SPIEGELEISEN.

The following table gives the quantity and value of ferromanganese and spiegeleisen produced in the United States from 1893 to 1906, inclusive:

Production of spiegeleisen and ferromanganese in the United States, 1893–1906.

1893	long tons	81,118	1901	long tons	291,461
1894	do	120,180	1902	do	212,981
1895	do	171,724	1903	do	192,661
1896	do	131,940	1904	do	219,446
1897	do	173,695	1905	do	289,983
1898	do	213,769	1906	do	300,500
1899	do	219,768			
1900	do	255,977	Total	do	2,875,203

Imports.—The quantity and value of ferromanganese and spiegeleisen imported into the country from 1903 to 1906, inclusive, are shown in the following table:

Ferromanganese and spiegeleisen imported and entered for consumption, 1903–1906, in long tons.

Year.	Ferromanganese.		Spiegeleisen.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	41,519	$1,699,666	122,015	$2,709,317	163,534	$4,408,983
1904	21,813	707,037	4,623	132,461	26,436	839,498
1905	52,841	1,884,651	55,457	1,336,104	108,298	3,220,755
1906	84,359	4,953,644	103,268	2,942,940	187,627	7,896,584

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 from domestic ores in 1906 is shown in the following table in distribution by States and Territories. These figures are the result of conference and adjustment between the Bureau of the Mint and the Geological Survey, and are accepted as final by the two bureaus. The basis for this table are data collected by the Bureau of the Mint of bullion deposits in the United States mints and assay offices and by statements from the smelting and refining establishments; the distribution by States is, moreover, checked and verified by the data collected by the Geological Survey directly from the producing mines. The table is derived from three items: (1) The unrefined domestic gold and silver deposited in the United States mints and assay offices; (2) the domestic gold and silver in fine bars reported by the private refineries; (3) the unrefined domestic gold and silver contained in ores, copper matte, etc., exported for reduction. The last is an item of small relative importance.

Approximate distribution by producing States and Territories of the product of gold and silver in the United States for the calendar year 1906, in fine ounces.[a]

State or Territory.	Gold.		Silver.		Total value (silver at commercial value).
	Quantity.	Value.	Quantity.	Commercial value.	
Alabama	1,137	$23,500	100	$68	$23,568
Alaska	1,033,537	21,365,100	203,500	137,747	21,502,847
Arizona	132,891	2,747,100	2,969,200	2,009,822	4,756,922
California	911,041	18,832,900	1,517,500	1,027,180	19,860,080
Colorado	1,109,452	22,934,400	12,447,400	8,425,520	31,359,920
Georgia	1,146	23,700	300	203	23,903
Idaho	50,102	1,035,700	8,836,200	5,981,135	7,016,835
Michigan			186,100	125,969	125,969
Missouri			31,300	21,187	21,187
Montana	218,752	4,522,000	12,540,300	8,488,404	13,010,404
Nevada	448,852	9,278,600	5,207,600	3,524,972	12,803,572
New Mexico	12,877	266,200	453,400	306,902	573,102
North Carolina	4,397	90,900	24,700	16,719	107,619
Oregon	63,860	1,320,100	90,700	61,394	1,381,494
South Carolina	3,609	74,600	100	68	74,668
South Dakota	319,512	6,604,900	155,200	105,053	6,709,953
Tennessee	39	800	25,600	17,328	18,128
Texas	164	3,400	277,400	187,769	191,169
Utah	248,208	5,130,900	11,508,000	7,789,650	12,920,550
Virginia	498	10,300	100	68	10,368
Washington	4,983	103,000	42,100	28,497	131,497
Wyoming	276	5,700	1,100	745	6,445
Total	4,565,333	94,373,800	56,517,900	38,256,400	132,630,200

[a] Gold value, $20.671834625323 per fine ounce. Silver value, 67 cents per fine ounce.

The gains and losses in the production of the various States and Territories, compared with the production of 1905, are shown in the following table:

Increase (+) or decrease (—) in production of precious metals in the United States in 1906, by States and Territories, in fine ounces.

State or Territory.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Alabama	— 871	— $18,000	— 200	— $115
Alaska	+311,511	+6,439,500	+ 34,300	+ 34,535
Arizona	+ 2,699	+ 55,800	+ 368,500	+ 420,345
California	— 17,619	— 364,200	+ 435,500	+ 367,160
Colorado	—133,839	—2,766,700	— 495,400	+ 530,412
Georgia	— 3,541	— 73,200	— 600	— 346
Idaho	— 1,930	— 39,900	+ 710,600	+1,024,519
Maryland	— 716	— 14,800	— 100	— 61
Michigan			+ 66,900	— 28,361
Missouri			+ 18,400	+ 13,318
Montana	— 17,768	— 367,300	— 914,400	+ 281,037
Nevada	+189,606	+3,919,500	— 655,900	— 51,763
New Mexico	+ 19	+ 400	— 98,500	+ 90,413
North Carolina	— 1,597	— 33,000	— 11,500	— 8,667
Oregon	+ 3,638	+ 75,200	— 1,800	+ 7,165
South Carolina	— 991	— 20,500		— 7
South Dakota	— 14,948	— 309,000	— 23,800	— 4,137
Tennessee	— 121	— 2,500	— 69,900	— 40,927
Texas	+ 72	+ 1,500	— 139,800	— 66,723
Utah	— 483	— 10,000	+1,188,200	+1,494,372
Virginia	+ 256	+ 5,300	— 100	— 54
Washington	— 12,916	— 267,000	— 77,300	— 44,337
Wyoming	— 870	— 18,000	— 1,600	— 902
Total	+299,591	+6,193,100	+ 416,300	+4,034,424

The total production of gold was 4,565,333 fine ounces in 1906, valued at $94,373,800. This is an increase over the production of 1905 of 299,591 fine ounces, valued at $6,193,100. Fourteen States and Territories showed decreases in gold production in 1906 amounting to 208,210 fine ounces and valued at $4,304,100. Of these the greatest losses were shown by Colorado, 133,839 fine ounces, valued at $2,766,700; California, 17,619 fine ounces, valued at $364,200; Montana, 17,768 fine ounces, valued at $367,300; South Dakota, 14,948 fine ounces, valued at $309,000; and Washington, 12,916 fine ounces, valued at $267,000. Of the 7 States and Territories showing an increase in gold production the greatest gains were in Alaska (311,511 ounces, valued at $6,439,500), and in Nevada (189,606 ounces, valued at $3,919,500). In no other case did the increase reach $100,000. The total increase of the 7 States and Territories is 507,801 fine ounces, valued at $10,497,200, and the difference between these figures and those of the total decrease gives the increase for the year already noted.

The production of silver in 1906 in the United States amounted to 56,517,900 fine ounces, with an average commercial value of $38,256,400. This shows an increase in quantity over the production of 1905 of 416,300 fine ounces, and in value of $4,034,424. Thirteen States and Territories report a decrease in quantity, amounting in all to 2,446,000 fine ounces, and 11 report a decrease in value amounting to $237,726. Nine States and Territories report an increase in quantity, amounting in all to 2,862,300 fine ounces, and 12 an increase in value, amounting to $4,272,150. The greatest decreases were in Montana (914,400 ounces), Nevada (655,900 ounces), Colorado (495,400 ounces), and Texas (139,800 ounces).

The greatest gains took place in Utah (1,188,200 ounces), Idaho (710,600 ounces), California (435,500 ounces), and Arizona (363,500 ounces). The increased price for silver during the year, however, in some cases brought about the seemingly contradictory result that a decrease in production—as, for instance, in Montana and Colorado—corresponded to an actual increase in the value of the product.

PRODUCTION OF GOLD AND SILVER IN UNITED STATES SINCE 1880.

The following table, from the report of the Director of the Mint on the production of gold and silver, shows the quantity and value of these metals produced in the United States since 1880:

Production of gold and silver in the United States from 1880 to 1906, inclusive.

Year.	Gold.		Silver.	
	Fine ounces.	Value.	Fine ounces.	Commercial value.
1880	1,741,500	36,000.000	30.318,700	34.717,000
1881	1,678,612	34,700.000	33,257,800	37,657,500
1882	1,572,187	32,500.000	36,196,900	41,105,900
1883	1,451,250	30,000.000	35.732,800	39,618,400
1884	1,489,950	30,800,000	37,743,800	41,921,300
1885	1,538,373	31,801,000	39,909,400	42,503,500
1886	1,686,788	34,869,000	39,694,000	39,482,400
1887	1,603.049	33,136,000	41.721,600	40,887,200
1888	1,604,478	33,167,500	45,792,700	43,045,100
1889	1,594,775	32,967,000	50,094,500	46,838,400
1890	1,588,877	32,845,000	54,516,300	57,242,100
1891	1,604,840	33,175,000	58,330,000	57,630,000
1892	1,597,098	33,015,000	63,500.000	55,662.500
1893	1,739,323	35,955,000	60,000.000	46,800,000
1894	1,910,813	39,500.000	49,500,000	31,422,100
1895	2,254,760	46,610,000	55,727,000	36,445,500
1896	2,568,132	53,088,000	58,834,800	39,654,600
1897	2,774,935	57,363,000	53,860,000	32,316,000
1898	3,118,398	64,463,000	54,438,000	32,118.400
1899	3,437,210	71,053,400	54,764,500	32,858,700
1900	3,829,897	79,171,000	57,647,000	35,741,100
1901	3,805,500	78,666,700	55,214.000	33,128.400
1902	3,870,000	80,000,000	55,500.000	29,415,000
1903	3,560,000	73,591,700	54,300,000	29,322.000
1904	3,892,480	80,464,700	57,682,800	33,456,000
1905	4,265,742	88,180,700	56,101,600	34,222,000
1906	4,565,333	94,373,800	56,517,900	38,256,400
Total	66,344,300	1,371,456,500	1,346,896,100	1,063,467,500

MINES REPORT.

By Waldemar Lindgren.

METHOD OF COLLECTING STATISTICS.

It should be distinctly understood that the table on page 5 contains the figures of the production of gold and silver which are accepted as final by the Geological Survey, inasmuch as they record in the main the quantities of these metals which were actually produced during the calendar year. It is difficult to trace the refined metals back to the States where the ore was produced, and it is still more difficult to trace them back to producing counties and districts. In order, therefore, to ascertain the state of the mining industry in each mining camp, the Geological Survey asks from each mining property the amount of gold and silver, as well as that of other metals, produced. Tabulated in proper form, these replies form the basis of this mines report.

The Mint Bureau records the production of the precious metals from gold bullion deposits in United States mints and assay offices, from the fine bars reported by the refineries, and from the gold and silver contained in ores and metallurgical products exported for reduction.

The statistics of gold and silver collected from the mines by the Geological Survey are obtained from the following 4 items: 1. Gold and silver in placer bullion produced during calendar year. 2. Gold and silver in mill bullion produced in mill of company during calendar year. 3. Gold and silver in base bullion, matte, etc. (by assay value), produced in smelter of company during calendar year. 4. Gold and silver in crude ore and concentrates (by assay value) shipped to custom works in calendar year.

The first item needs no explanation. The second and third items cover the cases of mining companies which have their own reduction works; they report the gold and silver bullion produced during the year, or the gold and silver contained in their metallurgical products sold to refineries, as there are very few smelting works owned by mining companies which also refine their base bullion. There is, as a rule, no great interval of time before the ore sent to these mills and smelters is reduced to gold and silver or base bullion, and, although there is some overlap at the beginning and close of the year, the tonnage shipped from the mine during the year corresponds with fair accuracy to the quantity of fine or base bullion or matte produced.

The greatest difficulties are found in the fourth item, comprising ores and concentrates shipped to custom works—generally smelters, more rarely mills—as a considerable interval of time, often thirty days or more, elapses before the ore reaches the works, and often much more before it is reduced and refined. It is mixed with other ores and loses its identity, and the assay value is the only guide the miner has to the quantity of metal produced. In these cases the miner is requested by the Geological Survey to give the tonnage and assay value of ores and concentrates shipped up to the end of the year. Two months or more often pass before the smelter return for the last ore shipped in December is received by the mine, and this, incidentally, is one of the causes delaying this report.

It should be emphasized that the table of mine production does not give the contents of the ore mined during the year. Only the ore that is treated or sold is recorded. Neither does this report give the assay value of the total tonnage; for if this were the case the heavy losses in concentration would be disregarded, and the results would be very much larger and wholly misleading. As far as possible the report aims to give the metals recovered from the tonnage sold or treated during the year. In items 2 and 3 this is substantially correct, except for the very small refining losses. In item 4 the amount given is theoretically larger than the actual recovery of refined metals by the combined smelting and refining losses. Practically, however, this is counterbalanced by several factors: (1) Small quantities of gold and silver are recovered from many ores, but not paid for by the smelting companies or recorded in the settlements. As a rule, payments are not made on less than

2 ounces of silver or 0.05 ounces of gold per ton. (2) Settlements are made on the basis of 95 per cent of New York price for silver and of $19 to $20 per ounce of gold. Small producers, who often report in terms of dollars alone, are very likely to give a correspondingly smaller value than the ore actually contains. The same class of producers occasionally also misunderstand the questions and report net instead of gross proceeds. The gold is sometimes also given in value only, which is then always smaller than the actual value of the metal in the ore by from $0.67 to $1.67 per ounce. (3) There is always a certain small percentage of the product which can not be obtained from the miners. This includes the output of scattered individual placer workers, often aliens; some of this is estimated on the basis of the record of mint deposits, but a little invariably escapes detection. There are further cases where owners of small mines decline to answer or where the property is not continuously operated and the owner can not be found. There is, lastly, the ore abstracted by "high graders" or ore thieves, which takes away a notable fraction of the production of mines containing rich ore. Through small assay offices this gold finds it way to the mints. The practice was carried on to a disgraceful extent during the year 1906 in the rich mines of Goldfield. The principal mine officers estimate that ore to the value of $1,250,000 was "appropriated" in that camp during 1906, and state that ore worth $250,000 was recovered from the thieves. Several suits in the courts for the recovery of parcels of ore indicated that the statement was well founded. Much rich ore is probably still secreted and will gradually reach the mints in 1907. The conditions prevailing at Goldfield in the last months of 1906 were, however, exceptional. Gold and silver from old metallurgical by-products, like slag, is also apt to escape notice. Taken together, the three items explained above will probably compensate for the losses in smelting and refining.

Returns are obtained from every mine of importance in the States and Territories, there being now practically no refusals to report. The mining companies appreciate that they are fully protected, as the individual returns are strictly confidential, while they profit from an exact knowledge of the aggregate production and by correct reports of the state of the industry. Willful misstatements are very rare, and, as already noted, the replies are more likely to be too low than too high. The only trouble experienced in 1906 was in Alaska, where many of the large placer mining companies failed to report. There are other ways, however, to obtain the totals for that region, as more fully explained by Mr. Brooks in his report.

COMPARISON OF MINT REPORT AND MINES REPORT.

Both of the plans outlined above (see pages 7 and 8) are admittedly open to some objections, but it may be questioned whether it would be practicable to make them wholly consistent and logical. The most important difference between the two reports is that, though covering the same time interval, they do not quite cover the same period of ore extraction, the mines report being as much as three or four months in advance of the mint report. The mill and placer bullion reaches mints and refineries soon after its production, and it does not require a long time to obtain it from the ore; but in smelting, and especially in custom work, several months may pass before the refined metals come on the market. Sampling, shipping, mixing, roasting, smelting, shipment to refinery, and refining—all these operations take time to perform.

The figures obtained by the two methods will agree, within certain limits of error, if the mining and smelting industries are carried on uniformly and at the same rate. But important disturbing factors may result in marked discrepancies between the two sets of figures, each one being a correct statement in itself. Especially is this so when abnormal conditions appear near the beginning or close of the calendar year. In time the discrepancies will balance if the reports are intrinsically correct.

In 1904 and 1905 the two reports agreed closely. In 1905 the refinery report gave $88,180,700 in gold and 56,101,600 ounces of silver, while the mines report recorded $88,159,881 in gold and 56,272,496 ounces of silver. In the latter half of 1906 the extremely rich ore bodies of the Goldfield camp were worked, and in the last month of the year gold-ore production from the Mohawk mine was rushed to an extraordinary degree, owing to the expiring of certain leases. At the same time, in the last months of 1906, the whole country experienced a great car shortage, resulting in a corresponding delay in ore shipment and scarcity of fuel for the smelters. This meant that smelting and refining of ore shipped in the last months of the year to custom works would take much longer than usual, and consequently that much of the gold from ores mined in 1906 would be credited to the refinery output of 1907. In a less degree these conditions obtained at all smelting centers and applied to silver as well as gold, although there was no such special cause for disturbance as in the case of the Goldfield ores.

The total of gold given by the mint report in 1906 is $94,373,800. The mines report has $97,219,645, an excess of $2,845,845. In Alaska, where there are special difficulties in collecting statistics, the mines report is about $700,000 higher than the mint report, a condition repeated from 1905. In the other States, where mill and placer bullion predominate, there is close agreement. In California the mines report has $18,732,452 against $18,832,900 of the mint report; in Oregon, $1,366,900 against $1,320,100; in Montana, $4,469,014 against $4,522,000. In the smelting States, such as Arizona, Colorado, and Utah, the mines report shows slight excesses over the mint report. The greatest difference exists in Nevada, where the mines report gives $10,470,704 against $9,278,600 of the mint report, a difference of $1,192,104. Undoubtedly the mines shipped ore corresponding to the higher figures, but as explained above and as confirmed by direct evidence, a large part of the gold in this ore was not refined in 1906.

The total of silver given by the mint report is 56,517,900 ounces. The mines report has 57,362,455 ounces, an excess of 844,555 ounces. In Arizona and Utah the figures correspond closely. The principal difficulty is again in Nevada, which is credited in the mint report with 5,207,600 ounces against 6,770,612 ounces in the mines report, an excess in the latter of 1,563,012 ounces. Delay in treatment of Tonopah ores is chiefly responsible for this difference. In Idaho the silver in the mint report is less than in the mines report by nearly 200,000 ounces, while in Montana the excess in the mint report is over 500,000 ounces.

MINES REPORT ON COPPER, LEAD, AND ZINC.

In the West gold and silver are so intimately connected with copper, lead, and zinc that it was found necessary to include these metals also in the requests for reports of production. Here, again, however, the smelters report on copper production published elsewhere in this volume by Mr. L. C. Graton contains the figures of actual production of metal and is considered as final. The general principles discussed above as applying for gold and silver apply also to the relation of smelters report to mines report for the baser metals.

Fairly exact results are obtainable in the case of copper, for most of this metal is produced by large companies which own their smelting plants and which thus report actual output of metal. Michigan is not represented in the following mines report, but taking the same figure for that State as appears in the special copper report, the total of the copper in the mines report is 916,971,387 pounds, whereas the smelters report, as shown by Mr. Graton, adds up to 917,805,682. This is an excellent agreement. The mines report gives, in pounds: Arizona, 266,831,864; California, 28,726,448; Idaho, 9,558,913; Montana, 290,700,975; New Mexico, 7,028,670, and Utah, 56,593,576. The smelters report gives the corresponding figures as follows: Arizona, 262,566,103; California, 28,153,202; Idaho, 8,578,046; Montana, 294,701,252; New Mexico, 7,099,842, and Utah, 50,329,119. The greatest discrepancy thus appears in the last State. To some extent the delay in smelting during the winter of 1905–6 was responsible for the discrepancies noted above. In Idaho the difference was assuredly traceable to this cause. In Colorado, where the copper is derived from custom works, the mine returns, as noted in 1905, were lower than the smelter returns, on account of small percentages of copper for which no pay was obtained by the mines; but in 1906 the production reported by the miners remained almost stationary, while that reported by the custom smelters decreased from over 9,000,000 pounds to about 7,500,000 pounds.

In regard to lead the relation of mines report and smelters report is less satisfactory. Practically all lead ores are treated in custom smelters, which, as is well known, are chiefly in the hands of one company. According to Mr. Boutwell's smelters report on the lead production, the Western States yielded 464,076,000 pounds in 1906, while the mines for the same States, as recorded in the following pages, reported 502,697,405 pounds. This is a very large difference, and to a considerable extent it remains unexplained. It is true that here, too, the mines report is several months ahead of the smelters report for the same year, and that in the fall of 1906 conditions of transportation and fuel supply were particularly bad. But on the other hand there was no unusual mine production in any camp during the latter part of 1906. There is a large difference in New Mexico (mines report, 2,987,369 pounds; smelters report, 1,280,000 pounds), which is only partly explained by the fact that some lead-zinc ores from the Magdalena district are used for pigments. In Colorado the difference is not so great (mines report, 104,102,269 pounds; smelters report, 100,994,000 pounds). In Idaho and Utah, the largest lead producers in the West, however, the discrepancies are most remarkable. Idaho mines report gives 255,014,446 pounds, while only 234,234,000 pounds is allotted to that State by the smelter returns. Utah mines report calls for 125,342,836 pounds, while the smelters say that 112,520,000 pounds represent the output. The bulk of the production in these two States is sold in the form of concentrates by a number of large mining companies. The figures given represent the assay values of these concentrates. Assuming a 5 per cent loss in smelting, which seems very liberal, in view of counteracting influences mentioned, under gold and silver, but in part applicable to lead, there still remains an excess of almost 9,000,000 pounds of mine returns above smelter returns in Idaho, and of almost 6,000,000 pounds in Utah.

The zinc returns are still more unsatisfactory. The principal zinc-mining States of the West are as follows, in their order of production: Colorado, New Mexico, Montana, Utah, Nevada, and Idaho. The ores are so complex, and they vary so widely in character and tenor, that the Missouri Valley measurement by tons of ore is of doubtful value. The loss of metal in concentration and smelting is very heavy. It is aimed in the mines report to obtain the tonnage and assay value of the product (crude ore and concentrates) shipped to the zinc works, and 25 per cent of the quantity of metal contained is then subtracted for smelter loss. The matter is still further complicated by the great consumption of zinc ores for the manufacturing of zinc white and lead-zinc pigment. The figures given in the reports for the different States, therefore, do not mean metallic zinc or spelter. They simply represent 75 per cent of the assay value of the ores shipped. It is probable that some better method may be devised, and it is especially planned for the 1907 report to obtain a better check on the quantity of ore consumed by the paint manufactories. At present the shipper of zinc ores often does not know whether his product will be used for the manufacture of spelter or of pigment.

In the smelters report published elsewhere in this volume, Mr. Boutwell has succeeded in apportioning for 1906 the metal according to source of ore on the basis of returns made by the zinc works. From his tables it appears that the Western States yielded almost one-fifth of the total spelter, or, in exact figures, 78,590,000 pounds, and that the principal part of the production was derived from the Central and Eastern States. The mines report for the Western States, on the other hand, indicated a total of 122,522,222 pounds, or nearly one-third more than the smelters report. A large part of this difference was undoubtedly due to ore used for pigments. Colorado has by far the greatest production, and the bulk of it is derived from Leadville mines. The mines report gives 86,965,308 pounds (three-fourths of assay value of product shipped), whereas the apportioned spelter output of the smelters is only 64,912,000 pounds. The New Mexico mines report 17,292,655 pounds, while the smelter statement is 1,110,000 pounds. A very large part of the output of the Magdalena district in New Mexico, which is the principal zinc camp in that Territory, is, however, known to be used for the manufacture of pigments. Some buyers of zinc ore from Leadville mines, for instance, are known to reconcentrate the products in Denver or Canyon before shipping to the zinc works, and considerable loss is, of course, involved in that operation. In the report for 1907 there will probably be an improvement shown in the zinc statistics in the reports from both mines and smelters.

The zinc ores of the West, except in rare cases, contain gold and silver. The cinders, after the distillation of the zinc, are naturally richer than the ore and are sold to lead smelters. Several hundred thousand ounces of silver, with some gold, are annually recovered from this source. These metals are not always paid for by the buyers, and part of the silver and gold from this source is apt to escape the collection of statistics from the mines.

UNITS OF MEASUREMENT.

Gold and silver are measured by the fine ounce. In the computing tables prepared by the Bureau of the Mint and the Geological Survey, gold is counted as $20.671834625323 per fine ounce. The average commercial price of silver in New York was 67 cents per fine ounce. The metal fluctuated between 63 and 72 cents, the latter figure being nearly reached in November, 1906.

As to the base metals, the average price of electrolytic copper in 1906 is taken as 19.3 cents per pound, that of lead at 5.7 cents per pound, and that of zinc at 6.1 cents per pound.

The values given are thus New York prices and do not represent the amounts obtained by the sellers of the ore.

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 the value of gold and silver reported by the producing mines in 1906 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 1905.

Production of gold and silver in the United States in 1906, as reported from the mines to the United States Geological Survey, by States and Territories, in fine ounces.

State and Territory.	Gold.		Silver.		Increase (+) or decrease (—).	
	Quantity.	Value.	Quantity.	Value.	Gold.	Silver.
Alabama	1,205.51	$24,921	124	$83	— $16,609	— $120
Alaska	1,066,029.91	22,036,794	166,068	111,266	+6,406,794	+ 31,101
Arizona	143,416.55	2,964,683	3,026,438	2,027,714	+ 165,469	+ 453,864
California	906,182.36	18,732,452	1,220,641	817,830	— 166,093	+ 167,821
Colorado	1,122,814.17	23,210,629	12,216,830	8,185,276	—1,813,344	+1,239,695
Georgia	1,502.05	31,050	599	402	— 65,860	— 226
Idaho	55,587.73	1,149,100	9,018,815	6,042,606	+ 73,482	+ 800,434
Maryland					— 14,821	— 56
Michigan			222,222	148,889		— 3,930
Missouri			a 31,268	20,950		+ 20,950
Montana	216,188.56	4,469,014	11,980,705	8,027,072	— 325,069	+ 35,367
Nevada	506,520.31	10,470,704	6,770,612	4,536,310	+5,200,885	+ 621,133
New Mexico	14,174.80	293,019	491,127	329,055	— 24,491	+ 106,063
North Carolina	3,973.16	82,131	30,769	20,615	— 43,554	+ 8,396
Oregon	66,123.79	1,366,900	79,346	53,162	— 38,335	— 1,582
South Carolina	3,819.63	78,959	92	62	— 16,152	— 5
South Dakota	330,956.06	6,841,469	150,875	101,086	— 148,023	— 9,295
Tennessee	234.06	4,838	55,931	37,474	+ 476	— 20,221
Texas	a 77.00	1,592	301,772	202,187	+ 1,344	— 31,867
Utah	252,439.42	5,218,386	11,550,634	7,738,925	+ 77,466	+1,072,897
Vermont			1,323	886		+ 886
Virginia	717.50	14,832	250	168	+ 9,850	+ 61
Washington	10,722.22	221,648	45,878	30,738	— 183,430	— 44,989
Wyoming	315.46	6,521	136	91	— 20,224	— 2,117
Total	4,703,000.25	97,219,645	57,362,455	38,432,846	+9,059,761	+4,444,233

a From smelters' report.

Compared with the mines report for 1905, this table indicates an increase of $9,059,761 in gold and of 1,089,959 fine ounces of silver.

Alaska.—Alaska expanded its gold production in 1906 to $22,036,794, an increase of $6,406,794 over 1905. The placers in the Yukon Basin (principally near Fairbanks) yielded 3,850,000 ounces more than in 1905, and those of the Seward Peninsula increased 2,700,000 ounces. The quartz mines of southeastern Alaska produced about the same amount of gold as usual, namely, $3,500,000. The copper mines of Ketchikan added a relatively small amount. An increase corresponding to that of 1906 is not to be looked for during 1907, but rather a decrease, owing to labor troubles at Fairbanks, Nome, and Juneau.

The silver output is nominal and remains about constant, most of it being derived from the small percentage of this metal which is contained in placer gold.

Arizona.—The gold production of Arizona amounted to $2,964,683, an increase of $165,469. Somewhat less than one-half of this came from Yavapai County, which includes the Prescott mining region. Mohave, Cochise, and Yuma counties come next, none of the remaining counties reaching the $100,000 mark. In Mohave and Yuma counties the larger part of the gold was derived from siliceous ores, while in Cochise five-sixths of the gold was derived from copper and also lead ores. In Yavapai County somewhat more than one-fourth was derived from siliceous ores, the remainder from copper ore. For the State as a whole approximately the same amounts of gold are derived from siliceous ores and from copper ores. The placer production approximates $40,000, partly from dry washings. On the whole the mining industry experienced a successful year. The mining of siliceous ores yielded less than in 1905, but there was an increase from copper ores and also from lead ores. Unless siliceous ores greatly increase there is reason to anticipate a small decline of the gold production in 1907.

Silver was produced in Arizona to the amount of 3,026,438 fine ounces, an increase of 420,726 ounces. Cochise County leads, closely followed by Yavapai, both with approximately 700,000 ounces. Next follows Gila with 110,098 ounces, and Graham with 107,045 ounces. The great copper mines at Clifton and Globe are chiefly responsible for the large silver production in Graham and Gila counties. The Cochise County silver product is about evenly distributed between the copper ores of Bisbee and the lead ores of Tombstone and other camps. Siliceous ores contribute also a large amount to the silver recovered in Yavapai County. As the silver of Arizona is predominantly derived from copper ores, it is likely that a reduction of the copper output for 1907 will adversely affect the output of silver.

California.—There is little change in the gold output of California. The production in 1906 was $18,732,452, a decrease of $166,093 from 1905. For the first time in many years a placer mining county leads, Butte having produced over $3,000,000; Nevada County comes next with about $2,600,000, closely followed by Amador; Calaveras, Tuolumne, and Yuba also exceed the $1,000,000 mark. The rearrangement is due to a decrease in the production of siliceous ores and to a great increase in placer gold from dredging operations. Increases are shown only by Butte, Sacramento, Shasta, and Yuba. California produced $7,375,925 of placer gold, of which $5,098,359 is due to dredging. Yuba for the first time appears as a heavy producer of dredging gold. The contribution from the copper ores was somewhat over $300,000. Labor troubles in some of the quartz-mining counties during 1907 are likely to diminish still further the production of the deep mines.

The silver production was not large, 1,220,641 ounces, but showed an increase of 144,467 ounces, due to heavier copper production in Shasta County.

Colorado.—Colorado produced $23,210,629 in gold, a decrease of $1,813,344. More than half of the total gold is derived from the telluride veins of Cripple Creek in Teller County. San Miguel free-milling ores contribute nearly $2,500,000. The smelting ores of Leadville in Lake County yield $1,500,000 and the partly free-milling ores of Gilpin County over $1,000,000. San Juan County and Ouray County both approach the $1,000,000 mark closely. Important diminution in output was recorded in Teller and Ouray counties, but this was partly offset by gains in San Miguel and other counties. Siliceous and dry ores amounted to 67 per cent of the total tonnage and were the source of over 96 per cent of the gold product. The placer output was comparatively small. The outlook for 1907 does not indicate the probability of great increase, if any.

Colorado produced 12,216,830 ounces of silver, an increase of 717,523 ounces. The smelting ores of Lake County lead in the output with nearly 4,000,000 ounces, while in their order Pitkin, San Miguel, Mineral, Ouray, San Juan, and Clear Creek are next in importance, the first three exceeding the 1,000,000-ounce mark. A higher price increased the value of the product. The increase was chiefly due to the veins of San Juan, San Miguel, and Mineral counties. On the other hand, the yield of the Leadville and Aspen deposits diminished. About 50 per cent of the silver product was derived from siliceous or dry ores, 28 per cent from lead ores, and 17 per cent from zinc or zinc-lead ores. No great change is expected in the production of silver for 1907.

Idaho.—The mines of Idaho yielded gold to the value of $1,149,100 in 1906, an increase of $73,482, the principal producing counties, with amounts varying from $229,024 to $86,607, being in their order Boise, Owyhee, Idaho, Elmore, Custer, Lemhi, and Shoshone. The placers of the Boise Basin showed a considerable increase, as did the siliceous ores of Custer. The De Lamar mines in Owyhee County decreased their output owing to technical causes. Somewhat less than two-thirds of the State production was from siliceous ores and one-third from placers. Copper and lead ores added only about $100,000. The total value of the placer output was $355,937, of which only about $38,000 was derived from dredging operations.

Of silver, 9,018,815 ounces were produced, an increase of 339,722 ounces; of this total, 7,415,995 ounces came from the lead ores of the Coeur d'Alene district, an increase of over 500,000 ounces. Only 765,549 ounces were yielded by siliceous ores and 564,123 ounces by copper ores.

Montana.—The gold production of Montana in 1906 was valued at $4,469,014, a decrease of $325,069 from the figures of 1905. Of this output $521,815 was derived from placers, chiefly in Madison County. This represented an increase of $124,914 over the production for 1905, chiefly due to extended dredging operations. The more important counties show a moderate decrease from the figures of 1905 in the gold derived, both from copper ores and from siliceous ores. A reduced copper production is likely to be felt in a reduced gold production for 1907.

The silver production was 11,980,705 ounces, a decrease of 1,350,595 ounces. The decrease is about evenly divided between the copper ores of Butte and the siliceous ores of other counties. Among the latter Granite, Jefferson, Lewis and Clark, and Cascade are the principal producers.

Nevada.—Nevada mines yielded $10,470,704 in gold, an increase of $5,200,885 over 1905. The unexpectedly heavy output of the Goldfield mines was $7,026,154, an increase of over $5,000,000 over the preceding year. The Tonopah district in Nye County produced $1,304,677 in gold, a figure not materially different from that of 1905. Lincoln County furnished in the Searchlight and De Lamar (Ferguson) districts an almost equal quantity of gold. Elko and Storey are the only remaining counties whose output exceeded $1,000,000. Elko, in the northeastern portion of the State, maintains a considerable output of siliceous ore from several districts near or north of Tuscarora. The Comstock output was diminished to about $300,000. The product is almost wholly from siliceous ores of high average grade. The placers contributed only about $50,000. An increase in Nevada gold for 1907 seems probable.

The silver output was 6,770,611 ounces, an increase of 288,530 ounces, which was pretty evenly distributed over all of the counties, corresponding to the general mining activity, only the Comstock mines in Storey County and White Pine County showed a decline. The Fairview district changed the insignificant output of Churchill County (including Douglas) to nearly 200,000 ounces. The Tonopah district was still the principal producer with 5,697,928 ounces. Of the total output 6,500,000 ounces were derived from siliceous ores. The remainder came chiefly from lead ores.

New Mexico.—The gold produced by the New Mexico mines was valued at $293,019, a decrease of $24,491. The Mogollon district in Socorro County and the Pinos Altos district in Grant County are the only regions of important production. Nearly nine-tenths of the gold was derived from siliceous ores, the remainder being placer product, and a small amount from copper ores.

A fair increase is noted in the silver product, which was now 491,127 ounces, mainly divided between Socorro and Grant counties. This statement hardly represents the real state of the mining industry, since there is a large and increasing tonnage of zinc ores which are very poor in silver or in which the silver is not recovered.

Michigan.—The mines of Michigan yielded 222,222 fine ounces of silver in 1906, a loss of 30,789 ounces compared with the output of 1905. This silver, to which 8 companies contributed, was chiefly derived from electrolytic refining of certain grades of Lake copper; part of it came, however, from "pickings" or metallic lumps saved in the stamp batteries. The amygdaloid ores contributed about three-fourths of the production, the remainder coming from the conglomerate lodes. The average value of silver in the ores is extremely small, rarely rising above 0.038 ounce per ton of ore. A detailed article on the Lake Superior copper mines for 1906 is contained in the report on copper production by L. C. Graton in this volume.

Missouri.—Although most of the lead of Missouri is "soft" and contains very little silver, a certain quantity of this metal is obtained from the ores of southeastern Missouri. The lead from this source is said to have a tenor of from 1 ounce to 1¾ ounces of silver per ton. A total quantity of 31,268 ounces is reported.

Oregon.—Little change is noted in Oregon. The total gold from mines in 1906 was $1,366,900, a decrease of $38,333. Northeastern Oregon (Baker, Grant, Union, Malheur, and Wallowa counties) yielded about $769,000, a decrease of over $100,000 as there was in 1905 from 1904. The remainder, or about $600,000, was derived from southwestern Oregon (Jackson, Douglas, Josephine, Lane, Coos, and Curry counties), which indicates a gain of about $80,000 over 1905. The total placer yield was $361,560, of which northeastern Oregon produced only $72,000.

The output of silver is insignificant, and in 1906 amounted to 79,346 ounces, derived from Baker County and to some extent also from Josephine and Lane counties. The production is slightly lower than in 1905.

South Dakota.—The mines of the Black Hills yielded $6,841,469 in gold, which represents a decrease of $148,023, or somewhat less than one-half of the decrease shown in 1905. As is well known, practically the whole product is derived from amalgamation, cyaniding, or smelting of the gold-bearing siliceous ores of the northern part of the Black Hills, the great Homestake mine contributing about two-thirds of the production. A considerable decline may be expected in the production for 1907 due to a fire in the Homestake mine and to general labor troubles.

The silver production was small, 150,875 ounces being produced in 1906, chiefly from cyaniding ores, a decrease of 31,874 ounces.

Southern Appalachian States.—These States, including Alabama, Georgia, North Carolina, South Carolina, Tennessee, and Virginia, yielded $295,535 in gold, a decrease of $158,841 from the output of 1905. Maryland was not a producer. The first 4 States showed a notable lessening of the output; increases were reported only from Tennessee and Virginia. North Carolina still showed the largest output, $82,131, and was closely followed by South Carolina, with $78,959. Georgia showed the greatest decrease, $65,860, its production amounting to only $31,050. As usual, siliceous ores yielded the greatest amount, principally from the Hillabee mine in Alabama, the Haile mine in South Carolina, and the Iola mine in North Carolina. The placer gold aggregated $30,000 in round figures.

Of silver 87,765 ounces were produced, a decrease of 29,744 ounces from 1905, the greatest loss being apparent in Tennessee copper ores. The only States having an important output of silver were North Carolina, with 30,769 ounces, and Tennessee, with 55,931 ounces. Almost the whole output of silver is derived from copper ores.

Texas.—Texas mines produced only a nominal amount of gold, valued at $1,592 and derived chiefly from the refining of the silver. On the other hand, a considerable quantity of silver was produced, amounting in 1906 to 301,772 ounces, a decrease of 85,634 ounces from 1905. The metal is chiefly derived from a siliceous oxidized ore of a deposit in Presidio County.

Utah.—Utah mines reported $5,218,386 in gold, an increase of $77,466 over 1905. As in 1905, the Bingham and Tintic districts, nearly corresponding to Juab and Salt Lake counties, were the most prominent producers of gold from smelting ores. Bingham yielded $1,632,786 and Tintic $1,925,066 in gold. Tooele County was another large producer, closely approaching an output of $1,000,000 in gold from the Camp Floyd district of cyaniding ores. Beaver and Piute counties yielded nearly $400,000 in gold from smelting and milling ores. The principal increase was derived from the Bingham district. The bulk of the gold was obtained from copper or copper-lead ores in Juab and Salt Lake counties. Only a small quantity o1 placer gold was obtained. The production for 1907 will probably about equal that of 1906.

Of silver 11,550,634 ounces were reported, an increase of 514,163 ounces. Only Colorado and Montana produced more silver than Utah, but each of the 3 States yielded close to 12,000,000 ounces. The bulk of the silver was derived from the copper-lead ores of Tintic, the copper ores of Bingham, and the lead ores of Park City. The gain for 1906 was due to greatly increased output from Tintic.

Vermont.—For the first time in several years Vermont appears on the list of gold and silver producing States, with a silver output for 1906 of 1,323 ounces, derived from copper ores.

Washington.—The mines of this State reported only $221,648 in gold, a decrease of $183,430 as compared with 1905. The production was divided between Republic district in Ferry County, the Pierre Lake district in Stevens County, and the Mount Baker district in Whitman County. Siliceous ores predominated. The placer output was about $20,000.

As to silver, the production was insignificant, amounting only to 45,878 ounces.

Wyoming.—There was practically no gold derived from copper ores and only a small quantity from siliceous ores and placers. The gold for 1906 was valued at $6,521. The silver output was only 136 ounces.

NUMBER OF MINES, ORE PRODUCTION, AND AVERAGE VALUES.

The following table indicates the number of producing mines in 1906, divided into placer mines and deep mines. In the former mines values, generally in gold, are extracted from gravels or sands; the "deep mines" work deposits in solid rock which have not been disintegrated and sorted by erosion. The total number of mines is of course much larger than the figures given, because many properties for various reasons are idle or are being developed without having yet attained a producing stage.

It is perhaps a little difficult, especially in the case of placers, to define what constitutes a mine. In some places a fairly large aggregate output is obtained, usually through traders and storekeepers, from transient or intermittent work of wandering miners which can not be credited to separate properties.

Number of producing mines in 1906, by States.

State or Territory.	Number of mines. Placer.	Deep.	Total.	State or Territory.	Number of mines. Placer.	Deep.	Total.
Alabama [a]	....	2	2	Oregon	205	74	279
Alaska	[b] 1,100	25	1,125	South Carolina	2	4	6
Arizona	19	152	171	South Dakota	6	29	35
California	634	383	1,017	Tennessee	1	2	3
Colorado	38	626	664	Texas	....	3	3
Georgia	8	6	14	Utah	7	126	133
Idaho	176	111	287	Vermont	....	1	1
Maryland	....	....	....	Virginia [c]	....	....	....
Michigan	....	8	8	Washington	14	38	52
Montana	62	308	370	Wyoming	4	6	10
Nevada	12	143	155				
New Mexico	19	52	71	Total	2,316	2,114	4,430
North Carolina	9	15	24				

[a] Includes Virginia. [b] Estimated in part. [c] See Alabama.

The table shows the number of gold and silver producing mines in the United States. In the States of the Cordilleran mountain system practically every mine producing lead, copper, or zinc also yields the precious metals. There are a few exceptions to this rule—for instance, a lead mine in Washington, a lead-zinc mine in Nevada, and a few small copper mines in New Mexico—but these exceptions are included in the table for the sake of completeness, so that it actually records the number of producers of gold, silver, copper, lead, and zinc in these Cordilleran States. It also records the gold and silver producing mines in Michigan and in the Eastern States, but does not include the properties in this territory which produce only copper, lead, or zinc. It has not been possible to trace the small silver production of Missouri to individual mines.

Compared with the corresponding table for 1905 the placer mines show little change, the number for 1905 being 2,287, against 2,316 in 1906. In both years Alaska shows the greatest number, followed by California, Oregon, Idaho, and Montana. In no other State is placer mining of great importance. The number of placers in California and Montana decreased somewhat, while southwestern Oregon and Idaho added many properties to the list of producers.

The number of deep mines was 1,929 in 1905, and 2,114 were recorded in 1906. California lost nearly 100 producing deep mines, but a fairly uniformly distributed increase in numbers appears in all of the other important States. In spite of extremely active prospecting Nevada added only 29 new producers to its record of 1905.

In total number of mines Alaska has now assumed the lead, with 1,125 mines, but is closely followed by California, with 1,017 mines. Colorado is third in rank, having 664 mines.

The best guide to the development of deep mining is, however, found in the tonnage record, which is given in the following table, now for the first time subdivided into the most important classes of ores and their average value in gold and silver.

Ore production in short tons and average extraction value of gold and silver per ton in 1906, by States.

State or Territory.	Dry or siliceous ores.		Copper ores.		Lead ores.		Zinc ores.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama [a]	9,565	$4.17						
Alaska	1,404,456	2.40	105,729	$0.94				
Arizona	272,611	6.33	3,089,856	.79	221,376	$3.49		
California	2,235,915	5.05	318,210	2.59	1,681	7.03		
Colorado	1,782,609	15.43	31,431	12.82	309,574	8.75	31,924	$1.60
Georgia	1,880	6.00	270	10.32				
Idaho	97,615	12.29	128,517	3.34	1,542,650	3.34		
Montana	480,843	7.08	4,963,756	1.58	20,734	24.15		
Nevada	463,672	31.64	5,184	5.84	18,940	13.19		
New Mexico	27,724	16.69	126,330	2.41	19,001	2.44	34,636	.05
North Carolina	8,074	7.70	12,294	2.12				
Oregon	136,332	7.67	1,942	4.75				
South Carolina	49,327	1.60						
South Dakota	1,780,674	3.90						
Tennessee			538,141	[b] .08				
Texas	24,567	8.29						
Utah	439,268	3.13	1,143,021	3.38	135,930	15.20	1,736	4.61
Vermont			7,399	.12				
Virginia								
Washington	15,029	14.55	11,168	1.25	936	.41		
Wyoming	458	10.40	60					
Totals and average.	9,230,616	7.87	10,483,308	1.55	2,270,822	5.08	68,296	1.18

State or Territory.	Copper-lead and copper-lead-zinc ores.		Lead-zinc ores.		Total and average.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama [a]					9,565	$4.17
Alaska					1,510,185	2.30
Arizona	1,246	$7.96			3,585,089	1.39
California			250	$84.40	2,556,056	4.75
Colorado	1,922	16.38	491,463	3.21	2,648,923	11.81
Georgia					2,150	6.54
Idaho	49	52.20	18,842	2.38	1,787,673	3.82
Montana	32,638	8.43			5,497,971	2.08
Nevada			8,511	.03	496,307	30.12
New Mexico					207,691	2.99
North Carolina					20,368	4.33
Oregon					138,274	7.63
South Carolina					49,327	1.60
South Dakota					1,780,674	3.90
Tennessee					538,141	[b] .08
Texas					24,567	8.29
Utah	[c] 572,325	[c] 9.64	56,539	2.13	2,348,819	5.51
Vermont					7,399	.12
Virginia					([d])	([d])
Washington					27,133	8.58
Wyoming					518	9.20
Totals and average	608,180	9.53	575,605	3.07	23,236,827	4.65

[a] Includes Virginia.
[b] From copper electrolytically refined.
[c] Includes 224,468 copper-lead zinc, at $7.27; 347,857 copper-lead, at $11.18.
[d] Included under Alabama.

In all 23,236,827 short tons were mined and sent to reduction establishments. This represents an increase of 1,896,138 tons over the corresponding figures for 1905—truly a remarkable record.

Among the important States a decline in tonnage was confined to California, South Dakota, and Oregon, and in each of these was due to the mining of a smaller quantity of siliceous ore. A strong advance was shown by Arizona (900,000 tons), Montana (478,000 tons), Utah (168,000 tons), Tennessee (139,000 tons), Colorado (144,000 tons), and Idaho (118,00 tons). In the first 4 States this was almost wholly due to the activity in copper mining continued from 1905 and stimulated by high prices for this metal. The camps showing the largest additions to the tonnage of 1905 were Bisbee and Globe in Arizona, Butte in Montana, Bingham in Utah, and Ducktown in Tennessee. Idaho recorded an increase of Coeur d'Alene lead ores, while Colorado added to its tonnage from the siliceous ores of the Telluride districts and from the mixed smelting ores of Leadville and Creede. Ores of lower grade than in 1905 were mined in Butte and Leadville, so that in spite of heavily increased tonnage the total quantities extracted fell off. The slump in the price of copper in 1907 will result in a much lower tonnage for that year in Butte and probably also in Arizona, while the Bingham and Tintic districts, as well as the Colorado camps, will be affected to a less extent.

The average extracted value of the ores in gold and silver is lower in 1906 than in 1905 by 17 cents per ton, and now stands at $4.65. The average value is higher in Arizona by 37 cents, in Idaho by 24 cents, and in Utah by 10 cents. The unusually rich gold ores of Goldfield increased the average value of Nevada ores by $9. On the other hand, Colorado ores decreased 92 cents, Oregon ores 40 cents, California ores 31 cents, and Montana ores 39 cents in average value per ton. In spite of the notable rise in values the ore production of Nevada for 1906 is only greater by about 64,000 tons than it was in 1905. In tonnage the important States, including Alaska, now rank as follows: Montana, Arizona, Colorado, California, Utah, Idaho, South Dakota, Alaska. In 1905 California occupied the second place.

The division of the tonnage shows that the copper ores and the siliceous ores are most important with, respectively, about 10,500,000 and 9,200,000 tons. Gold and silver bearing lead ores amounted to only about 2,300,000 tons, while the remaining divisions, zinc ores, lead-zinc ores, and lead-copper ores, aggregated only about 1,250,000 tons. The greatest average extracted values in gold and silver are shown by the siliceous ores, $7.87 per ton, and they vary from $31.64 per ton in Nevada to $15.43 per ton in Colorado, $12.29 per ton in Idaho, $6.33 per ton in Arizona, $5.05 per ton in California, $2.40 per ton in Alaska, and to the minimum $1.60 per ton in South Carolina.

The copper ores are much poorer in gold and silver, the average extraction value being only $1.55 per ton. They range from $12.82 in Colorado to $3.38 in Utah, $1.58 in Montana, $0.79 in Arizona, and to only a fraction of a cent in Tennessee and in the Lake Superior copper mines.

The lead ores average $5.08 per ton, much of the value being in silver. Utah lead ores and copper-lead ores, chiefly from Park City, Bingham, and Tintic districts, contain from $10 to $15.20 in gold and silver. Those from Colorado contain $8.75, while the Idaho lead ores, largely from the Coeur d'Alene district, average only $3.34, of which all but a small fraction is in silver.

The zinc ores of Colorado average only $1.60 per ton, but it is to be noted that in some of the ores included the silver is not extracted. The same applies to New Mexico. The lead-zinc ores average higher—$3.07 per ton. In many cases they are concentrates, and the richer lead ores are separated from the poorer zinc blendes.

Tables showing the extent of concentration will be found in many of the State reports, but it is not yet possible to compute a general table illustrating this for all of the Western States.

On the whole 1906 was a very prosperous year for the mining industry. High prices for the metals stimulated prospecting and development work to an unusual degree. Wages showed a tendency to advance. There was a great scarcity of labor, and during the last months of the year the freight congestion on the railroads became so serious as to interfere with the operation of many smelting works and to delay shipments of ore.

The year was comparatively free from labor troubles, which, unfortunately, can not be said of 1907. In Arizona copper mining was especially active at Bisbee and Globe. Smelting works were built or enlarged. In California the advance in dredging operation was marked. Colorado suffered perhaps to some extent from the great attention given to Nevada and from some local causes, but nevertheless experienced a very successful year. In Montana the Butte copper mines prospered and recorded an extremely heavy production of low-grade ore. Crowds of prospectors examined the ranges of Nevada, and Goldfield yielded millions in gold from the wonderfully rich ore of the Mohawk and Florence mines. Concentrating and cyanide mills were provided for Tonopah and projected for Goldfield. Concentrating mills were built for the great low-grade copper deposits at Ely. In Utah most of the new activity centered at Bingham, where large quantities of low-grade copper ore were mined by steam shovels at a cost said to approach 30 cents per ton. Concentration and smelting works were provided for these ores.

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 $2\frac{1}{2}$ per cent or more of copper are considered as copper ores, while those with over $4\frac{1}{2}$ 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 1906.

The following table shows the source of gold in the United States in 1906, by kinds of ore and by States:

Source of gold in 1906 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces.

State or Territory.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama		1,205.51						1,205.51
Alaska	900,113.63	162,005.12	3,911.17					1,066,029.92
Arizona	1,959.29	64,953.71	62,298.80	14,088.98		115.77		143,416.55
California	356,810.37	533,858.37	15,406.90	49.34	48.38			906,182.36
Colorado	2,595.88	1,079,321.07	9,189.58	19,679.77	594.58	355.41	11,077.88	1,122,814.17
Georgia	839.48	545.17	117.40					1,502.05
Idaho	17,099.62	33,235.06	2,516.40	2,675.17		4.08	57.40	55,587.73
Montana	25,242.81	123,725.62	55,053.90	8,269.57		3,896.66		216,188.56
Nevada	2,556.05	500,676.33	127.72	3,160.01			.19	506,520.30
New Mexico	1,296.81	12,485.97	364.98	27.04				14,174.80
North Carolina	575.96	3,010.70	386.50					3,973.16
Oregon	17,490.46	48,201.96	431.36					66,123.78
South Carolina	13.06	3,806.57						3,819.63
South Dakota	302.34	330,653.72						330,956.06
Tennessee	52.06		182.00					234.06
Texas				77.00				77.00
Utah	416.63	62,866.25	120,766.53	12,785.54	50.00	[a]54,998.70	555.77	252,439.42
Vermont								
Virginia		717.50						717.50
Washington	929.24	9,348.76	444.23					10,722.23
Wyoming	67.01	248.45						315.46
Total	1,328,360.70	2,970,874.84	271,197.47	60,812.42	692.96	59,370.62	11,691.24	4,703,000.25

[a] 4,783.07 copper-lead-zinc + 50,215.63 copper-lead.

General statement.—The totals in this table indicate that siliceous or dry ores, which in general may be considered as gold ores proper, furnished about 63 per cent of the whole production, and that placers yielded approximately 28 per cent. The base-metal ores furnished only about 8.5 per cent of the total output, although the tonnage of these ores, as shown in a previous table, was exceedingly heavy. The copper ores yielded most of the gold from this source, or nearly 6 per cent of the total, while the lead and lead-copper ores only gave 2½ per cent of the total. The gold from zinc ore was insignificant in amount.

Compared with 1905 there was a heavy increase in placer gold, little change in the siliceous ores, a moderate increase in gold from copper and lead-copper ores, and only slight changes in the sum of the gold from lead and lead-zinc ores.

Placers.—Placer gold was obtained in 1906 to the value of 1,328,360.70 fine ounces, equivalent to $27,459,653, while in 1905 the quantity was only 934,709.26, valued at $19,222,155. The increase of 1906 over 1905 was $8,237,498, and that of 1905 over 1904 was $6,557,949. Alaska was of course most conspicuous in this great advance, but California also added about $1,500,000 to its yield of placer gold in 1905. Several of the other States, though of less importance, showed an increase in 1906, notably Montana, Oregon, Nevada, and Idaho.

Dredging continues as the source of the increase in California. The yields from this branch of mining in that State in recent years have been as follows: 1904, $2,187,038; 1905, $3,276,143; 1906, $5,098,359, and a still further increase is not unlikely. The total yield of the dredges in all States was about $6,150,000, divided between California, Montana, Alaska, Oregon, Colorado, and Idaho. Thirty-eight dredge companies were operating in the United States, as follows: California, 24; Montana, 4; Idaho, 3; Alaska, 2; Colorado, 3; Oregon, 2. In California and Montana, however, one company in some cases operated several dredge boats.

Opinions conflict about the possibility of large dredging operations in Alaska. An increased yield from this source may be expected from other States, but it is not likely that any of them will approach California in yield. The results of dredging along Snake River in Idaho have been disappointing, and the whole yield from placers along this stream has diminished to about $23,000 from $27,018 in 1905.

Drift mining in frozen ground has yielded most of the gold from the lower Tanana in Alaska. About two-thirds of the gold from the Seward Peninsula is derived from this method of mining. In California drift mining at great depths below the surface remains an important branch, but the yield in 1906 was only about $600,000, a decrease of approximately $200,000 from 1905.

The balance of placer gold is won by the hydraulic method or by surface sluicing work, which is practiced in all of the placer States. A very small amount of placer gold is derived from dry washing in New Mexico and Arizona.

Dry and siliceous ores.—The States which yielded over 100,000 ounces from this source rank as follows: Colorado, California, Nevada, South Dakota, Alaska, and Montana. The division necessarily includes many varieties of ore, and several different methods of reduction are applied to them. The gold ores of California, Oregon, and Alaska are as a rule free milling, though concentration and cyaniding of tailings are very often combined with the simple amalgamation process. The ores of the Homestake mine in South Dakota fall into the same general class as do the Telluride and Ouray siliceous ores and ores from many scattering occurrences in Idaho, Colorado, and Arizona.

In many cases in Colorado, in Yavapai County, Arizona, and in other places, the siliceous ore contains but little free gold and is concentrated without amalgamation.

The pan-amalgamation process for siliceous gold-silver ores has become almost obsolete, and is used at only a few places in Montana, Nevada, and Arizona. The rich siliceous ores of western Nevada were to a great extent sold to lead or copper smelters, although the high contents in alumina are objectionable in some of them. The rich Goldfield ores were widely distributed in the fall of 1906 among the smelters from California to Denver. The Tonopah ores were also largely shipped to smelters. Freight and treatment charges on this class of ores ranged from $12.50 to $42 per ton, the latter for the richer ores, containing $100 per ton. Beyond a tenor of $100 per ton the charges increase still further.

Large mills are being built at Tonopah for the handling of these gold-silver ores by stamp or rolls, followed by concentration and cyaniding of tailings. At Goldfield a part was treated in local mills by amalgamation, concentration, and cyaniding. The partly free-milling ores near the surface are now changing to ores requiring concentration and cyanide treatment.

The quartzose gold ores formed by replacement of limestone are generally cyanided and yield a total of several hundred thousand ounces. The 3 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, Colorado, 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.—In 1906, 271,197 ounces of gold were obtained from copper ores, against 255,568 ounces in 1905. This moderate gain contrasts with the great increase in tonnage of copper ores treated, but is of course due to their ordinarily low tenor in gold and silver. The important States rank as follows: Utah, Arizona, Montana, California. The richest ores are obtained from the Bingham and Tintic districts in Utah, giving a total for the State of 120,767 ounces, a slight decrease from the figures of 1905. Arizona copper ores are generally poor in gold and silver, but the richer ores from the United Verde raised the gold from this source to 62,299 ounces, a considerable increase over 1905. The copper ores of Butte yielded a little more than in 1905 in spite of a decreased copper production, the total for Montana being 55,054 ounces. Renewed activity in Shasta County added to California's share of gold from copper ores, and recently developed copper mines in the Coeur d'Alene district increased Idaho's output.

With few exceptions the copper ores are of the sulphide class, containing either chalcocite or chalcopyrite. A large majority of them are concentrated and smelted, the gold being recovered during the electrolytic refining of the copper.

Lead ores.—From lead ores proper only 60,812 ounces of gold were recovered. This was less by about 6,000 ounces than in 1905, and emphasizes the scantiness of the supply of higher grade lead ores. Heavy losses were recorded in Colorado, Montana, and Utah, but were partly offset by smaller gains in Arizona and Nevada. In gold from lead ores the States rank as follows: Colorado, Arizona, Utah, Montana, Nevada, Idaho. The gold from Idaho lead ores has been partly overlooked in earlier statistics. It is present, however, to the amount of from 25 to 50 cents per ton in the heavy shipments of Coeur d'Alene concentrates, and most of it is undoubtedly recovered. The larger part of the lead ores are concentrated before smelting. The oxidized ores form only a very small percentage of the total.

Zinc ores and mixed ores.—Only a very small amount of gold is recovered from zinc ores. Together with the silver it remains in the cinders after the distillation of the zinc, and these cinders, if of sufficiently high grade, are sold to the lead smelters. The lead-zinc ores are generally concentrated to effect the separation of the galena and sphalerite. A total of 11,691 ounces of gold was recovered from these ores, which were derived almost wholly from Colorado. The copper-lead sulphide ores are almost wholly confined to Utah and there chiefly to the Tintic and Park City districts; the output increased to 59,371 ounces from 38,771 ounces in 1905.

Practically no gold is derived from oxidized lead or zinc ores.

DISTRIBUTION OF SILVER PRODUCT IN 1906.

The following table shows the source of silver in the United States in 1906, by kinds of ore and by States:

Source of silver in 1906 in States and Territories, as reported from the mines to the United States Geological Survey, by kinds of ore and by States, in fine ounces.

State or Territory.	Placers.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Copper-lead and copper-lead-zinc ores.	Lead-zinc ores.	Total.
Alabama		124						124
Alaska	114,678	23,529	27,861					166,068
Arizona	274	571,621	1,724,501	718,816		11,226		3,026,438
California	41,913	376,345	756,276	16,107	30,000			1,220,641
Colorado	1,596	6,351,861	317,336	3,436,204	58,007	36,015	2,015,811	12,216,830
Georgia	34	28	537					599
Idaho	3,665	765,549	564,123	7,616,612		3,692	65,174	9,018,815
Michigan			222,222					222,222
Missouri							[a] 31,268	31,268
Montana	3,638	1,267,848	9,981,089	511,360		216,770		11,980,705
Nevada	1,296	6,452,182	41,273	275,469			391	6,770,611
New Mexico	195	304,917	118,548	64,882		2,585		491,127
North Carolina	133	623	30,013					30,769
Oregon	3,354	75,538	454					79,346
South Carolina	2	90						92
South Dakota	73	150,802						150,875
Tennessee			55,931					55,931
Texas		301,772						301,772
Utah	57	111,614	2,032,205	2,688,624	10,416	[b] 6,545,390	162,328	11,550,634
Vermont			1,323					1,323
Virginia		250						250
Washington	141	37,979	7,178	579				45,877
Wyoming	9	127						136
Total	171,058	16,792,799	15,880,870	15,328,653	98,423	6,815,678	2,274,972	57,362,453

[a] Smelters report. [b] 2,290,437 copper-lead-zinc + 4,254,953 copper-lead.

General statement.—The total silver product for 1906 was, as usual, about evenly divided between siliceous ores, copper ores, and lead ores. In percentages of the total the division is as follows: Siliceous ores, 29.3 per cent; copper ores, 27.7 per cent; lead ores, 26.7 per cent; copper-lead ores, 11.8 per cent; lead-zinc ores, 4 per cent; zinc ores, 0.2 per cent; placers, 0.3 per cent. Compared with 1905 there was a small loss from siliceous ores, a larger loss from lead ores, a small gain from copper ores, and a rather heavy increase from the mixed ores. The States rank as follows: Colorado, Montana, Utah, Idaho, Nevada, Arizona, and California.

Placers.—The placers yielded 171,058 ounces as a by-product; corresponding to the greater yield of placer gold, the gain in silver over 1905 was large.

Dry and siliceous ores.—The total quantity from this source was 16,792,799 ounces, compared with 17,187,889 ounces in 1905. The important States rank as follows: Nevada, Colorado, Montana, Arizona, California.

Although the total is large, the proportion of silver from ores in which that metal predominates is small. This emphasizes the fact that silver is practically a by-product of smelting ores and gold-silver milling ores, and explains why the rise in value during the last few years has failed to increase the production greatly. Nevada produced nearly 6,500,000 ounces of silver from siliceous ores, chiefly from Tonopah, but even these contain 1 part of gold to 3 parts of silver, by value. The Colorado production closely approaches the figures for Nevada; but here again most of it came either from mixed ores, either pyritic or siliceous, which are concentrated and smelted, and which also contain lead, copper, or gold, or from the gold-silver ores, partly free milling, from the Gilpin or San Juan regions. Montana has in Granite County a district of purely silver ores, but the yield from this source fell off in 1906, the largest quantity of silver in Montana being derived from Butte copper ores; the output of the State from siliceous ores is a little over 1,250,000 ounces. Arizona comes next with almost 600,000 ounces, but in no other State does the quantity reach half a million ounces.

The silver is recovered from siliceous ores by amalgation or cyanide processes; from smelting ores by desilverization of lead bullion or by electrolytic refining of copper.

Copper ores.—From copper ores 15,880,870 fine ounces were recovered; the smallness of the increase over 1905, in spite of heavily increased tonnage, is explained by the low tenor of the copper ores in silver. The States rank as follows: Montana, Utah, Arizona, California, Idaho, and Colorado. Montana yielded nearly 10,000,000 ounces, the largest silver production in any State from any one kind of ore. This represents a decrease of about 100,000 ounces from the output of 1905 in spite of heavily increased tonnage. Arizona, from a very heavy tonnage, produced only 1,750,000 ounces. Utah, from a very much smaller tonnage, reported over 2,000,000 ounces. None of the other States reached the 1,000,000-ounce mark. The extraction of gold and silver per ton from the ores of the principal copper camps runs approximately as follows:

Yield of gold and silver per ton of copper ore from the principal copper camps, in 1906, in fine ounces.

	Gold.	Silver.
Clifton	0.002	0.08
Globe	.006	.25
Bisbee	.017	.7
Butte	.01	2.0
Bingham	.08	.9
Tintic	.46	11.4

Copper ores shipped from the Coeur d'Alene district yielded a notable addition of silver to the production of Idaho, which for this class of ore was nearly 600,000 ounces. The silver from California copper ores was nearly doubled in 1906, owing to greatly increased activity in Shasta County, and approached 800,000 ounces.

About 85 per cent of the silver-bearing copper ores of the West are now sulphides. Oxidized ores are still contributed by Arizona, New Mexico, Idaho, and other States.

Lead ores.—The lead ores have always been one of the most important sources of silver, but a decided declining tendency in the output has been noted during the last few years. The total is now only about 15,000,000 ounces. Idaho is far in the lead, with over 7,500,000 ounces, chiefly from the low-grade lead ores of the Coeur d'Alene district, which only average about half a cent in gold and 5 ounces in silver per ton. These figures are of course materially raised by concentration of the ore. Colorado follows Idaho with a production of about 3,500,000 ounces, a notable loss compared with 1905 and with 1904. Aspen, Leadville, and Clear Creek continue to be the most productive districts. Utah ranks third, with about 2,700,000 ounces, which is notably less than the output of 1905. Park City district still further reduced its output of silver from lead ores. Arizona ranks fourth, with 700,000 ounces, to which Tombstone ores contribute largely. Montana, formerly an important producer of lead ores, now ranks fifth, with an output of only 500,000 ounces.

Oxidized lead ores now yield very little silver. Ores of this character are about exhausted. Small quantities are still furnished by Leadville, Aspen, and other placers in Colorado, and by Arizona, New Mexico, and Nevada.

Copper-lead ores.—Ores of this character, more or less mixed with sphalerite, are marketed almost exclusively from Utah, with a smaller quantity from Montana. The Tintic and Park City districts yielded nearly the whole of the Utah production, most of it coming from the former district. These ores are rich in silver, and 6,500,000 ounces represented their yield, an increase of about 1,000,000 ounces compared with 1905.

Zinc ores and zinc-lead ores.—The zinc ores proper contribute a very small amount of silver. Zinc-lead ores are produced chiefly in Colorado, and in 1906 yielded about 2,300,000 ounces. They are usually concentrated with zinc and lead products. The division between the two classes is more or less arbitrary, but the greater activity in zinc mining is clearly reflected in the total silver yield from these ores, which was about 2,370,000 ounces, against 1,720,000 ounces in 1905.

PRODUCTION BY STATES AND TERRITORIES.

ALASKA.[a]

By Alfred H. Brooks.

INTRODUCTION.

An increase of nearly 50 per cent in the value of the gold output of 1906 over that of 1905 is the most concrete evidence of the advance of gold mining in Alaska. That copper mining, too, has undergone a rapid expansion is manifest by an increase of at least 20 per cent in production over the previous years. This progress has consisted chiefly in the development of the older districts rather than in the discoveries of new mineral fields, and can therefore be interpreted as an index of continuous advance rather than of abnormal expansion. Though the placer mines of Nome and Fairbanks were

[a] Much of the work of compiling this report was done by C. W. Wright, who paid special attention to the lode deposits; by Sidney Paige, who compiled the data on placers, and by A. G. Maddren, who compiled the placer statistics. Many of the statements are taken from Bull. U. S. Geol. Survey No. 314.

by far the greatest producers of wealth in 1906, yet they have probably received less attention from investors than the problems of railway construction along the Pacific slope of the Territory. This is another indication of the healthy expansion of commercial interests and argues well for a long period of prosperity.

The first systematic attempt to gather statistics of production from Alaska were undertaken by the United States Geological Survey in 1905. Estimates furnished by residents in the Territory, checked by the personal observations of the geologists working in various fields, constituted the bulk of this material. In 1906 the improvement of the mail facilities and the general accessibility of the country was deemed to have gone far enough to warrant an attempt to obtain statistics through schedules sent to the individual producers. This experiment was, however, only partially successful. Though nearly all the lode miners throughout the Territory have been prompt to reply and to send the desired information, the returns received from placer miners were very disappointing. Most of the small operators in the less important districts have, indeed, shown their willingness to cooperate in this statistical work by furnishing the desired information; but, on the other hand, the majority of the large operators, especially in the Nome region, have either ignored the request for information entirely or have returned the schedule without furnishing any information as to production. This seems particularly unjust, because it is the large operators who have benefited most by the work of the Geological Survey, and it seems as if they should have shown their good will by acceding to the request for information. The fear of the operator that by replying to the questions asked on the circular he is revealing information which might be used to his disadvantage is wholly groundless, because the schedules are used only to make up totals of districts and all individual productions are held in strict confidence. It is the earnest hope of the writer that in the future mine operators may further the collection of reliable statistics and show their confidence in the Geological Survey by furnishing the desired information.

In those districts where the statistics obtained by schedule were deficient, general estimates based on all available data have been made. The figures are in part furnished by members of the United States Geological Survey, in part by residents of the Territory. The limit of error in the statistics of gold production is believed to be within 2½ per cent. A preliminary statement of the distribution of the gold output has already been published.[a]

Alaska not being divided into counties, the distribution is referred to the geographical provinces in general use, such as southeastern Alaska, Copper River Basin, Cook Inlet region, Yukon and Seward peninsulas. The production of the individual mining districts[b] when available has been given.

In the general tables southeastern Alaska and Prince William Sound are combined under the name Pacific coast belt.

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[a] Bull. U. S. Geol. Survey No. 314, 1907, pp. 19-39.

[b] 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.

The figures of the total production of gold, silver, and copper in the years 1905 and 1906 are shown in the following table:

Production of gold, silver, and copper in Alaska, 1905–1906.

	1905.		1906.		Increase(+) or decrease(−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.......fine ounces..	756,101	$15,630,000	1,066,029.91	$22,036,794	+309,928.91	+$6,406,794
Silver.............do....	132,724	80,165	[a] 166,068	111,266	+ 33,344	+ 31,101
Copper.........pounds..	4,805,238	749,617	[b] 5,871,811	1,133,260	+ 1,066,573	+ 383,643

[a] Silver is valued at 67 cents per fine ounce. [b] Copper is valued at 19.3 cents per pound.

The gold production of Alaska in 1906 is estimated at $22,036,794 and the silver at $111,267; the number of ounces of gold was 1,066,-029.91, and of silver 166,071. In 1905 the output of gold was valued at $15,630,000. This increase of $6,406,794 is due largely to the remarkable growth of the Fairbanks district. The copper output of Alaska for 1906 is estimated at 5,871,811 pounds, valued at $1,133,260, an increase over 1905 of 1,066,573 pounds, valued at $383,643.

Production of gold, silver, and copper in Alaska in 1906, by districts.

District.	Gold.		Silver.		Copper.	
	Quantity, fine ounces.	Value.	Quantity, fine ounces.	Value.	Quantity, pounds.	Value.
Pacific coast belt, including southeastern Alaska and Prince William Sound.......	167,125.66	$3,454,794	51,750	$34,673	5,871,811	$1,133,260
Copper River and Cook Inlet.................	16,060.50	332,000	1,605	1,075	....	....
Yukon Basin............	520,031.25	10,750,000	72,804	48,778	....	....
Seward Peninsula.......	362,812.50	7,500,000	39,909	26,740	....	....
Total.............	1,066,029.91	22,036,794	166,068	111,266	5,871,811	1,133,260

In the following table the gold production of 1905 and 1906 is shown by districts:

Value of gold production in Alaska in 1905 and 1906, by districts.

District.	1905.	1906.	Increase (+) or decrease (−).
Pacific coast belt, including southeastern Alaska and Prince William Sound..........	$3,430,000	$3,454,794	+ $24,794
Copper River and Cook Inlet Regions..........	500,000	332,000	− 168,000
Yukon Basin..........	6,900,000	10,750,000	+3,850,000
Seward Peninsula..........	4,800,000	7,500,000	+2,700,000
Total..........	15,630,000	22,036,794	+6,406,794

With regard to the source of the metals according to character of deposits, the gold placers are by far the largest producers, more than four-fifths of the entire output being credited to this source. The siliceous ores are next in value of product and the copper lode mines last. The gold value of the auriferous lode mine production was

$3,435,000 in 1905 and $3,348,943 in 1906, a decrease of $86,057. In the following table the source of the precious metals is indicated:

Source of gold, silver, and copper in Alaska in 1906, by kinds of ore.

Ores.	Gold.		Silver.		Copper.	
	Quantity, fine ounces.	Value.	Quantity, fine ounces.	Value.	Quantity, pounds.	Value.
Siliceous ores	162,005.12	$3,348,943	23,529	$15,765		
Copper ores	3,911.17	80,851	27,861	18,666	5,871,811	$1,133,260
Placers	900,113.62	18,607,000	114,678	76,835		
Total	1,066,029.91	22,036,794	166,068	111,266	5,871,811	1,133,260

Returns from statistics show that 11 gold and silver mines were on a productive basis in 1906. It has been impossible to collect very accurate information as to the number of placer mines in operation in 1906. 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.

Fourteen copper mines were on a productive basis during 1906, an increase of 6 over 1905.

The tonnage of all the lode mines of Alaska in 1906 was 1,510,185 short tons, an increase of 87,670 tons over 1905. Of siliceous ores 1,404,456 tons were mined, of which 1,353,286 tons must be credited to the Treadwell group of mines on Douglas Island, New Juneau, leaving only 51,170 tons as the product of the other gold quartz mines. The average gold and silver extraction from all siliceous ores was $2.40 per ton. For the 51,170 tons of the siliceous ores other than those from the Treadwell group, it was $4.58 per ton. A total of 105,729 tons of copper ores yielded an average of $0.94 per ton of gold and silver, and copper to the amount of 2.77 per cent. The copper percentage in Prince William Sound was estimated at 3.69. It may be noted from the tables that the content of silver in siliceous ores is less than 1 per cent of the value of the ore.

REVIEW BY DISTRICTS.

PACIFIC COAST BELT.

SOUTHEASTERN ALASKA.[a]

The most notable advance in lode mining during 1906 was the development of the copper deposits of the Ketchikan district and of Prince William Sound.

The remarkable increase in the production of copper from the mines on Prince of Wales Island has brought Alaska well to the front as a copper-producing territory. The first important shipments were made in the latter part of 1905 and since that time there has been a steadily increasing production. For the most part the ores of southeastern Alaska carry but a small percentage of copper and less than a dollar in gold, and therefore require exceptional mining and transportation conditions to insure profitable extraction.

[a] The account of mining development here presented is largely taken from report on progress of investigations of mineral resources of Alaska in 1906, by Alfred H. Brooks and others, Bull. U. S. Geol. Survey No. 314, 1907.

While steady progress has been made in the auriferous mines of the Juneau district, there were no marked developments. No important discoveries have been reported of new auriferous lode districts. Southeastern Alaska may be divided into five districts or precincts, namely, from south to north, Ketchikan, Wrangell, Sitka, Juneau, and Skagway.

Ketchikan district.—Gold plays but a very minor rôle in the mining interests of the Ketchikan district, and its production has been largely from the copper ores, which carry from $0.50 to $2 in gold per ton of ore. In this section there are apparently no defined lines or zones along which gold has been extensively distributed. It is found scattered here and there at numerous localities, but at only a few of these have developments been extensive. Near Hollis, on Prince of Wales Island, a number of claims were prospected in a small way, the ore bodies consisting of auriferous quartz veins. At the Treasure group on Granite Mountain a little development work was carried on, and at Dolomi prospecting was advanced on the Valparaiso and other veins. On Gravina Island, at the Goldstream mine, exploratory work was carried on and small shipments of ore were made. The Sea Level mine on Revillagigedo Island was examined late in 1906 with a view of resuming operations in 1907. On Cleveland Peninsula mining and prospecting have been confined to Helm Bay and Smuggler Cove, on the southwest end. The five-stamp mill on the Gold Standard group was operated during the latter part of the year and shipments of high grade ore were made. At the Old Glory group, adjacent to the Gold Standard group, small developments were advanced.

All the copper-producing mines of Southeastern Alaska are on Prince of Wales Island, in the Ketchikan district. The chief copper ore is chalcopyrite, accompanied by pyrite, magnetite, and pyrrhotite. At the Hadley smelter on Kasaan Peninsula 80,000 tons of ore were reduced in 1906 largely from the Mamie and Stevenstown mines. The Mount Andrew mine, which for several years has been idle, was energetically developed during the year, and in October the first ore shipment was made. A 3,600-foot cable tram has been installed and large ore bins and a wharf built at tide water. Prospecting between the White Eagle and Mount Andrews properties and at other points on Kasaan Peninsula has revealed new ore bodies. At the mammoth group an aerial tram and wharf were being built preparatory to shipping ore in 1907. Developments on the Copper Queen mine, the Poor Man's group, and the Sunny Day group were suspended during the year. The mines at Karta Bay have been among the largest copper producers on the island. The Khayyam mine, on Skowl Arm, made a large shipment of ore early in 1906, but has since been idle. At head of the North Arm the Cymru Mining Company began shipments on the first of October. The Niblack mine on the south side of Niblack Anchorage has been operated steadily throughout the year and has yielded a large production of copper ore. The ore is essentially low-grade chalcopyrite, with small values in gold and silver. Along the east shore of Hetta Inlet mining was carried on at the Copper Mountain mine, the Jumbo mine, the Copper City mine, and the Corbin mine. At the Jumbo No. 4 claim a short aerial and surface tram, connecting with an aerial tram 822 feet long, over which ore will be transported to 3,000-ton bins built on the wharf at tide water, was completed and considerable work was done on the ore bodies. Large developments are also being undertaken at the Houghton claims, a mile north of the Jumbo group. At the Corbin property, 3 miles north of Copper Harbor on the east shore of Hetta inlet, developments consisted in the erection of buildings, a compressor plant, and a wharf. At Copper City mine, 8 miles south of Copper Harbor, operations were resumed in May and continued throughout the year, the principal feature in the mine working being the development of the vein below the 100-foot level. On Gravina Island, at Seal Bay, and on Dall Head the copper deposits were prospected during the summer; and near Vallenar Bay new ore bodies were located.

The following table shows the total metal production of the ores derived from the copper mines in the Ketchikan district for 1905 and 1906, and a second table is added in which the average content per ton of ore is given. Outside of the Ketchiken district there are no producing copper mines in Southeastern Alaska:

Total production of copper mines in the Ketchikan district for 1905–6.

	Tonnage.	Copper.		Gold.		Silver.		Total value.
	Short tons.	Quantity, pounds.	Value.	Quantity, fine ounces.	Value.	Quantity, fine ounces.	Value.	
1905	30,400	1,901,392	$295,616	1,178	$34,370	13,000	$7,867	$337,853
1906	85,139	4,350,571	839,660	3,031	62,656	27,152	18,192	920,508

Average content per ton of ore.

	Tonnage.	Copper.		Gold.		Silver.		Total value.
	Short tons.	Quantity, pounds.	Value.	Quantity, fine ounces.	Value.	Quantity, fine ounces.	Value.	
1905	30,400	62.5	$9.75	0.038	$0.78	0.43	$0.26	$10.75
1906	85,139	51.1	9.86	.036	.74	.32	.21	10.81

Wrangell district.—The mineral bodies exposed at the head of Duncan Canal and on Woewodski Island at the entrance, both carry small percentages of copper, the latter, however, containing, principally, values in gold. At the former locality little advance has been made on the group of claims owned by the Portage Mountain Mining Company. On Woewodski Island the Olympic Mining Company renewed operations late in the summer at the Smith camp, and further investigations will be made of the quartz veins which were extensively developed in former years.

Explorations on the silver-lead properties located in Glacier and Groundhog basins on the mainland have been meager, and no mining company has yet undertaken their development, owing to the distance from tide water.

Sitka district.—Many gold and silver bearing quartz veins and lodes, usually of low grade, have been discovered in the area adjacent to Silver Bay on Baranof Island. Only meager developments have been accomplished in recent years. At Rodman Bay, on the north side of the island, mining operations were closed in 1904. At Port Conclusion and Port Lucy the prospects had been abandoned. The only area on Chichagof Island within which auriferous veins of importance have been discovered lies to the east of Cape Edward. The prospects are on the north and south slopes of the mountainous divide between Klag Bay and Hirst Cove. The gold is present, both native and combined with sulphides, the latter composing but a small percentage of the ore. Exploration has been carried on at the Young group of claims, generally known as the De Groff mine, and a small gold production is reported. It is planned to erect a 5-stamp mill on the property early in the spring of 1907. Prospecting has been carried on at the Golden Horn and Golden Gate claims and at the Bear group of claims.

Juneau district.—The mines which were operated during the year in the Juneau district have, with hardly an exception, given satisfactory returns, though many of the new and extensive developments that were planned failed of accomplishment. Two large stamp mills at the head of Gold Creek and on Nevada Creek were built, and the capacity of some of the power plants and mills at present in operation was increased.

On Douglas Island, at the Alaska-Treadwell mine, the shaft has now reached a depth of 1,500 feet, and from it the 1,450-foot level is being opened. Other developments have been confined to the 1,050-foot and 1,250-foot levels. There is apparently little change in the character and value of the ore in depth. The annual report for the year ending May 31, 1906, states that a total of 888,411 tons of ore was milled during the year, yielding $1,902,455, or $1.07 per ton in bullion and $1.07 per ton in concentrates. The mining and development expense was $0.84 per ton and the cost of milling $0.15 per ton. For the shipment and treatment of concentrates $0.12 per ton is to be added, and this, with minor expenses, makes the operating cost $1.19 per ton of ore milled. On the Seven Hundred Foot fraction operations were renewed this year, and considerable ore was mined from the 660-foot level. On the 770-foot and 880-foot levels developments were advanced, and some ore was mined. The lowest, or 990-foot level, was opened, and the sample returns were reported to be encouraging. The Mexican mine is now developing its 880-foot, 990-foot, and 1,100-foot levels. The ore mined has been mainly from the 550-foot and 660-foot levels and, to some extent, from the 770-foot and 880-foot levels. The last annual report gave a total of 237,862 tons ore milled to January, 1907, yielding $763,024, or an average of $3.19 per ton. At the Ready Bullion mine the inclined shaft has been sunk to the 1,500-foot level, and developments furthered on the 1,350-foot and 1,200-foot levels. The ore mined was principally from the 750-foot and 1,200-foot levels. The yearly report on January 1, 1907, gave a total tonnage of 236,690 tons, yielding $473,043. The power plant of the group has been improved by increase of water supply and the substitution of oil for coal as fuel, all of which will reduce costs.

The Nevada Creek mine of the Alaska Treasure Consolidated Mines Company, on the southwest end of Douglas Island, has undergone energetic development during the past year. Besides over 1,100 feet of tunneling, a cable tramway 1 mile in length has been built. A 20-stamp mill has been erected to operate at the end of 1906. On the Red Diamond group, at the head of Nevada Creek, operations were discontinued. On the Mammoth group assessment work only was done. The proposed mining improvements on the lode system, which is strongly developed within the Gold Creek drainage and extends over the Sheep Creek divide, were not accomplished, and progress in actual mining over the preceding year has been slight. Operations at the Ebner mine were continuous during the year, and results similar to those of former years were attained. The 15-stamp mill was in almost continuous operation. The 30-stamp mill of the Alaska-Juneau milled an average of 4,200 tons per month from May to November. At the Perseverance mine the greater portion of the work done was in the erection of a 100-stamp mill to begin operations early in 1907. On the Boston group of claims the present developments consist of a shaft 118 feet deep and 500 feet of drifting.

The placer deposits of Silver Bow Basin were again leased by the Silver Bow Hydraulic Company, and operations began the latter part of April and closed the latter part of October. During September work was suspended because of low water.

At Salmon Creek a 2-stamp mill has been installed for test purposes on the Wagner group of claims. On Montana Creek no development work of note was carried out. On Windfall Creek the Detroit-Alaska Mining Company washed about 1,000 yards of gravel. On Peterson Creek a test mill has been installed. At the Eagle River mine a 20-stamp mill has yielded a considerable output, though mining was greatly hindered by a fault in the ore body. In Yankee Basin a cross-cut tunnel to undercut several veins was being driven, and in October it was 400 feet long. In the Berners Bay region the Jaulin mine operated a 10-stamp mill during the months from May to October, with a large resulting output, and underground developments were extended. At the other mines within the Berners Bay region no additional developments have been made. Mining progress during the last year has been very slight along the mainland belt to the south of Juneau. None of the mines or prospects have been extensively worked and no noteworthy production has been reported. At Taku Harbor and Limestone Inlet promising prospects are being investigated. At Port Snettisham a small amount of work was done on the Crystal mine. Exploration was in progress on the Holkham Bay group of claims on the south side of Endicott Arm. The Helvetia Gold Mining Company carried on active work at the head of Windham Bay. The mining interests on Admiralty Island have changed but little, and on the two properties, the Portage group, at Funter Bay, and the Mammoth group, at Young Bay, there has been a notable lack of development. Two miles southeast of the Portage group the Mansfield Gold Mining Company is developing copper deposits.

Skagway mining district.—There are no gold quartz mines in the Skagway district. The only gold produced has been from the placer mines on Porcupine and Nugget creeks in the Chilkat drainage basin and from the beach diggings at Lituya Bay. These placer mines were mostly idle in 1906 and there was no production for the year.

COASTAL REGION FROM CROSS SOUND TO ALASKA PENINSULA.

The beach placers at various places along the seaboard between Lituya Bay and Unga Island yield only a small annual production. Yaktag beach, which is about 60 miles east of Controller Bay, is estimated to have produced about $25,000 in 1906. About $10,000 has been taken from the beaches of Kodiak and the other islands lying to the southwest.

In Prince William Sound two mines, the Gladhaugh and the Bonanza, made shipments of ore to the Tacoma smelter throughout the year, and several other properties undergoing development also made some production. In the Gladhaugh mine the shaft has reached the 600-foot level. Much prospecting was done on Latouche and Knight islands and at Boulder, Landlocked, and Coulena bays. It seems probable that in 1907 the number of productive mines will be increased.

COPPER RIVER BASIN.

In the Copper River region the most active placer mining operations were in the Nizina basin, tributary to the Chitna. It is reported that 5 claims were operated in the summer of 1906, employing in the aggregate 30 men. In the Chistocna district no rapid progress is reported, but considerable mining was carried on.

The two copper belts on the north and south sides of the Wrangell Mountain continue to be a field of much prospecting. Developments have been confined chiefly to the more accessible southern belt, which it is expected will be connected by railroad with tide water in the next two years. The mineral belt has been carefully traced by prospectors and probably most of it has been located. There has been systematic development on a number of the larger holdings, notably on the Hubbard-Elliot property near the west end of the range and on the Bonanza near the east end.

In the upper copper belt several new prospects are reported, some of them so near the international boundary that until the line is definitely delimited it will not be known on which side they lie.

COOK INLET REGION.

Sunrise district.—The output of the Cook Inlet placers has fallen off since 1905. The greater part of the mining was confined to Resurrection Creek and its tributaries, Crow Creek, Sixmile Creek, East Fork, Canyon Creek, and Mills Creek. A small amount of work was probably done on a number of other streams, but the quantity of gold produced could not have been great. Present mining is confined largely to the working of high benches, and the utilization of water under pressure is the method most generally employed. Mining on Willow Creek, a tributary of the Susitna River, was in progress during 1906.

Yentna district.—The one important advancement in the Cook Inlet region is the exploitation of the placers of the Yentna district, located approximately 75 miles northwest of the mouth of Susitna River. They occupy the headwaters of Kohiltna River, a tributary of the Yentna, 25 miles above the confluence of the latter with the Susitna. The diggings, excepting those of Lake Creek, are shallow. The value of the production for 1906 of Cook Inlet and Copper River is estimated to have been $400,000.

Copper is reported in the Talkeetna Mountains near the head of Kashwitna River, also in the high mountains between Knik and Maranuska River. On Lynx Creek, a southern tributary of East Fork of Sixmile Creek, the Ready Bullion Copper Company is prospecting near the head of the creek. The ore is chalcopyrite with pyrite and pyrrhotite. A crosscut tunnel 350 feet has been driven and 240 feet of drifting had been done at the end of September. An adit driven to strike the ore 1,000 feet in depth has proceeded 800 feet.

SEWARD PENINSULA.

The Nome district continues to be the leading mining center of Seward Peninsula, with the Council district second. Of the production of $7,500,000 for the entire peninsula probably 50 per cent must be credited to the third-beach placer near Nome.

Nome region.—During the summer of 1906 much attention was given to the area of the Nome tundra. On the first or present beach many of the old properties were worked and some very good new ground was discovered in the vicinity of Otter Creek. The third beach is the principal producer of the region. With these operations and those of Glacier Creek, Anvil Creek, and Grass Gulch, most of the important work was connected, though minor operations were carried on at scattered localities, especially on Buster Creek.

The construction of the Seward and Pioneer ditches, begun in 1905, was carried forward in 1906, so that both now deliver water on the tundra north of Nome.

A wood stave pipe line to bring water to the Nome River basin is under construction by the Wild Goose Company. As yet no gold-bearing veins of proved value are known in the Nome region.

Iron Creek region.—Mining on Iron Creek and its tributaries has been retarded by the inaccessibility of the region, but railroads and wagon roads are now being built. A liberal estimate of the output of the creek and its tributaries would not exceed $50,000. About 13 miles of ditch have been constructed.

Kougarok district.—This district was probably visited by prospectors as early as the summer of 1899. A rush from Nome took place in March, 1900, and another in July of the same year. The mining interests in the Kougarok district may be said to have lain dormant for a number of years, though some gold was produced each year, chiefly on Dall Creek. With the successful construction of ditches at Nome came a renewed interest in this outlying placer field. Ditch building began in 1903. In 1905 and 1906 ditch construction went on with great activity, and at the end of the summer upward of a hundred miles of ditch were planned, about half being completed. Up to 1906 the Kougarok district could only be reached by an overland journey. In 1906 the Seward Peninsula Railway was extended northward to the head of Nome River and then down the Kruzgamepa to Lanes landing. Surveys have been made looking to a further extension of this line up the Kougarok Valley. The total gold output, including that of 1905, is estimated at $585,000. The production in 1906 was very small owing to the lack of water.

Solomon region.—In the Solomon River region few new developments were in progress. The most active work was conducted at the dredge near Rock Creek and at the Big Hurrah quartz mine. The dredge is reported to have handled much ground at low cost, and with satisfactory returns. The Big Hurrah mine continues operations, and still remains the only productive lode mine in the entire district. Placer mining continued on Solomon River and its tributaries, and estimates place the production during the winter of 1905–6 at $75,000. The summer production is not known.

Council region.—The more important producing streams in the Niukluk basin are Fox River, Melsing, Ophir, Goldbottom, and Elkhorn creeks, and Casadepaga River. The mining is almost entirely confined to the summer months. Ophir Creek still continues to be the producer of first importance.

Several veins of promising character have been developed as a result of active prospecting for lode deposits. During the summer of 1906 renewed attempts were made to reopen the silver-bearing galena lode on Omalik Creek, a branch of Fish River.

YUKON BASIN.

Fairbanks district.—There was great scarcity of water up to the last week in August, after which time considerable rain fell. The underground character of the workings permit of continuous operation throughout the year. Means of communication are being rapidly extended by wagon road and railroads. Cleary, Fairbanks, Dome, Vault, Esther, Goldstream, and Pedro creeks and their tributaries are the chief producers. Cleary continues to stand first, with Fairbanks second. A gold-bearing zone about 10 miles wide and extending roughly northeast and southwest for about 30 miles seems to be established. Worthy of special note are the rich placers found on Vault Creek, which had been previously unproductive. A ditch 72 miles long to bring water from the upper Chatanika drainage basin has been surveyed.

Of the outlying districts tributary to Fairbanks the Tenderfoot probably made the largest production, estimated at $100,000. The gravels on Tenderfoot Creek are deep, but on the smaller creeks are said not to exceed 8 to 10 feet. It would appear that these deposits lie in a different zone from those of Fairbanks.

Bonnifield and Kantishna districts.—In 1903 gold placer mining commenced in the Bonnifield country about 60 miles south of Fairbanks, and during 1906 the Kantishna region, about 150 miles southwest of Fairbanks and 30 miles north of Mount McKinley, was an area of considerable activity. These regions produced, respectively, about $30,000 and $175,000 in placer gold. In the Bonnifield district the principal creeks are Tobalkanika Creek, Homestead Creek, Grubstake Creek, Roosevelt Creek, Hearst Creek, and Gold Creek. The creeks of the Bonnifield region may be divided into two classes—those that have, in a part of their valleys at least, cut into hard bed rock and those that are still cutting their valleys entirely in unconsolidated deposits, including gravels, sands, clays, and coal beds. The greatest part of the gold has in all probability been derived from the thick gravels. All work has been accomplished on a small scale under adverse conditions; most of the mining is being done above timber line, and the work is hampered by lack of water. The soft nature of the bed rock in some of the creeks means a large amount of material that adds difficulty to a situation caused by lack of water. In general, it may be said that the quantity of gold is not such as to overshadow the economic factors of water supply, character of bed rock, presence or absence of bowlders in the gravels, timber resources, and transportation; but that in every case these are the determining factors in the situation.

The rich, shallow diggings discovered in the Kantishna region in 1905 were found to be more local than at first supposed, and the results of 1906 were unequal to expectation. The streams are Spruce Creek, Glen Creek, Friday Creek, Glacier Creek, and Caribou Creek. The placers are in an area of crystalline schists, and the gold-producing creeks head near one another. The gravels are shallow. The bulk of the gold in every case has, in all probability, been derived from the valley in which it is found. The geologic environment and mineral associations of the Kantishna and Fairbanks regions are practically the same. The bulk of the production has come from Eureka Creek and most of the remainder from Glacier Creek. There was no lack of water during 1906, but in a dry season the small creeks would shrink below the economic limit. The auriferous gravels thus far discovered are adapted only for summer work from the first of June to the early part of September. Although the rich ground first discovered has been largely worked out, there is some fair ground still available, and about fifty men intended to remain during the winter of 1906–7 to prospect.

Rampart district.—The total gold output of the Rampart district for 1906 is estimated to have a value of $270,000. The writer is indebted for valuable information to Messrs. H. F. Thum and E. H. Chapman, of Rampart. The working area was extended in 1906 to Boothby and Skookum creeks. Three hydraulic plants were operated during part of the summer on Hoosier, Ruby, and Hunts creeks. The Alaska Road Commission has begun the construction of a highway from Rampart up Big Minook. Another road has been built from Baker Hot Springs to Glen Creek, a distance of 24 miles, by Thomas Manley. Mr. Manley has also surveyed a ditch from Hutchinson Creek to Thanksgiving Creek, a distance of 15 miles. If the scheme is carried out, and there is sufficient water, it will lead to extensive mining developments in the Glen Creek region. It is of interest to note that the same operator has imported a churn drill for prospecting, the first in the district.

Birch Creek district.—The gold-bearing area tributary to Birch Creek in the central Yukon region is usually known as the Birch Creek district. The whole region is tributary to the town of Circle, located on the west bank of the Yukon. Wagon roads are almost entirely lacking and are the first need of the region. In spite of adverse conditions, the Birch Creek district stands to-day as one of the few placer camps which has been developed entirely without the aid of outside capital. In 1906, however, several groups of claims passed into the hands of strong companies. This will eventually revolutionize mining methods and bring about a great increase of production. As the installation of mining plants will require several years, however, the production meanwhile will decrease.

The influx of prospectors in 1898, following the discovery of the Klondike, led to considerable prospecting along the streams tributary to the Yukon between the boundary and Circle. So far as known no placers have been found in the streams in the region entering the Yukon from the north. On the south side Washington, Fourth of July, and Woodchopper creeks, together with some smaller streams, have produced gold. The placers, however, so far as they have been opened up have revealed neither high values nor extensive pay streaks. They have the advantage of being more accessible than most of those in the Yukon Basin. The output of Fourth of July Creek since 1898 is estimated to total between $25,000 and $30,000. Mineral Creek, a tributary of Woodchopper, produced about $18,000 in 1906.

Fortymile district.—Though this is the oldest of the Yukon camps, progress has been very slow, chiefly because of lack of transportation facilities. This is being remedied to a certain extent by the construction of a wagon road to Steele Creek. The principal producing creeks are Jackwade, Chicken, and Lost Chicken and their tributaries. The producing creeks in the territory tributary to Eagle include several confluent with Seventymile Creek, together with American Creek and some smaller streams. Considerable interest has been taken in the Fortymile region in the subject of dredging, but no plants have yet been set up. There are also plans for ditch building, but these have not gone beyond preliminary surveys. The writer is indebted to Mr. C. B. McDowell, of the Fortymile region, for the following statement in regard to the developments in that district:

> As dredging has proved so successful in the Klondike, many efforts are being initiated here looking toward working this section in a similar manner. Russel King, of London, has purchased several miles of Walkers Fork and is now installing a 5-foot bucket dredge on the properties. He expects to begin operations in the early part of June. The McDowell-Allan Company is also installing a dipper dredge on South Fork of Fortymile River and likewise expects to begin operations early in the summer. A company installed a dredge on the Canadian side of Fortymile River late last summer and will work its ground in this fashion the coming summer. Another dredge is now being installed at the boundary on the Fortymile for operations this summer. G. L. Savage, of New York, began operations late last fall on a ditch line to carry water from Mosquito Fork into the Chicken Creek basin for hydraulic purposes. Considerable prospecting for quartz was carried on last year, and while there were two good surface showings found—one gold and one copper—sufficient work has not yet been done to demonstrate whether they are of good value or not.

According to the statement of Mr. J. H. Van Zandt, deputy collector at Fortymile, 11,974 ounces of gold were shipped through his office in 1906. The entire production of this district in 1906 is estimated at $300,000.

Koyukuk district.—Little information is at hand regarding the remote Koyukuk district, but it is reported that the gold production in 1906 was from $150,000 to $200,000. There has been no reduction in the cost of operating, and until that takes place there will probably be no expansion in the mining. The richest placers are reported from Newlands Creek. Late in the fall of 1906 a report came to Fairbanks of the discovery of new placer grounds on Big Creek, in the Chandlar basin. The Chandlar is tributary to the Yukon from the northwest, about 20 miles below Fort Yukon. No workable placers have previously been found in this region.

ARIZONA.

By V. C. Heikes.

PRODUCTION.

For the calendar year 1906, as reported by 171 producers, including 19 placers, the value of Arizona's production of gold, silver, copper, and lead totaled $56,812,355. Of this total the gold yield was 143,416.55 ounces, valued at $2,964,683, and the silver 3,026,438 ounces, which, at the average commercial price for the year, was valued at $2,027,714, or a total value for the two metals of $4,992,397. This is $619,333 greater than the value of the 1905 production of gold and silver. There was an increase in the kinds of ore mined. Siliceous ore increased from 266,218 tons in 1905 to 272,611 tons in 1906, an increase of 6,393 tons. To this class of ore the Commonwealth mine, in Cochise County, contributed the largest tonnage. Copper ore increased from 2,360,256 tons in 1905 to 3,089,856 tons in 1906, an increase of 729,600 tons. Graham County has the greatest output of copper ore, Cochise County following. Lead ore increased from 48,439 tons in 1905 to 221,376 tons in 1906, or an increase of 172,937 tons. The average value per ton of gold and silver siliceous ore in 1906 was $6.33; of copper ore, 79 cents; of lead ore, $3.49, and of copper-lead ore, $7.96. During 1906 there were treated at gold and silver mills 164,036 tons of ore, containing $1,369,058 in gold and averaging $8.34 per ton and 537,191 ounces of silver, averaging 3.2 ounces per ton. At concentrating mills 1,384,841 tons of ore produced 219,411 tons of concentrates (6.3 tons into 1). The concentrates contained $356,176 in gold, and averaged $1.62 in gold and 1.6 ounces of silver per ton. Crude ore shipped to smelters amounted to 1,916,148 tons, containing $1,198,947 in gold, averaging 63 cents per ton; 2,127,146 ounces of silver, averaging 1.1 ounces per ton; there were 120,064 tons of tailings and slag re-treated, the contents of which are included under mill bullion and concentrates.

The statement of production for 1905 and 1906, showing increase and decrease, and valued at each year's average commercial prices, is as follows:

Production of gold, silver, and associated metals in Arizona in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold........fine ounces..	135,412	$2,799,214	143,416.55	$2,964,683	+ 8,004.55	+ $165,469
Silver..............do....	2,605,712	1,573,850	3,026,438	2,027,714	+ 420,726	+ 453,864
Copper.........pounds..	228,418,679	35,633,314	266,831,864	51,498,550	+38,413,185	+15,865,236
Lead...............do....	4,940,910	232,223	5,638,735	321,408	+ 697,825	+ 89,185
Zinc................do....	140,000	8,260	....	....	− 140,000	− 8,260
Total..............	....	40,246,861	....	56,812,355	....	+16,565,494

The production of ore in Arizona in 1906 was 3,585,089 short tons, having an average value of $15.83 per ton, as against 2,678,059 short tons, having an average value of $15.01 per ton in 1905, an increase in 1906 of 907,030 tons in quantity and of 82 cents in average value per ton.

GOLD.

The total gold production for the Territory amounted to 143,416.55 ounces, valued at $2,964,683, in 1906, as against 135,412 ounces, valued at $2,799,214, in 1905, an increase of 8,004.55 ounces in quantity and of $165,469 in value. The greater part of the year's supply continues to come from Yavapai County, with Mohave, Cochise, and Yuma counties following in order of their yield. Increases in gold are recorded in Cochise, Graham, Mohave, Pima, and Yuma counties. The decrease in Yavapai County represented by 6,503.89 ounces is not caused by a general decline in output by all producers, but by a decline in the tonnage of gold-bearing ore by two of the largest producers. The new custom smelter at Humboldt has been the means of maintaining the metal production and increasing the tonnage. Other counties benefited by this smelter are Mohave, Pinal, and Yuma. The collection of figures for the placer production of the Territory has always been somewhat difficult for the reason that numerous individual operators work spasmodically, which results in a small output being sold and traded to the merchants of the locality. For 1906, therefore, this information was sought from each of the traders securing gold, and a reasonable estimate was placed upon the production of each locality. Increases are recorded from copper ore of 6,630.80 fine ounces and from lead ore of 4,818.98 fine ounces. The production from different kinds of ores by counties will be found in the following table:

Source of gold production in Arizona by kinds of ore in 1906, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Mixed ores.			Grand total.
				Lead ore.	Copper-lead ore.	Lead-zinc ore.	
Cochise	93.36	5,302.51	17,257.11	7,205.84	50.00		29,908.82
Coconino and Maricopa	14.51	755.00					769.51
Gila			2,317.93				2,317.93
Graham		409.10	2,237.09		53.59		2,699.78
Mohave		28,961.70	413.00	1,635.32			31,010.02
Pima	281.76		695.42				977.18
Pinal	13.54	624.06	5.00				642.60
Santa Cruz			6.50		12.18		18.68
Yavapai	859.54	15,355.00	39,326.75	5,247.82			60,789.11
Yuma	696.58	13,546.34	40.00				14,282.92
Total	1,959.29	64,953.71	62,298.80	14,088.98	115.77		143,416.55

Comparison of these totals for 1906 with the gold output for 1905 is as follows:

Production of gold in Arizona in 1905 and 1906, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Grand total.
					Copper-lead ore.	Lead-zinc ore.	
1905	2,064.00	67,572.00	55,668.00	9,270.00	121.00	717.00	135,412.00
1906	1,959.29	64,953.71	62,298.80	14,088.98	115.77		143,416.55
Increase (+) or decrease (−)	−104.71	−2,618.29	+6,630.80	+4,818.98	−5.23	−717.00	+8,004.55

SILVER.

The silver yield in 1906 amounted to 3,026,438 ounces, valued at $2,027,714, as against 2,605,712 ounces, valued at $1,573,850, in 1905, an increase in 1906 of 420,726 ounces in quantity and of $453,864 in value The increase continues to be greatest in Cochise County, which relies largely on the output of the Tombstone mines. Gila County also shows an increase that came mainly from the ores of the Old Dominion Copper Company and a number of new producers in 1906. A reduction of the silver output in Santa Cruz County is caused by a suspension of the active operation of the Mowry Mines. Silver increased in siliceous, copper, and lead ores as is shown in the following table:

Source of silver production in Arizona, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Total.
					Copper-lead ore.	Lead-zinc ore.	
Cochise	13	444,049	706,484	606,626	197	....	1,757,369
Coconino and Maricopa	2	....	314	....	....	....	316
Gila	....	12,000	110,098	....	....	....	122,098
Graham	....	21,089	107,045	....	2,770	....	130,904
Mohave	....	65,156	46,128	33,895	....	....	145,179
Pima	43	....	79,661	....	7,500	....	87,204
Pinal	2	952	1,963	....	....	....	2,917
Santa Cruz	....	....	18,440	43,260	759	....	62,459
Yavapai	119	24,316	654,108	29,896	....	....	708,439
Yuma	95	4,059	260	5,139	....	....	9,553
Total	274	571,621	1,724,501	718,816	11,226	....	3,026,438

Comparison of these totals for 1906 with the silver output for 1905 is as follows:

Production of silver in Arizona in 1905 and 1906, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.		Total.
					Copper-lead-zinc ore.	Copper-lead ore.	
1905	306	441,952	1,480,732	594,330	240	88,152	2,605,712
1906	274	571,621	1,724,501	718,816	....	11,226	3,026,438
Increase (+) or decrease (−)	−32	+129,669	+243,769	+124,486	−240	−76,926	+420,726

COPPER.

The output of the Territory increased from 228,418,679 pounds, valued at $35,633,314, in 1905, to 266,831,864 pounds, valued at $51,498,550, in 1906, an increase of 38,413,185 pounds in quantity and of $15,865,236 in value.

Cochise County, in the Warren mining district, produced mainly from two properties, the Copper Queen and Calumet and Arizona, and yielded the largest part of the output, which increased from 108,498,440 pounds, valued at $16,925,757, in 1905, to 130,029,016 pounds, valued at $25,095,600, in 1906, an increase of 21,530,576 in quantity and of $8,169,843 in value. Graham County continues to hold second place in the Territory as a producer of copper, and increased from 53,939,212 pounds, valued at $8,414,517, to 59,270,459 pounds, valued at $11,439,199, in 1906, an increase of 5,331,247 pounds in quantity and of $3,024,682 in value. This increase would have been greater had it not been for the serious floods at the end of November, which disabled all the works in the region for a time. Yavapai County, with the United Verde mine, the largest producer, continues to hold third place, and Gila County, depending mainly on the Old Dominion mine, follows. Pima County increased its output from 5,954,770 pounds, valued at $928,944, in 1905, to 6,230,778 pounds, valued at $1,202,540, in 1906, an increase of 276,008 pounds in quantity and of $273,596 in value. The output of the county is mainly that of the Imperial copper mines in the Silver Bell district, but the increase is due largely to properties producing in the Helvetia and Pima districts.

LEAD.

The lead produced in Arizona shows an increase from 4,940,910 pounds, valued at $232,223, in 1905, to 5,638,735 pounds valued at $321,408, in 1906, an increase of 697,825 pounds in quantity, and of $89,185 in value. The increase was greatest in Santa Cruz and Mohave counties, but Cochise County has the greatest quantity of lead to its credit, though showing a decrease from the 1905 production.

ZINC.

Zinc was not produced from any part of the Territory in 1906. The product may be an item of importance for 1907, and will be produced from Yavapai, Mohave, and Santa Cruz counties.

PROGRESS OF MINING INDUSTRY IN ARIZONA IN 1906.

Among the events in 1906 was the consolidation of four of the Bonanza Circle properties at Bisbee and the defeat in the same camp of the purposes of the Western Federation of Miners to affiliate with the local union. Labor troubles occurred during the year but were of little importance except at the Morenci camp in Graham County, where the difficulty was amicably settled. During the latter part of the year labor was granted a very material increase in wages in a number of camps, and this increase is to continue in force as long as copper sells above 18 cents per pound.

The Arizona legislature has in hand the question of the proper taxation of producing mines of the Territory, and according to the annual report of the governor the idea seems to be to tax a mine according to the market value of the ore extracted therefrom. The value of the ore extracted each year is to be taken as the value of the mine for that year. The mine producing nothing would consequently be assessed at substantially nothing beyond the improvements upon it.

Another feature of interest in the Territory during the year was the successful blowing in of the Arizona Smelting Company's plant at Humboldt, in Yavapai County.

At Sasco, in Pinal County, on the Arizona Southern Railroad, a new smelter of 300 tons capacity per day is being erected by the

Southern Arizona Smelting Company. This plant, though mainly constructed for taking care of the ore of the Imperial mine in the Silver Bell district, will also handle custom business. It was reported that a new smelter will be built at Phoenix by a corporation known as the Phoenix and Eastern Smelting and Refining Company, but no other particulars are given, except that the ores of the Cave Creek district in Maricopa County will be handled at this plant and that much of the custom work will come from Pinal County. There is a report that a new smelter is to be built at Globe, in Gila County, where material was being received at the close of the year for a copper smelting plant for the Mitchell Mining Company; and it is reported also that the Globe Consolidated Mines Company has in contemplation a smelting plant.

Arizona shows the largest increase in its output of copper in 1906, and mainly for that fact the quantity of gold and silver was greater in proportion. Had it not been for the shortage in labor, which was a difficulty all through the year, for a shortage in the fuel supply at the end of the year, and for the idleness of smelting works about the end of November at Clifton, the increase in copper would have been greater.

Arizona has 13 counties. From 11 of these counties mine operators reported production of metals in 1906. There are 211 mining districts in the Territory. Sixty-one have a production credited to them for 1906. Later in this report a brief review is given of each of the productive counties.

Production of gold, silver, copper, and lead in Arizona in 1906, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Cochise	29,908.82	$618,270	1,757,369	$1,177,437	130,029,016	$25,095,600
Coconino and Maricopa	769.51	15,907	316	211	239,366	46,198
Gila	2,317.93	47,916	122,098	81,806	28,492,391	5,499,031
Graham	2,699.78	55,809	130,904	87,706	59,270,459	11,439,199
Mohave	31,010.02	641,034	145,179	97,270	315,992	60,986
Pima	977.18	20,200	87,204	58,427	6,230,778	1,202,540
Pinal	642.60	13,284	2,917	1,954	142,859	27,572
Santa Cruz	18.68	386	62,459	41,848	10,382	2,004
Yavapai	60,789.11	1,256,623	708,439	474,654	42,080,740	8,121,583
Yuma	14,282.92	295,254	9,553	6,401	19,881	3,837
Total	143,416.55	2,964,683	3,026,438	2,027,714	266,831,864	51,498,550

County.	Lead.		Total value.
	Quantity.	Value.	
	Pounds.		
Cochise	2,124,605	$121,102	$27.012,409
Coconino and Maricopa			62,316
Gila			5,628,753
Graham	221,600	12,631	11,595,345
Mohave	904,399	51,551	850,841
Pima	48,888	2,787	1,283,954
Pinal			42,810
Santa Cruz	1,468,556	83,708	127,946
Yavapai	729,787	41,598	9,894,458
Yuma	140,900	8,031	313,523
Total	5,638,735	321,408	56,812,355

The following table shows, by counties, the tons of ore sold or treated, 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 1905 and 1906, by counties, in 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.	
	1906.	Increase (+) or decrease (−) compared with 1905.	1905.	1906.	1905.	1906.	1905.	1906.
Cochise	1, 195, 648	+244, 883	19	19	$19. 31	$22. 60	$1. 38	$1. 50
Coconino and Maricopa	1, 930	− 810	2	3	6. 09	32. 28	6. 09	8. 35
Gila	415, 471	+174, 143	10	14	16. 58	13. 55	. 42	. 31
Graham	1, 259, 161	+306, 652	9	18	8. 96	9. 21	. 08	. 11
Mohave	64, 832	+ 12, 120	21	27	11. 34	13. 12	11. 14	11. 38
Pima	64, 883	+ 27, 697	9	12	25. 93	19 78	. 86	1. 21
Pinal	2, 552	− 9, 413	10	9	11. 34	16. 77	1. 85	5. 97
Santa Cruz	122, 049	+120, 541	3	5	42. 45	1. 05	30. 95	. 35
Yavapai	396, 788	+ 32, 091	33	39	19. 83	24. 93	5. 04	4. 36
Yuma	61, 775	− 874	6	6	4. 88	5. 07	4. 68	4. 65
Total	3, 585, 089	+907, 030	122	152	15. 01	15. 83	1. 62	1. 39

The total tonnage, by kinds of ore sold or treated, in each county of Arizona during 1906 is shown in the following table:

Subdivision of tonnage of ore sold or treated in Arizona in 1906, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.
Cochise	106, 424	1, 022, 454	66, 690	80
Coconino and Maricopa	1, 800	130	....	....
Gila	30	415, 441	....	....
Graham	1, 864	1, 257, 020	....	277
Mohave	61, 093	940	2, 799	....
Pima and Santa Cruz	101	64, 033	121, 909	889
Pinal	1, 687	865	....	....
Yavapai	38, 151	328, 904	29, 733	....
Yuma	61, 461	69	245	....
Total	272, 611	3, 089, 856	221, 376	1, 246
Value per ton in gold and silver	$6. 33	$0. 79	$3. 49	$7. 96

In 1905 the subdivision of the tonnage was as follows: Siliceous ore, 266,218 short tons; copper ore, 2,360,256 tons; lead ore, 48,439 tons; copper-lead ore, 3,146 tons; total, 2,678,059 tons.

The total tonnage of ore sold or treated in each county of Arizona, 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 of milling and smelting ore and concentrates, with value of gold and quantity of silver contained in bullion, produced in Arizona in 1906, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills.	Concentrates produced.		
	Quantity.	Gold value in bullion.	Silver in bullion.	Quantity.	Quantity.	Gold value.	Silver.
	Short tons.		*Fine ounces.*	*Short tons.*	*Short tons.*		*Fine ounces.*
Cochise	42,466	$153,238	507,149	43,516	511	$44,820	138,070
Coconino and Maricopa	1,800	15,607					
Gila				66,646	33,323	11,080	26,805
Graham	13	124	10	1,058,915	162,960	34,336	65,323
Mohave	54,315	584,945	14,486	100	305	3,500	31,500
Pima							
Pinal	525	11,268	663	1,162	31	1,633	289
Santa Cruz				116,744	14,593		30,348
Yavapai	3,456	323,848	10,824	97,758	7,688	260,807	69,492
Yuma	61,461	280,028	4,059				
Total	164,036	1,369,058	537,191	1,384,841	219,411	356,176	361,827
Per ton		8.34	3.2			1.62	1.6

County.	Crude ore to smelter.			Old tailings treated.
	Quantity.	Gold value.	Silver.	Quantity.
	Short tons.		*Fine ounces.*	*Short tons.*
Cochise	1,046,107	$418,282	1,112,137	[a] 63,559
Coconino and Maricopa	130		314	
Gila	348,825	36,836	95,293	
Graham	150,078	21,349	65,571	[b] 50,155
Mohave	4,067	52,589	99,193	[c] 6,350
Pima	64,883	14,376	87,161	
Pinal	865	103	1,963	
Santa Cruz	5,305	386	32,111	
Yavapai	295,574	654,199	628,004	
Yuma	314	827	5,399	
Total	1,916,148	1,198,947	2,127,146	120,064
Per ton		0.63	1.1	

[a] Values included in gold and silver bullion.
[b] Values included in concentrates (slag re-treated).
[c] Values included in mill bullion and concentrates.

The table following gives the number of mines classified according to their chief products in 1906:

Number of mines in Arizona, classified by chief products in 1906.

County.	Mines reporting product.	Gold placer mines.	Deep mines.					
			Gold.	Silver.	Gold and silver.	Gold, silver, and copper.	Gold, silver, copper, lead.	Gold, silver, and lead.
Cochise	21	2	1	2	3	10	1	2
Coconino and Maricopa	4	1	1			2		
Gila	14			1		13		
Graham	18		1	1	2	13	1	
Mohave	27		4		12	4		7
Pima	16	4				11	1	
Pinal	10	1	1		3	5		
Santa Cruz	5					2	2	1
Yavapai	46	7	5	3	12	15		4
Yuma	10	4			2	2		2
Total	171	19	13	7	34	77	5	16

PRODUCTION BY INDIVIDUAL COUNTIES.

COCHISE COUNTY.

This county continues to lead in the total value of its output. The ores sold or treated by 19 producers amounted in 1906 to 1,195,648 short tons, valued at $27,010,470, as against 950,765 short tons, valued at $18,359,810, in 1905. The increase in 1906 was 244,883 short tons, in quantity and $8,650,660 in value. Of this tonnage of ore mined in 1906, there were treated at gold and silver mills 42,466 short tons, containing $153,238 in gold and 507,149 ounces of silver. Concentrating mills treated 43,516 short tons, producing 511 tons of concentrates, containing $44,820 in gold and 138,070 ounces of silver. Crude ore treated at smelters amounted to 1,046,107 tons, which contained $418,282 of gold and 1,112,137 ounces of silver. Of old tailings, 63,559 tons were treated by the cyanide process, the values being included under ore to gold and silver mills.

Production of gold, silver, and associated metals, in Cochise County, Ariz., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold......fine ounces..	20,820	$430,388	29,908.82	$618,270	+ 9,088.82	+ $187,882
Silver............do....	1,453,312	877,800	1,757,369	1,177,437	+ 304,057	+ 299,637
Copper........pounds..	108,498,440	16,925,757	130,029,016	25,095,600	+21,530,576	+8,169,843
Lead.............do....	2,677,980	125,865	2,124,605	121,102	− 553,375	− 4,763
Total............	....	18,359,810	....	27,012,409	....	+8,652,599

The production of ore in Cochise County, Ariz., in 1905 was 950,765 short tons, valued at $19.31 per short ton; in 1906 it was 1,195,648 short tons, valued at $22.60 per ton, an increase of 244,883 tons and of $3.29 per ton.

Source of gold and silver in Cochise County, Ariz., in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead-zinc.	Copper-lead ore.	Total.
Gold............	1905	....	4,617.00	9,690.00	6,513.00	....	....	20,820.00
	1906	93.36	5,302.51	17,257.11	7,205.84	....	50	29,908.82
Silver............	1905	....	308,104	610,478	526,712	240	7,778	1,453,312
	1906	13	444,049	706,484	606,626	....	197	1,757,369

California district.—At Paradise, the deepest shaft in the district is on the Planet claim and sunk to a depth of 1,455 feet. This is property of the San Simon Company.

Cochise Consolidated Copper Company, owning 13 claims known as the Treasury group, started in January, 1907, the operation of a concentrating plant equipped with Sutton dry concentrators. The mill has a daily capacity of 100 tons of ore, which carries copper, lead, zinc, gold, and silver.

There were 77.40 ounces of placer gold reported from this district.

Cochise district.—The Magazine Copper Company operated under bond the People's Party group. Shipments of copper ore were made, carrying 8 per cent of copper and 5 ounces of silver. The company expects to ship regularly to the smelters this class of ore. The Arizona Consolidated Mining Company has developed to a depth of 500 feet the Republican mine at Johnson camp. Sulphide ores have been encountered, carrying 15 per cent of copper and some silver. The output was about 100 tons a week. The Manzoro Mining Company, located near the Dragoon post-office, made several tests on ore taken out during development work. The property is equipped with a 20-stamp mill, including three Wilfley concentrating tables. The mine is opened by several shafts, the deepest of which is 200 feet. Some tungsten ore was produced in the course of development work on property near Johnson. Operations are carried on in a rather crude manner, and shipments amount to but a few tons per month. Practically no work has been done on ledges, and the ore now being recovered is produced by dry washers and rockers working in placer deposits.

Dos Cabezas district.—During the year water was plentiful for a number of months, so that considerable placer ground was worked by several companies and a number of Mexicans, many of the latter making from $4 to $6 a day with simply a gold pan, while others used the rudely constructed arrastras.

The Cottonwood Mining Company has developed to a depth of 420 feet. The mill on the property, which is equipped with five stamps and a concentrating table, was operated part of the year. The Western Mining Company has recently taken over property from which several shipments have been made carrying copper, gold, and silver, and promises to be quite an important producer of such ore during 1907. The Arizona Gold Mining Company owning claims in Apache Pass recently began production from the Lula claim on which a shaft has been sunk 80 feet. The ore taken out in development work carried values in gold and silver.

Tombstone district.—The Tombstone Consolidated Mines Company has reached the 1,000-foot level with a 3-compartment shaft. A large station will be cut at this point. It is the intention of the company to push the underground workings into the old Grand Central and Contention properties to tap the ore bodies that are known to lie below water level and in which those respective companies were working at the time they were compelled, by excessive water, to shut down. Since installing the new boilers the company has not had the least trouble in handling the water and the quantity pumped has been gradually reduced from nearly 5,000,000 gallons to 4,000,000 every 24 hours. It has been determined that the water of the district does not run in regular courses but is held in crevices of the rock, and it is estimated by the company's engineer that between 3 and 4 per cent of the whole mass below water level and above the expected dry zone is water which will finally, by persistent pumping, be drained out of the underground areas. The concentrating and cyanide plant is now of 225 tons daily capacity, which will be increased as development of the mines progresses. The mill's 25 stamps were operated the greater part of the year, and several new cyanide tanks were put into commission. The concentrates shipped to El Paso gave satisfactory results. This company has been sinking its working shafts on the Silver Thread, Tranquillity, Emerald, Lucky Cuss, Tough Nut, and West Side claims. In all of these except the Silver Thread the ore bodies, it is reported, have continued down unchanged as to volume or value save that the gold content is increasing with depth. The Silver Thread shaft is progressing rapidly and is nearing the 600-foot level. The intention of the company is to sink the shaft down to the body of copper ore that was uncovered in the winze on the 500-foot level. The winze had reached a depth of 135 feet from the 500-foot level when the copper was struck at the time the water prevented further work.

The Old Glory Mining Company, operating the Black Eagle and Luck Sure properties, made regular shipments of ore carrying silver. The Herschel mine, operated by a company of the same name, is developed by shaft 352 feet deep and is a regular shipper of lead ore carrying silver and some gold. This mine was worked during the early eighties and produced liberally. The vein is small but regular. An average of two carloads of ore have been shipped each month during the year.

Turquoise district.—The Black Diamond mine encountered a body of ore 500 feet from the surface in the Dividend tunnel. The ore is reported to carry from 10 to 20 per cent copper. The property is developed by shafts and tunnels and is equipped with a copper furnace of 200 tons capacity. The Commonwealth mine and mill were operated by the same lessees that have had charge of the property during the last two years. Several shafts have been sunk, the deepest of which is 526 feet, and drifts on nine levels have been run, the longest of which is 3,700 feet. Some good-sized shipments of doré bullion were made to San Francisco during the year. The lessees continue to improve the 80-stamp panamalgamation milling plant by installation of better crushing machinery, and have added several more large cyanide tanks, which nearly doubles the output of the mill. The Copper Bell mine was compelled to close down for a short time during the year on account of the shortage of coal. The new double-compartment shaft, which is 335 feet deep, is expected to be continued to the 500-foot level, and although the property is equipped with two copper furnaces—one of 350 tons and the other of 70 tons capacity—the ores are more profitably shipped to Graham and Gila counties to be used as flux in smelters where sulphide ores are lacking. The Leadville mine was a regular shipper of copper ore carrying gold.

Warren or Bisbee district.—In order to secure greater economy in the mining and smelting operations, a new organization, to be known as the Superior and Pittsburg Copper Company, absorbed the Calumet and Pittsburg, Lake Superior and Pittsburg, Pittsburg and Duluth, and Junction companies. The new concern is one of the largest copper-mining companies in Arizona and owns 1,388 acres of mineral-bearing ground. The ores are shipped to the Calumet and Arizona smelters at Douglas, Ariz., but it is proposed to erect separate smelters. The most important news in the district is the finding of another new body of high-grade sulphide ore in the Pittsburg and Duluth ground. The strike was made in a drift which is being run from the 1,100-foot level of the Lake Superior and Pittsburg shaft.

The Copper Queen Consolidated Mining Company continues to be the largest shipper of copper ore from this district, and in addition has shipped considerable slag and flue dust from the old smelter site at Bisbee to the smelting plant owned by the company at Douglas

The smelter is being enlarged, and the foundation of the tenth furnace is completed. It is stated to be the purpose of the company to add other furnaces during the next year, and one that will have the capacity of 1,200 tons of ore daily, or as great as that of three furnaces of the size now in commission. The large mixing beds of this company are probably the best arranged of any in the West. The ore is shoveled from the cars, which are run upon tracks parallel to the beds, the required class of ore and the lime being thrown from the cars into the beds by long shovels. After the ore is bedded down and until the matte is passed through the converter everything is handled by machinery. A steam shovel loads the ore from the mixing bed into the cars, and the latter are brought to the furnace by electric power. The tracks run both to the rear and front of the blast furnace, so that the ore is dumped from both sides. The company plans to concentrate all its ore at the new Sacramento shaft at Bisbee, to use a skip, and then by a belt conveyor to distribute to a train of cars the ores from every section of the mine, thereby securing a more perfect smelting mixture than is now obtained.

The Shattuck-Arizona Copper Company is fast taking its place as one of the big producers of the district and is now shipping a little more than half as much as the Calumet and Arizona. The daily output averaged in the neighborhood of 250 tons a day at the close of the year. The shipments of ore are being made to the Copper Queen smelters. The initial work of sinking the main shaft of this mine was only started two years ago in August. The company owns 178 acres of ground, the greater part of which is unexplored. The shaft was completed to the 900-foot level, and the management reports large bodies of ore on the 600, 700, and 800 foot levels, and on the latter level a new sulphide ore body was encountered which is reported as being the richest in the mine. Two raises from the 800 to the 700 foot level are both in bodies of oxide ore, and on the latter level four oxide ore bodies have been opened up. An aerial tramway was put into commission in August and connects the mine with the El Paso and Southwestern Railroad tracks. The management reports having made many additions to the mining plant and changes in equipment during the year. The development work in the mines has not been so great as had been hoped for because of the shortage of fuel. However, more ore was developed during 1906 than has ever been developed during any one year since the ore was first found in the property.

The development work of the Calumet and Arizona Mining Company was mainly confined to the Irish Mag, Senator, and Buckeye claims. New ore bodies were developed on each of these claims, and old ones continued to produce. The amount of development work totaled 14,818 feet for the year. The total number of dry tons of ore smelted was 215,671, with a copper content of 8.95 per cent dry assay. The ore smelted includes 5,490 tons of custom ore purchased for converter lining. Barren quartz was formerly used for the latter, but has been abandoned, and it is found that the siliceous ores carrying precious metals give satisfaction. The company was greatly inconvenienced throughout the year on account of shortage of fuel, the congestion which existed on the Texas railroads making it impossible to purchase sufficient coal to meet requirements. The smelting works of this company at Douglas have had the addition of a fifth furnace, which was completed during the year. This makes it possible to treat 1,200 tons of ore per day from the mines at Bisbee, including the Bonanza Circle group. The smelter uses about 100 tons of lime per day and is getting out almost sufficient copper-bearing lime from the mines to answer all demands.

The published annual report of the Superior and Pittsburg Copper Company gives its total output of refined copper as 9,045,750 pounds, and the value of gold and silver as $21,941.41, averaging $4.85 per ton of refined copper. The ore mined was 110,700 tons; ore smelted, 110,328 tons, which, less its moisture, gave 95,779 dry tons and a recovery of 4.722 per cent of copper. The total number of feet of development work during the year was 40,018.7. The most important ore bodies developed on the company's holdings have been on the west side of the property from the Cole shaft, and through the use of this shaft, on the 1,100-foot level, oxide ore bodies were found on the Jessie Glencairn claim and on the 1,000-foot level of the Sunnyside claim. On the eastern part of the property at Hoatson and Junction shafts the development work has continuously shown bunches and bodies of oxide ore. At the Briggs shaft the No. 20 crosscut due south from the shaft ran through 400 feet of leached and copper-stained ground. The average number of men employed for the year was 799.

The Mountain View Development Company, operating a group of nine claims, has done mainly prospecting work, the ore taken out in development work being shipped.

Yellowstone district.—The La Vantia Mining Company operated the Pierce mine near Benson, on which is located a 5-stamp mill and a concentrator of 15 tons daily capacity. Some bullion was produced, and several tons of concentrates were shipped to the smelter. The property is being developed.

COCONINO COUNTY.

Francis district.—The Highland Mary Mining Company, owning the Highland Mary and the Blue Rose claims, made a small shipment of copper ore.

Grand Canyon district.—The Grand Canyon Copper Company, located near Grand View, shipped copper ore from the old mine dumps. The mine, which has been idle for some time, is being developed and has a shaft 140 feet deep and a tunnel 2,300 feet in length.

GILA COUNTY.

The county ranks fourth in the total value of its metallic production for 1906. According to reports received from 14 deep mines the output of crude ore amounted to 415,471 short tons, valued at $5,628,753. This is an increase of 174,143 tons and of $1,627,707 over the total output of 1905. The total production of metal is as follows: Gold, 2,317.93 ounces, valued at $47,916; silver, 122,098 ounces, valued at $81,806; copper, 28,492,391 pounds, valued at $5,499,031. The total quantities of metals won from the ores show an increase over 1905 in each metal except gold, which is $3,081 less in 1906. Silver increased 37,116 ounces in quantity and $30,477 in value; copper, 3,500,597 pounds in quantity and $1,600,311 in value.

The output of copper in the county is mainly from the Old Dominion, which, since the beginning of its smelter operations, has been obliged to ship in the fluxing ores and mattes, secured primarily for their sulphur content, from Bisbee and Mexico. The quantity of sulphur, however, derived from the ores of Globe is increasing so rapidly that the prospects are that within a short time the district will be independent of imports for its supply. The prediction is made by an operator in the camp that, with ore coming from the Arizona, the Commercial, and other local mines, the coming year will relieve Globe district of the necessity of looking to foreign sources for any ingredients of its furnace mixture.

Globe district.—The Old Dominion Mining Company of Maine, which operates the United Globe and the Old Dominion Mining and Smelting Company of New Jersey, is now engaged in the erection of the fifth unit of its smelter and the additional building of a reverberatory furnace. With these two units in operation, the company expects to maintain a monthly output in the neighborhood of 4,000,000 pounds of copper. One of the large veins under Buffalo Hill has recently been struck in drifting from the Gray shaft of the United Globe mines, and the ore contains, besides copper and sulphur, a notable amount of precious metals. The Continental group of the Old Dominion Company is producing more copper and sulphur than was anticipated, and the lower levels of the Old Dominion mine likewise are producing sulphur ores in quantity. The Globe Consolidated is 370 feet deep in its shaft on the Gem claim. The Mallory mine, operated by the same company, is expected to become a shipper of sulphide copper ores in 1907.

The Proctor mine was operated by lessees during the year and produced in the neighborhood of 80 tons of copper ore. The Keystone mine has developed into a profitable producer. The property is located in the foothills of Pinal Mountains, 6 miles south of Globe. A tunnel 800 feet long has been driven and has opened 5 feet of ore that is reported to be very rich in copper. It is reported that the Live Oak mine, which is opened to a depth of only 150 feet, has produced altogether $400,000 in copper. Exposed in the mine by lessees is one of the largest bodies of siliceous copper ore in the district. Work has been renewed by a new company after considerable litigation to dispossess the lessees. One carload of ore was shipped from the Cox and Coplin mine to the smelter which carried values in silver. The Apache Consolidated Copper Company, operating the Livingston group, shipped a good grade of copper ore which was taken out in development work. The Gibson Copper Company, operating the Summit claim, which is developed by an incline shaft 340 feet deep, also shipped good ore and performed considerable development work on the property during the year. The Black Warrior mine, operated by the Warrior Copper Company, has developed its property by tunnels aggregating 1,200 feet in length and was a regular shipper of good copper ore. The Arizona Commercial Copper Company, operating the Copper Hill and Black Hawk mines, is sinking a shaft on each property, the former being 800 feet deep and the latter 500 feet. Altogether there is approximately a mile of underground openings in the property. The Copper Hill is mining an excellent body of sulphide ore. About 50 tons of this ore are being shipped to the Old Dominion smelter daily, where it is milled and the concentrates are smelted. The Black Hawk shaft is to be continued to the 600-foot level. In the west drift of the fifth level of this mine there has been exposed a good vein of ore. Other producers which shipped mainly copper ores are the Eureka and Pascoe claims. The Globe Standard Company carried on development work on a vein of gold-silver-lead ore by tunnel and shaft, the latter down 83 feet.

Mazatzal district.—The Copper Butte group of claims were productive of a small shipment of ore carrying copper and silver.

San Carlos district.—The Saddle Mountain Mining Company operates a group of claims and has a copper matte smelter of 150 tons capacity at Christmas camp. This camp is located on the Gila River at the southern end of the county. From 200 to 400 men have been employed, and an average of two carloads of copper matte have been shipped per week. Most attention has been given to the production of copper and making preparations for grading a tramroad to connect the mines with the smelter. The company proposes to bridge the river so that the gold and silver ores can be used in connection with the copper smelting.

GRAHAM COUNTY.

The metal output of this county for 1906 was valued at $11,595,345, as reported by 18 operators located in 8 mining regions. As compared with 1905 this is an increase of $3,062,463 and of 9 new producers and 3 new districts. The 18 mines producing may be classed according to their chief product as 1 gold, 1 silver, 2 gold and silver, 13 copper-gold-silver, and 1 gold-silver-copper-lead. The quantity and value of each metal produced are shown in the table following:

Production of gold, silver, and associated metals in Graham County, Ariz., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	2,236	$46,222	2,699.78	$55,809	+ 463.78	+ $9,587
Silver..................do....	57,191	34,543	130,904	87,706	+ 73,713	+ 53,163
Copper............pounds..	53,939,212	8,414,517	59,270,459	11,439,199	+5,331,247	+3,024,682
Lead..................do....	800,000	37,600	221,600	12,631	− 578,400	− 24,969
Total..................	....	8,532,882	....	11,595,345	....	+3,062,463

The production of ores in Graham County, Ariz., increased from 952,509 short tons, valued at $8.96 per ton, in 1905 to 1,259,161 tons, valued at $9.21 per ton, in 1906—a gain of 306,652 tons and of 25 cents in value per ton.

Source of gold and silver in Graham County, Ariz., in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Siliceous ore.	Copper ore.	Copper-lead ore.	Total.
Gold..	1905	3.00	2,136.00	97.00	2,236.00
	1906	409.10	2,237.09	53.59	2,699.78
Silver...	1905	5,024.00	47,167.00	5,000.00	57,191.00
	1906	21,089.00	107,045.00	2,770.00	130,904.00

The total output of ore mined in 1906 was 1,259,161 short tons, of which 13 short tons were treated at gold and silver mills, yielding $124 in gold and 10 ounces in silver. There were treated at concentrating mills 1,058,915 short tons of ore, resulting in 162,960 tons of concentrates containing $34,336 in gold and 65,323 ounces of silver, worth $43,766. Ore treated at smelters amounted to 150,078 short tons, containing $21,349 in gold and 65,571 ounces of silver, worth $43,-932.57. Slag re-treated amounted to 50,155 short tons. The gold and silver values are included in concentrates. According to a subdivision of the kinds of ore milled or smelted in the county, it is shown that of siliceous ore there were 1,864 short tons; copper ore, 1,257,020 short tons; and copper-lead ore, 277 short tons.

Ash Peak district.—The Ash Peak Mining Company, operating the Commercial claims, shipped an ore which was valuable as a lining for copper converters as well as for its silver content.

Clark district.—The Mascot Mining Company operated 9 claims known as the Iron Bell group and 11 claims known as the Morris property and made several shipments of copper ore. The property is located 35 miles west of Safford and is developed by a shaft which has been sunk to a depth of 100 feet.

Copper Mountain and Greenlee districts.—The flood at Clifton about the end of November, which seriously damaged the smelting works of that camp, also contributed to the restriction of the output. The Detroit Copper Mining Company of Arizona, located at Morenci, is remodeling its converting plant. A reverberatory furnace has been running steadily on slag and flue dust, which is mixed with crude oil, and the new enlarged concentrator has been in full operation for several months. It has a capacity of 1,000 tons every 24 hours. The mine is developed by shafts 250 and 275 feet deep, also by tunnels 500 and 4,000 feet long. On Chase Creek the Depee mill operated on a small tonnage of gold ore produced from the Katydid and other claims. The Clifton King was another producer of quite an important quantity of gold ore containing good values, which was shipped to the smelters.

The Arizona Copper Company, at Clifton, in the Greenlee district, is the most important producer in the county. The milling plant is equipped with a new jig which brought the capacity of the plant originally built for 1,000 tons up to 1,450 tons. The 300-ton leaching plant for oxide ores and the smelter were kept in operation during almost the entire year, except during November, when a disastrous flood damaged the smelting works. The company has introduced electrical traction in the mines.

The New England and Clifton Copper Company shipped during the latter part of the year an average of about 40 tons of copper ore per day, said to average better than 10 per cent copper, to the Shannon smelter. The ore is hauled by wagon about 2½ miles to an ore bin and then loaded on tramway cars, which are hauled to a connection with the Arizona Copper Company's railroad.

The Shannon Copper Company took advantage of the high price of copper and better supply of iron sulphide ore from other camps to handle its low-grade ores, of which it treated an immense tonnage. The Standard Copper Company develops its property by shaft 121 feet deep and tunnel 1,045 feet long. The other properties producing in the district are Stevens Copper Company, Standard Consolidated Copper Company, and Clifton Copper Mines (Limited). The New York and Arizona Gold and Copper Company has been organized to develop a group of 25 claims known as the Buzzards Shadow and Lillian group. Some of the claims have been worked years ago by an arastra. The property is to be developed by tunnels which will cut the ore bodies at a good depth.

Lone Star district.—The Gila Valley Copper Company has carried on development work for several years and a concentrating mill of 60 tons' daily capacity was erected during the year. Its mine is developed by six shafts. This property formerly belonged to the Federal Mining Company.

Mayflower district.—A few tons of ore were shipped from the Tipton, Philip, and Frank Morris claims assaying about 25 per cent in copper. The property is undeveloped.

Stanley Butte district.—The Ocean group claims produced a few tons of ore taken from the surface for a test. The property is under bond and it will probably be a producer during 1907. The Tri-Bullion Smelting and Development Company made several shipments of selected ore carrying lead, copper, gold, and silver.

MARICOPA COUNTY.

The railroad under construction by the Santa Fe Railway Company from Wickenburg to Bengal in California is completed to Parker on the Colorado River, in Yuma County. The transportation facilities have afforded many mining companies the chance of putting in more extensive equipment. The mining regions reached by the new line of railway are nearly all in Yuma County but have not become regular producers of ore.

Agua Fria district.—The Relief Gold Mining Company has developed its property to a depth of 500 feet. Numerous faults and breaks have been encountered in the upper levels. Sufficient gold-bearing ore is taken out, averaging $5 per ton, to keep the mill running one shift per day. The mine is being developed and it is expected with a deeper shaft that more water will be encountered for use in the mill. The lack of water has been the great drawback to the continuous operation of the plant.

MOHAVE COUNTY.

Of much importance to the mining industry of the county was the installation of an electrical power plant at Kingman by the interests controlling the Gold Road Mining and Explorations Company. The plant is constructed mainly to supply its mines and milling plant at Gold Roads, 24 miles southwest of Kingman, with electrical power. Another electrical plant is contemplated at Needles, Cal., to furnish mines at Vivian in this county with power, and as well to pump water from the Colorado River for milling purposes. One producer—gas power plant—is reported to be working successfully in the Walapai district. New concentration mills have been constructed on the De la Fontaine and Star Spangled Banner mines at Stockton Hill, and also on the Golden Gem mine, the property of the Golden Star Mining Company 14 miles north of Stockton Hill; and near by the

Cerbat Mountain Mining Company is preparing for the erection of a plant. Through the operations of 27 producers, an increase of 6 reporting over the preceding year, the output of the county amounted to 64,832 short tons of ore, having a total value of $850,841. The gold produced amounted to 31,010.02 ounces, valued at $641,034; silver to 145,179 ounces, valued at $97,270; copper to 315,992 pounds, valued at $60,986; and lead to 904,399 pounds, valued at $51,551. Comparing these figures with those for 1905, the ore increased 12,120 short tons in quantity and $253,316 in value in 1906.

A brief description of properties and their location by districts follows:

Bentley district.—The Grand Gulch Mining Company shipped about 12 cars of ore, some of which was taken from the old dumps. Development work was carried on by a 400-foot shaft. It will be possible to operate the property as long as the price of copper is high, a condition necessitated by the long haul of 65 miles to the railway station at Moapa, Nev.

Buck Mountain district.—The Garnette claim made an important shipment of gold and silver ore to the smelter at Needles, Cal.

Cedar Valley district.—The Yucca Mining Company did mostly development work and only operated the cyanide mill for a short time. The mill is equipped with 10 stamps and concentrators. The shaft on the property is 350 feet deep.

Gold Basin district.—The Minnesota and Arizona Gold Mining Company operated until May. A 10-stamp mill treated the ore by amalgamation and cyanide processes. The mine is developed by a shaft 100 feet deep, and by 2 tunnels 900 and 1,100 feet, respectively. A long tunnel is contemplated to tap the veins in the El Dorado claim at a depth of 600 feet on the incline. Other properties operating and producing are the Gold Belt, Never Got Left, and Jim Blaine mining claims.

Indian Secret district.—The Mohave Gold and Silver Company shipped to the smelter a small quantity of sorted ore taken from the Grant, Cornopia, and Good Luck claims carrying $20 in gold and 300 ounces of silver per ton. The total development work will aggregate 2,115 feet in shafts and 1,100 feet of drifts. There are from 200 to 500 tons of ore on the dumps, at each of the three claims being developed. This ore is ready for the amalgamation mill of about 50 tons daily capacity which will be built sometime during 1907.

San Francisco district.—The Gold Road Mining and Explorations Company, operating the Gold Roads mine and cyanide mill of 160 tons daily capacity, had a very prosperous year, and continues to be the principal producer of gold in the county. The vertical shaft has reached a depth of 700 feet. On the 600-foot level the main ore shoot has been opened up for a length of 750 feet and is 10 feet wide for nearly the whole distance. The company is bettering its present power facilities by the installation of a big electric plant at Kingman.

The German-American Mining Company, owning a group of claims near Vivian, has been a producer of gold and silver for four years. Its property is developed to a considerable extent. The 10-stamp mill, with a 30-ton cyanide plant attached, was in operation a part of the year. Insufficient water was the cause of the decreased production. There is a possibility that sufficient water to supply the whole district will be furnished from the Colorado River by an independent company, and with this prospect the German-American Company is getting its property into shape for a permanent production.

The Arizona Pyramid and Boulevard Mining Company, equipped with a 20-stamp mill, treating ore by amalgamation, concentration, and cyanide, operated part of the year. The mine is developed by a vertical shaft 400 feet deep, and the ores extracted carry gold and silver.

West of the Gold Road camp, the Pasadena Mining Company has been developing in a small way, and its neighbor, the Hilty mine, equipped with a steam hoist and 10-stamp mill, has been idle on account of scarcity of water. The Victor and Virgin mine and mill are being supplied with water from a pipe line, which is being laid from the Colorado River.

Wallapai district.—The Altata mine, which is developed by a 300-foot shaft and a tunnel 350 feet long, produced several hundred tons of ore, which carried copper, gold, and silver. This ore was encountered while cutting a station on the 130-foot level; and it continued downward about 60 feet. At the 200-foot level, the ore was cut into again.

The St. Louis Consolidated group of mines has been worked for the last two years, and shipped during 1906 a large tonnage of silver-lead ore to the Needles smelter. From the Ramrod dump several hundred tons of tailings that were treated by cyanide yielded some gold bullion. The Cerbat Mountain Mining Company, developing the Vanderbilt group, shipped some ore to the smelter. The mine is opened by a 250 foot incline shaft and by a tunnel 280 feet long. The cyanide mill of 30 tons daily capacity will be finished in 1907. The Keystone mine is developed by a shaft 265 feet deep and equipped with a 5-stamp amalgamation mill. The ore produced during the year was shipped to the smelter and yielded mainly silver, with some copper and gold. The Spread Eagle group, near Mineral Park, was developed and produced some ore, which netted the company for its lead, gold, and silver about $2,000. The depth attained in the mine is over 100 feet. The Lucky Boy group shipped several carloads of ore to the smelter. The contents were mainly gold and silver; the mine is developed by a shaft 500 feet deep. A plant is to be put in to handle low-grade ore, which has been encountered on the 200-foot level. The property has produced many thousand dollars' worth of rich silver and gold ore, the silver predominating and averaging as high as $400 per ton. The rich ore near the surface has all been stoped out and shipped to the smelters. The Midnight claim was a producer of some ore taken out in development work, which was shipped to the smelter. An incline shaft has been sunk to a depth of 200 feet in a mass of vein matter in which there are many small streaks of good ore that is of a shipping grade.

The Arizona-Mexican Mining and Smelting Company owns several properties in this district and also operated the smelter at Needles. Its Champion and Star Spangled Banner properties were large producers of lead, gold, and silver. On the Banner mine there is a 35-ton concentration mill equipped with jigs and tables which was kept in operation during the larger part of the year. The mine is developed by a tunnel 1,600 feet long, in which there is a winze 135 feet deep.

The Minnesota-Connor mine, owned by the Philadelphia and Arizona Mining and Milling Company, re-treated at its mill a lot of old tailings and shipped some crude ore to the smelter, which yielded values in gold and silver. The property has been under bond for the last three years to other parties, and the dump and surface workings have been made to produce all the values obtained during that time. The mill, of 150 tons daily capacity, is equipped with roller crushers, jigs, Wilfley tables, and vanners. The shaft on the Minnesota claim has been sunk to a depth of 530 feet, and drifts have been run off on the vein at each hundred feet where big ore bodies were opened up. Since the property was located, about twenty-five years ago, it has produced several hundred thousand dollars.

The Chloride Gold Mining Company made several shipments of ore to the smelters, carrying lead, gold, and silver. The main shaft has reached a depth of 335 feet on the vein, and drifts have been run off on the 200-foot level into the Samoan and Fourth of July ground, a distance of 230 feet. On this level a tunnel has reached the shaft and passes into the mountain several hundred feet beyond the vein. The Samoan vein has an average width of about 4 feet, with pay ore in streaks from 1½ to 3 feet wide. A good wagon road connects the mine with the railroad, but thus far the ore has been packed on burros.

The C. O. D. Mining Company produced from the Little Chief claim at Stockton Hill and shipped to the smelter some ore taken out in development of the property. Other properties producing in the district were the Distaff and the La Cruz claims. The Stockton Hill Mining Company operates the De la Fontaine and Cupel mines, the former being opened to a depth of 400 feet. A new concentrating mill, producing a lead and zinc product, is about ready to go into commission, and as soon as teams have been obtained the work of hauling ore from the mine to the mill will be commenced. The shaft at the mine is being timbered and put in shape to handle ore through the tunnel level. At least a thousand tons are on the dump and will be sent to the mill.

PIMA COUNTY.

The production of the county for 1906 came from 9 districts, in which 16 properties produced. Twelve of these were deep mines and 4 were placers. The total ore output amounted to 64,883 short tons, valued at $1,278,101, which, with the placer yield, amounted to $1,283,954. This total continues to give the county fifth rank among the counties of Arizona in value of its metal production. The gold produced amounted to 977.18 ounces, valued at $20,200; silver, to 87,204 ounces, valued at $58,427; copper, to 6,230,778 pounds, valued at $1,202,540, and lead, to 48,888 pounds, valued at $2,787. A comparison of these figures with those of the preceding year shows that the ore tonnage increased 27,697 tons and the total value of the output, including the placer production, increased $305,690. The gold increased 148.18 ounces and $3,063 in value; silver, 37,841 ounces and $28,612 in value; copper, 276,008 pounds and $273,596 in value, while the lead decreased 1,500 pounds and increased in value $419.

This county contains many richly mineralized mining districts, which have, for more than two hundred years, produced large quantities of gold and silver. In early days, with silver high in value, large fortunes were taken from remote districts in the western and southern portions of the county before the great Tombstone and Bisbee districts in Cochise County were touched. After being so prominent in production in the earlier days, the declining price of silver rendered unprofitable the working of mines for that metal, and until the last few years but little real development work has been carried on. Gold has never been a prominent factor in the mineral output, and not until the demand for copper became so great were mining operations conducted in an extensive manner. The Southern Pacific transcontinental line crosses Pima County, and the southern branch extends south through Santa Cruz County to the Mexican border. From the main line the Arizona Southern Railroad branches off at Red Rock and connects with the Silver Bell mining district. Another branch line to be completed, known as the Twin Buttes Railway, will bring Pima and Papago districts into connection with Tucson.

Amole district.—This district lies about 10 miles northwest of Tucson, and is locally known as the Tucson district. Its ores are of low grade, and contain copper, gold, silver, and lead. Considerable development work continues to be carried on by a number of mining companies.

Ajo district.—This district lies near the western border of the county, and many of its mining properties are often mentioned as being in the Meyer and Growler districts. It is distant about 50 miles from Gila Bend, on the main line of the Southern Pacific. The property known as the Ajo mine was famous for its rich ores of copper and silver more than half a century ago. The remoteness of the camp has greatly hindered development work.

Arivaca district.—This district is one of the very old ones in Arizona and claims the earliest mining operations, which were productive of a large output of silver. It includes the Gija Mountains and a part of the San Luis range, and is distant in a southerly direction by wagon road about 65 miles from Tucson. The Twin Butte Railroad extends to within about 20 miles. Gold and silver ores are produced and deposits of tungsten ore are reported.

Bavoquiviri district.—The southern end of the Bavoquiviri range is included within the district bearing the same name. It is distant by wagon road about 60 miles from Tucson and is likely to be connected with a railroad to the foot of the range should a survey prove it possible. The ores in the district carry gold and silver.

Cababi district.—The Cababi and Comababi ranges are included within the Cababi district, 75 miles west of Tucson by wagon road. Much work was done in the eighties upon several properties within this district and high-grade silver ore was extracted. Several companies are now opening up copper properties in this vicinity, and many of the mining claims are patented.

Empire district.—This district lies southeast of Tucson and centers about the Empire Mountains, a short spur of the Santa Rita range. The shipping point is Pantano, a distance of about 10 miles. The principal mines of the district produce silver, lead, and copper ore.

Greaterville district.—This district has its chief product in placer gold. It lies about 50 miles south of Tucson, and its nearest railroad point is Sonoyta, a station on the Southern Pacific branch, and about

10 miles distant. The production reported by a dealer in placer gold and two operators amounted to 136.64 ounces. A lack of water in the district has been a drawback to large operations. The Santa Rita Water and Mining Company did no work except to keep its several miles of ditches and pipe lines in repair.

Quijotoa district.—The district lies west of the Cababi district and is 70 miles almost directly west of Tucson. As a silver producer it achieved great prominence about twenty years ago and is noted for its dry placer diggings, worked by Indians and Mexicans and producing each year a small amount of gold, which is coarse but mostly embedded in a cement very difficult to handle. Within the district there are copper deposits of some promise. The Imperial Gold Mining Company owns most of the productive placer ground.

Silver Bell district.—Located about 35 miles northwest of Tucson in the Silver Bell mountains, this district has the distinction of having in operation the largest copper-producing mine in Pima County. It is reached by a wagon road from Tucson or by rail connecting with the Arizona Southern Railroad at Red Rock. Copper ores carrying gold and silver predominate and are of a smelting character. A large number of claims in the district are patented. During the past two years there has been great activity in development and production by the Imperial Copper Company, its output being about 100 tons per day of ore carrying 6 per cent copper and $1\frac{1}{2}$ ounces silver. The owners of this property have completed another organization known as the Southern Arizona Smelting Company, having in construction at Sasco, 12 miles from the mines in the Santa Cruz valley on the Arizona Southern Railroad, a 300-ton copper matting and converting plant. These two companies are allied to those owning the Tombstone, Congress, and Poland properties, the latter two being located in Yavapai County. At the Imperial mines development work has been pushed ahead rapidly and the Mammoth shaft, now 660 feet deep, is being sunk still deeper. Developments in a winze 700 feet from the shaft show a large body of sulphide ore at a still greater depth than the shaft. Advantage was taken of the increased price of copper to ship lower grade ore than formerly. A concentrating mill of 300-tons daily capacity will be erected at the mine, as an abundant supply of water has been developed in it. The nominal capacity of the smelter is 300 tons of average ore per day, but it will, it is said, handle more than this amount of the free smelting Imperial ore. Space in the smelter building is provided for the addition of another furnace for custom business. The Oxide Copper Company operated the Copper Prince group of 30 claims, which lie south of the Imperial mine. The shaft is 500 feet deep and a good grade of copper ore carrying gold was shipped during the year.

Helvetia district.—The north end of the Santa Rita Range is included within this district, and is reached from Tucson by wagon road, a distance of 30 miles. The district has the promise of a railroad, which will probably skirt the eastern slope of the Catalina Range and intersect the Southern Pacific Railroad at Tucson. The ores contain copper, lead, silver, and gold.

The Helvetia Copper Company carried on development work in its property by tunnels and shafts, and is equipped with a 150-ton copper furnace. An important ore body was encountered on the 800-foot level in the Isle Royal shaft. The workings are said to be the deepest of any in the county. The copper matte produced at the furnace is hauled to Vails station on the Southern Pacific Railroad, a distance of 14 miles.

The Lincoln Consolidated Mining Company, operating the Garcia group of 13 claims, has been developed by 6 shafts 50 to 120 feet in depth. The property produced some ore during the year which is to be shipped 12 miles by wagon to the Twin Buttes Railroad. The Tip Top Copper Company shipped considerable copper ore and continued to develop its property, which has a total of 4,800 feet of crosscuts and tunnels. The company is working a large force of men and has started to make daily shipments to El Paso. Other properties developing are the Copper Alec and the Cuprite group, both of which made shipments of ore.

Pima district.—The San Xavier region and Olive Camp are embraced within this district, which is located 18 miles southwest of Tucson. The line of the Twin Buttes Railroad extends into this district, its terminus being at the property of the Twin Buttes Mining and Smelting Company. The ores contain copper principally, and in addition silver and lead. The South San Xavier Copper Company commenced shipping ore the latter part of the year.

The Mineral Hill Consolidated Copper Company shipped ore during part of 1906. The Mineral Hill Copper and Gold Company owns the Hughes, Costello, and Esperanza groups, and shipped 3,500 tons of copper ore carrying silver and gold. The Senator Morgan mine operated by the Twin Buttes Mining and Smelting Company is developed by two vertical shafts, one 155 feet, the other 135 feet, with levels, crosscuts, winzes, and drifts. The ore carries principally copper with silver values. Important shipments were also made by the Paymaster Mining Company.

The Calumet and Arizona Company has three diamond drills in operation in the district on groups of mines recently bonded. The result of their work has not been made public.

PINAL COUNTY.

The deep mines reporting production for 1906 numbered 9, a decrease of one deep mine as compared with 1905. Placer gold was reported from one property. The total ore output amounted to 2,552 short tons, valued at $42,810, in which value the small placer production is included. The gold produced amounted to 642.60 ounces, valued at $13,284; silver, 2,917 ounces, valued at $1,954, and copper, 142,859 pounds, valued at $27,572. A comparison of the figures of 1906 with those of 1905 shows that the ore decreased 9,413 tons in quantity and $93,116 in value. This decrease is largely accounted for by the transfer of figures for the 1906 production of the Saddle Mountain Mining Company from Pinal to Gila County, where the largest part of its production originates. No lead was reported. The county should have a larger production as soon as the gold and silver properties of the Saddle Mountain Company are operated, and a railroad is completed to the Pioneer district, where the Lake Superior and Arizona Mining Company's properties are located. The Mineral Creek district also promises production. The placer production will also increase the total to some extent.

Casa Grande district.—The Desert Queen Mining Company has found difficulty in operating its property, an old and important mine, with the present equipment of a 2-stamp plate-amalgamation mill, followed by cyanide treatment for the tailings. The mining is by shallow shafts and open cuts.

The Bonanza Reef mines have been taken over by the Arizona Mercantile Transportation and Smelting Company. The property has a 700-foot vertical shaft and a tunnel 216 feet long. It is well developed above the 500-foot level. There is also a 20-stamp mill with cyanide plant having a capacity of 50 tons of ore per day. Other equipment consists of a silver-lead smelter and a 50-ton copper furnace. Only test lots of ore were treated during the year.

Mineral Creek district.—The Big Lead Mining and Smelting Company started its mill at Ray early in December and has been operating steadily since that time. Concentrates turned out at this plant are high grade, carrying about 35 per cent copper with considerable gold and silver. This product is being held at the property.

Pioneer district.—The Lake Superior and Arizona Mining and Smelting Company operated the Golden Eagle group in a small way, shipping a few carloads of copper ore which carried some gold and silver. The property is opened by an incline shaft 612 feet deep and by tunnels 3,328 feet long. There are two veins under development occurring at contact between quartzite and limestone. The ores are mainly siliceous oxides and carbonates, associated with iron and manganese. From the Eureka property in this district there were shipped several carloads of high-grade copper ore. A depth of 158 feet has been reached, and a crosscut is said to reveal an ore shoot 7 feet wide, with a 2-foot streak of 7 per cent copper ore. The American Copper Company is operating the Coughlan Mine. The development work consists of a 140-foot tunnel, which is connected with a shaft. A trial shipment was made during the year. Good ore has been found in the old shaft of the Queen Mining Company's property, which adjoins the Golden Eagle group. This shaft was put down to develop the property for silver, and has recently been reopened to the 300 and 400 foot levels. On the latter level high-grade carbonate ore is reported to occur.

Riverside district.—The old Bryan mine, which is included in the Riverside group, shipped several carloads of copper sulphide ore, and development work of several hundred feet was performed on the property. The ore is said to average 5 feet in width, and assays 12 per cent of copper and 28 per cent of iron. The Gold Coin Mining Company, operating a group of the same name, milled 25 tons of ore, from which was recovered about $800 in gold. This property is located north of Troy and 7 miles from the railroad. The Troy-Manhattan Copper Company, owning the Manhattan mine, shipped some ore containing copper during the year. The property is developed by a vertical shaft 146 feet in depth, by an incline shaft 400 feet deep, and by 2,000 feet of drifts and tunnels.

Old Hat district.—The Mandina, Guadeloupa, and Colonel Bill properties, near the Southern Bell mine, in this district, produced a little ore. There is on the properties a 3-stamp mill, which is equipped with 2 Wilfley tables.

Saddle Mountain district.—The property of the Saddle Mountain Mining Company is located across the Gila River from its copper mines and smelter, in Gila County, and comprises fifteen claims of gold and silver deposits on Saddle Mountain, in Pinal County. The claims are developed by some 4,000 feet of underground work, and are said to be in condition to produce 30 or more tons per day of ore carrying about 15 ounces in silver and $2.50 in gold per ton. The company has done no great amount of work on the claims for the last two years, owing to almost continuous high water in the river, but has paid special attention to its copper properties in Gila County. A bridge and tramroad are contemplated to connect the gold and silver properties with the smelter, so that the ore can be used in connection with the copper smelting.

SANTA CRUZ COUNTY.

The activity of the Mowry Mines Company in the completion of a lead smelter of 100 tons daily capacity and the reopening of a number of old mines in 1905, made the mining prospects of this county look very bright for the future. During 1906 a consolidation was effected whereby the Santa Cruz Mining and Smelting Company took over the Mowry lead mines in the Patagonia district and the Alto copper mines in the Santa Rita range. Both properties have been working at great disadvantage because of the cost of $5 per ton for fuel, resulting from a wagon haul of 14 miles to the Southern Pacific Railroad. It is announced that a smelting plant of 750 tons capacity will be built by the company on the Santa Cruz River and that a railroad will connect mines and smelter.

There were five producers reporting production for the year 1906. The total ore output amounted to 122,049 short tons, valued at $127,946. The gold produced amounted to 18.68 ounces, valued at $386; silver, 62,459 ounces, valued at $41,848; copper, 10,382 pounds, valued at $2,004; and lead, 1,468,556 pounds, valued at $83,708. Comparison of the figures for 1906 with those for 1905 shows the ore tonnage to have increased 120,541 short tons in quantity and $63,938 in value.

Aztec district.—This district, bounded by the Tyndall district on the west and the Wrightson district on the north, is reached by a wagon road from Patagonia, a distance of about 5 miles. The Ivanhoe Mining Company owns a number of claims in the district containing silver and copper ores.

Harshaw district.—This district lies on the east side of the Patagonia range. An excellent wagon road follows the line of division between this and the Patagonia district and gives access to all properties at a distance of from 3 to 25 miles. It is probable that a line of railroad will shortly put this district in direct railroad connection with the Southern Pacific branch line, the junction point being the town of Patagonia. The camps of Harshaw, Mowry, Duquesne, Washington, and Lochiel are within the boundaries of the Harshaw district. The most important mining corporation operating is the Santa Cruz Mining and Smelting Company, which was recently organized and took over the Mowry mines and smelter. The plant consists of a concentrator and a lead smelter. Another important organization is the Patagonia Mining Company, owning the Hardshell and Flux group of claims. The character of the ore is silver-lead, carrying some gold. It is reported that about 50,000 tons of ore have been shipped from these properties in the past. Only development work was done in 1906. The World's Fair group produced ore during the year, as it has done during the last sixteen years.

The greatest depth opened on the property is 600 feet. Its location is about 13 miles south of Patagonia. The ore contains silver, lead, copper, and gold.

Oro Blanco district.—The district embraces the whole of the mountain range bearing the same name, as well as a part of the Tumacacori Range. The Mexican border line forms the southern line of this the largest mining district in the county. Nogales, 40 miles east, is the nearest railroad point, but by reason of more favorable grades the bulk of the hauling is to Tucson, 70 miles to the north. The extension of the Twin Buttes Railroad and the building of the projected north and south road to the Gulf of California will bring the most distant parts of this district within not more than 10 or 15 miles from a railroad.

Patagonia district.—The west side of the Patagonia Range is included within this mining district, and a number of mines are being operated. Access is had both by Patagonia and from Nogales, many of the camps being reached more directly from the latter point, distant from 10 to 20 miles. The district is bordered on the east by the Harshaw-district, which was mentioned in a former report as part of the Patagonia district. There are a number of mining claims situated within its boundaries that are, according to a new division of the districts, located on the Harshaw side of the range.

The Four Metals Mining Company, with properties located on the east side of the Patagonia Mountains, made a small shipment of ore carrying copper, gold, and silver. The company is prospecting the Gross group, from which the shipment was made. The National Consolidated Mining Company, with property located about 12 miles in a northerly direction from Nogales on the west side of the Patagonia Mountains, is developing a large group of claims. The ore shipped during the year carried lead, copper, gold, and silver.

Wrightson district.—The Happy Jack Mining Company, operating the Mountain View claims, made an important strike during the year and shipped ore rich in lead, with copper, gold, and silver. The property has a vertical shaft 200 feet deep and a tunnel 950 feet long.

YAVAPAI COUNTY.

This county continues to hold third place in the aggregate value of its mineral production, which amounted in 1906 to $9,894,458, of which $1,256,623 was in gold and 708,439 ounces, valued at $474,654, were in silver. This was reported by 39 deep-mine producers and buyers of placer gold in 7 localities. The tonnage amounted to 396,788 short tons, of which there were treated at gold and silver mills 3,456 short tons. From this were extracted $323,848 in gold, and 10,824 ounces of silver, valued at $7,252. From 97,758 short tons of ore there resulted 7,688 short tons of concentrates, containing, besides other values, gold, $260,807, and silver, 69,492 ounces, valued at $46,559.64. Crude ore shipped to smelters amounted to 295,574 short tons, containing in gold $654,199, and in silver, 628,004 ounces, valued at $420,762.68. The placer yield was $17,769 in gold, and 119 ounces of silver, worth $80. Of the 65 milling plants in the county, 18 were in operation, and of the 6 smelting plants 2 were in commission. The aggregate daily capacity of the reduction plants in Yavapai County is estimated to be over 6,500 tons, about equally divided between mills and smelters. In 1906 only 1,087 tons, counting three hundred and sixty-five days in the year, were handled daily, and of that quantity about two-thirds were treated in smelters. The United Verde Copper smelter, at Jerome, has a larger capacity than any other plant in this county, but the Arizona Smelting Company's plant, at Humboldt, with its new additions, will almost equal it. The Cleopatra Copper Company, near Jerome, recently completed a 50-ton copper matting plant. The matte product will either be bessemerized at the Verde works or shipped out of the Territory. Among the milling plants operations are generally wet concentration, usually preceded by amalgamation, and in a few instances followed by cyanidation. The placer mines in the southern part of the county, at Rich Hill and in other localities, produced less than in 1905. The table following shows that the copper and lead output increased as well as the tonnage of ore mined.

Production of gold, silver, and associated metals in Yavapai County, Ariz., in 1905 and 1906

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.............fine ounces..	67,293	$1,391,070	60,789.11	$1,256,623	− 6,503.89	− $134,447
Silver..................do....	786,707	475,171	708,439	474,654	− 78,268	− 517
Copper...............pounds..	34,279,734	5,347,638	42,080,740	8,121,583	+7,801,006	+ 2,773,945
Lead....................do....	697,806	32,797	729,787	41,598	+ 31,981	+ 8,801
Zinc.....................do....	140,000	8,260	....	....	− 140,000	− 8,260
Total.................	....	7,254,936	....	9,894,458	....	+ 2,639,522

The production of ores in Yavapai County, Ariz., increased from 364,697 short tons, valued at $19.83 per ton, in 1905, to 396,788 short tons, valued at $24.89 per ton, in 1906, a gain of 32,091 tons and of $5.06 in value per ton.

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., in 1905 and 1906, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold...............	1905	1,287.00	21,650.00	40,884.00	2,755.00	....	717.00	67,293.00
	1906	859.54	15,355.00	39,326.75	5,247.82	....	....	60,789.11
Silver.............	1905	156.00	37,189.00	707,898.00	34,780.00	6,684.00	....	786,707.00
	1906	119.00	24,316.00	654,108.00	29,896.00	....	....	708,439.00

The producing properties, located by districts, are briefly described in the following paragraphs:

Agua Fria district.—The Carrol Gold and Copper Company, operating the Carlton group, took out a number of tons of ore during development work. There are four claims in the group, covering several large and well defined veins, carrying values in gold, silver, and copper. An incline shaft has been sunk to a depth of 240 feet about 20 feet below water level and is reported to have passed through ore bodies of considerable extent. The flow was too strong to handle with buckets and sinking was temporarily stopped.

Big Bug district.—The Arizona Blue Bell Copper Company, operating the Blue Bell mine, was transferred during the year to the

Arizona Exploration Company. This company is composed principally of stockholders of the Arizona Smelting Company, owners of the smelting plant at Humboldt. The Blue Bell mine is situated about 4 miles south of Mayer, and is connected with the Bradshaw Mountain Railroad by an aerial tramway at a station, north of Cedar Canyon, a short distance south of Mayer. All machinery at the mine is run by electricity, furnished by a transmission line 10 miles in length, running from the smelting works to the plant at the mine. The mine is developed by a shaft 300 feet deep, and the ore shipped during the year carried mainly copper with gold and silver. The George A. Treadwell Mining Company, with headquarters at Mayer, operated the Boggs, Hackberry, and Iron Queen groups, all producers during the year.

The Ideal Mining and Development Company operated the Gladstone and McCabe mines at McCabe, having a 1,000-foot incline shaft on the Gladstone and a vertical shaft 900 feet deep on the McCabe mine. These properties were large producers of ore, carrying copper, silver, and gold, which was shipped to the smelter at Humboldt.

The American Copper and Gold Company renewed operations on the Iron King mine and produced a considerable tonnage of ore containing mainly copper, with some silver and gold, which was shipped to the Humboldt smelter. The property embraces 20 patented claims at the town of Blanchard near Humboldt. The mines are opened by 5 shafts, ranging in depth from 200 to 500 feet, and by 3,000 feet of laterals exposing large bodies of copper-bearing iron sulphides, siliceous copper ores, and dry silica ores. Work was discontinued about one year ago. The concentrating mill located on the property was not operated.

The Jessie Mines Company resumed operations in sinking a double compartment shaft, which is now 659 feet deep, and will be continued to the 1,000-foot station. The ore shipped during the year carried gold and silver values.

The Poland Mining Company, with property at the head of Big Bug Creek and situated about 14 miles southeast of Prescott, was operated the entire year and employed about 120 men in mining and milling. The mine is opened by a tunnel, which is 8,071 feet long and has cut several veins. The mill is equipped with 20 stamps, amalgamation plates, and concentrating tables. The greatest value of the ore is in lead, with important amounts of gold and silver.

The Lelan mine, which is developed by a shaft 500 feet deep and several drifts aggregating 1,500 feet, is equipped with a 10-stamp mill for amalgamation and concentration. Development work was carried on in the mine, although the mill was run only about 40 days from lack of water. A new pumping plant and increased mill capacity are planned. The values in the ore are mainly gold and silver. Other producers are the Triangle Mining Company and the Red Rock mining claims.

The Redman Mining, Milling and Smelting Company, with properties located about 2 miles west of the Humboldt smelter, has been developing the property with good results. The vein is the inner of 3 parallel veins which follow a porphyry dike 135 feet in width, and has been opened by a shaft 75 feet in depth, showing a pay streak about 2½ feet in thickness said to sample $24.65 in copper and gold.

The Storm Cloud group of claims is traversed by the same network of veins as that tapped by the Senator tunnel. The group covers 2 parallel veins, about 100 feet apart, one of which has a large quantity of surface iron croppings. A body of ore, over 3½ feet in thickness and reported to carry values high in copper with some gold and silver, was recently uncovered in this latter vein.

Eight patented claims, constituting the Crook group of the Nassau Mining Company, cover 3 parallel ledges, known as the Crook, Premium, and Evergreen veins. The Crook has a record of producing $250,000, and follows a granite and porphyry contact. Development work is carried on in a crosscut tunnel, 1,500 feet long, which taps the vein at a depth of 300 feet at its face.

Black Canyon district.—This district embraces an area 20 miles long and 15 miles wide adjoining Big Bug district on the south and Peck district on the east. The Richinbar Mines Company, operating the Golden Oak and Compromise claims, had the misfortune in April to lose by fire its power house, which is being rebuilt and will be completed in the spring of next year. The Golden Oak property has over 3,000 feet of development work, and has been prospected to a depth of 500 feet. It is said this development work has blocked out a large body of ore averaging $15 per ton in gold and silver. A 10-stamp mill, equipped for amalgamation, concentration, and cyaniding, is run by electricity generated by water power from the Agua Fria River.

The Parker group, which is equipped with an amalgamation and concentration mill of from 15 to 25 tons daily capacity, treated a number of tons of ore carrying gold and silver. It is found that the tailings carry a large percentage of the values and a small cyanide plant will be added to the mill.

Black Hills district.—The Black Mountain Copper Company has opened its property by several shafts, the deepest of which is 140 feet. The ore shipped to the smelter during the year carried mainly copper. After the installation of a new hoist and mill the property is expected to become a regular producer.

The Yaeger Canyon Copper Company operates the Queen Bee mine. The ore, which carries mainly copper, is treated in a 50-ton concentrating plant, and is equipped with rollers and Wilfley & Bartlett tables. The mine is developed to a depth of 800 feet.

Black Rock district.—The Oro Grande Mines Company operated on low-grade ores its 10-stamp mill, equipped for amalgamation only. The plant was in operation only part of the year. The deepest shaft on the property is 340 feet.

Copper Basin district.—Important operations were carried on by the Commercial Mining Company, known as the Copper Basin group. Copper ore was shipped to the Arizona Smelting Company. The Logan claim was another producer of the district.

Eureka district.—The nearest railroad station to the Eureka district is Hillside, on the Santa Fe branch. It is believed that a railroad will be built into the district during the coming year. The Hillside claim is developed by drifts on 2 levels with short crosscuts to each. The work will aggregate about 11,000 linear feet. A 5-stamp concentrating mill was kept in operation part of the year, and a number of tons of rich concentrates carrying gold and silver were shipped to the smelter. The American Mines and Exploration Company and the Giroux syndicate have been installing machinery on several properties acquired, but nothing is known of the result of operations for the year. The Neiman property was a producer of a little ore. A shaft has been sunk 50 feet with a drift 80 feet long.

Hassayampa district.—The Mount Union Consolidated Mining Company's property has been developed by over 5,000 feet of underground work, which includes a shaft 622 feet in depth, with levels at every 100 feet. The holdings comprise 19 claims. The mill is equipped with two 5-foot Huntington and 6 concentrating tables. Lead concentrates carrying gold and silver were shipped to the smelter. The Dunkirk group of 10 claims has passed into the possession of the Mount Tritle Copper Company. The Dunkirk mine has a record of producing rich gold and silver ore. Development work consists of tunnels 160 feet and 300 feet in length and a shaft 50 feet deep. The Commerical Mining Company is operating the property known as the Senator group, which is being developed by a tunnel to tap a series of 5 parallel veins traversing Senator Mountain. This tunnel has been driven over 3,000 feet, tapping the veins of the Cashier and Ten Spot mines at depths ranging from 500 to 700 feet.

The Climax Mining Company has development work consisting of 5 tunnels. A 10-stamp mill, equipped with amalgamation and concentrating tables, was operated on a small quantity of ore taken out in development work during the year and produced some gold and silver. The Independence group of claims was equipped with a mill and cyanide plant during the year. The tunnel is 300 feet long, with a winze 70 feet in depth. A small amount of ore was treated in the mill before the close of the year.

Martinez district.—The Congress Consolidated Mines Company (Limited) is developed by 5 incline shafts from 2,050 to 4,000 feet deep, with an aggregate of 15 miles of drifts, etc. The mining plant comprises 12 hoisting engines, ranging in size from 10 to 200 horsepower. The milling plant comprises the original 40-stamp mill (Mill No. 1) and an almost new 40-stamp mill (Mill No. 2). The cyanide plant consists of a roasting furnace and seven 90-ton leaching tanks, also three 200-ton leaching tanks for treating the coarsest sands, which require roasting. The company has the distinction of having the deepest shaft in the Territory.

Peck district.—The De Soto Mining Company develops its property by a tunnel which is 2,700 feet in length. Its ore was shipped to Humboldt and there concentrated, and the concentrates were smelted at the plant of the Arizona Smelting Company, an allied corporation. The ore contains mainly copper, with low values in gold and silver. The Hora B. group produced a small shipment of silver ore during development work, which is carried on by vertical shaft 280 feet deep, with a tunnel 500 feet long. Ore from the Golden Bell and Thiesing group of claims was treated in a 2-stamp mill on the property. The ore of the Golden Bell contains mainly gold, while the Thiesing contains lead, gold, and silver. At the Lincoln mine several thousand tons of ore were treated, and concentrates were shipped that carry good values in gold.

Squaw Creek district.—The White Horse Mining Company recently purchased the Fuller group of claims and has continued development work. The shaft on the property is 127 feet in depth and will tap the vein at a depth of 188 feet. The pay streak in the tunnel is reported to be 5 feet in width. The mill was operated for testing purposes a short time during the year.

Tiger district.—There was more activity in the mines in this district this year than ever before. Crown King, the terminus of the Bradshaw Mountain Railway, is the distributing point for at least twenty different mining companies.

The Tiger Gold Company successfully operated its 20-stamp mill equipped for amalgamation and concentration, and turned out considerable bullion and concentrates. The mine is opened by eight tunnels from 200 to 1,700 feet in length and by a double compartment shaft 300 feet deep.

The litigation carried on against the Crown King Mining Company by stockholders was terminated during the year. Before this litigation the Crown King produced in all over $1,500,000, some of the ore being of very high grade. During 1903 the present company equipped the property with a new concentration plant to treat the tailing dump, said to contain 60,000 tons, with values in gold, silver, copper, and zinc. After considerable experimental work there was produced a copper-iron concentrate reported to assay, gold, 1.02 ounces per ton; silver, 10 ounces per ton; copper, 2.9 per cent, and a zinc product assaying, zinc, 28 per cent; gold, 0.96 ounce; silver, 9 ounces, and copper, 3.5 per cent.

The Gazelle and Castle Rock Mining companies are both installing steam hoists on shafts that are stated to have exposed a good grade of gold ore. These two companies are located about 1 mile below Harrington.

Turkey Creek district.—The Hidden Treasure mill at Cordes operated on ore from the Golden Fleece claim located near Turkey.

Walker district.—The Saint Anthony Mining and Milling Company is developed by a shaft 150 feet deep, with drifts aggregating 300 feet. The ore shipped during the year carried silver and gold. This property is within a short distance of the Lynx Creek mouth of the Poland tunnel. Some ore was treated at the Pine Mountain mill during the year from the Pine Mountain claim.

Weaver district.—The Rincon Mines Company operate the Welcome mine, which is developed by an incline shaft 1,056 feet deep. The mill on the property was kept in operation the greater part of the year and produced concentrates carrying lead, gold, and silver. Work was renewed on the Octave mine for six months, but there was no production. The work consisted of unwatering the mine and sinking the main shaft from 1,650 to 2,000 feet. It was found advisable to discontinue work preparatory to installing a heavier sinking plant, which will be capable of operating to a depth of 3,000 feet.

Verde district.—The fire zone in the United Verde Copper Company's mine has been worked successfully on the 300-foot level, and the management is now engaged in opening a stope on the 400-foot level. During the year many improvements have been made, chief among which are the installing of a large air compressor, the doubling of the capacity of the smelter, and the building of an additional furnace. Improvements have been outlined that will cost over a million dollars. These include the running of a 7,000-foot tunnel into the mine, which will tap the vein at a depth of 1,000 feet, which is 100 feet deeper than the present workings; also the probable removal of the smelter to the mouth of the new tunnel when it is completed. It is estimated that it will take two and a half years to complete the tunnel.

The Pittsburg Jerome Company has its shaft down 400 feet. As depth was obtained more or less copper stain and some pay rock was encountered at a number of points. The company reports having passed through 12 feet of pay sulphide ore.

YUMA COUNTY.

The completion of the Arizona and California Railway, a branch of the Santa Fe, in the northern part of the county, running from Wickenburg, in Maricopa County, to Parker, on the Colorado River, in Yuma County, is the principal event of interest for the year. Reports of production were received from purchasers and producers of placer gold in four localities. The total ore output in 1906 was 61,775 short tons, valued at $299,060, reported by six deep mines in four districts. This is a decrease of 874 short tons and of $6,694 in value as compared with 1905. The gold produced amounted to 14,282.92 ounces, valued at $295,254; silver, 9,553 ounces, valued at $6,401; copper, 19,881 pounds, valued at $3,837; and lead, 140,900 pounds, valued at $8,031. The gold increased 388.92 ounces and $8,039 in value; silver decreased 2,180 ounces and $686 in value; copper increased 19,531 pounds and $3,782 in value, and lead decreased 119,230 pounds and $4,195 in value.

Castle Dome district.—The Castle Dome mines, operated by the Dome Exploration Company, is 50 miles northeast of Yuma and 20 miles from the Colorado River. The main shaft is 250 feet deep, and there are about 160 feet of crosscuts and 375 feet of drifts. The ore shipped carries mainly lead, with some silver. The La Colorado property also produced some lead ore.

Ellsworth district.—The Socorro Gold Company, which was a gold producer in 1906, has carried on exploratory work for the last two years. The ores became of lower grade at 600 feet in depth. The property is equipped with a 20-stamp amalgamation and cyanide mill.

The Harquahala Mining Company, operating the old Bonanza and Golden Eagle properties, commenced development work and overhauled the old 40-stamp mill and cyanide plant. At the close of the year material for a 5,000-foot aerial tramway was delivered at the property to connect the Golden Eagle shaft with the mill. The company secures its water supply from near Harrisburg, about 8 miles distant, pumping it to the top of the mountain through a 4-inch pipe line connected with a large storage reservoir, from which it runs to the mine by gravity. The Emerald claim made one shipment of copper ore carrying gold.

Kofa district.—The principal producing property of this district is that of the King of Arizona Mining Company. It is reported that the 1,000-foot shaft and crosscuts expose a wide body of pay ore. A roll mill of 200 tons daily capacity and a cyanide equipment are kept in constant operation, producing gold and silver bullion. One hundred and twenty-five men are employed.

Plomosa district.—From the Iron Queen and Copper Prince claims some copper ore carrying silver was shipped. The same producers took out a small amount of placer gold from claims in the same district.

CALIFORNIA.

By Charles G. Yale.

PRODUCTION.

California produced in 1906, according to returns from the mines, 906,182.36 fine ounces of gold, valued at $18,732,452, a decrease from 1905 of $166,093. In silver the production was 1,220,641 fine ounces, equivalent to $817,830, an increase for the year of $167,821. The most marked increase was in the copper, the gain in which for 1906 was over 12,000,000 pounds in quantity and $2,939,388 in value as compared with the output of 1905. The lead shows a slight falling off, and zinc appears for the first time in the statistical tables of California. The comparative table of output for the last two years is as follows:

Production of gold, silver, and associated metals in California in 1905 and 1906.

	1905.		1906.		Increase(+) Decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold...........fine ounces..	914,217.14	$18,898,545	906,182.36	$18,732,452	− 8,034.78	− $166,093
Silver................do....	1,076,174	650,009	1,220,641	817,830	+ 144,467	+ 167,821
Copper............pounds..	16,697,544	2,604,816	28,726,448	5,544,204	+12,028,904	+2,939,388
Lead.................do....	447,723	21,043	338,718	19,307	− 109,005	− 1,736
Zinc..................do....	....	....	206,000	12,566	+ 206,000	+ 12,566
Total................	....	22,174,413	....	25,126,359	....	+2,951,946

The distribution of the output of these metals in 1906, by counties, is shown in the following table:

Production of gold, silver, and associated metals in California in 1906, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Amador................	109,345.69	$2,260,376	21,760	$14,579	8,648	$1,669
Butte..................	145,935.14	3,016,747	16,199	10,853	....	....
Calaveras..............	79,539.82	1,644,234	110,597	74,099	5,082,320	980,888
Del Norte..............	287.59	5,945	51	34	....	....
Eldorado...............	20,885.71	431,746	4,015	2,690	....	....
Fresno.................	410.85	8,493	124	83	440,000	84,920
Humboldt...............	2,336.27	48,295	355	238	....	....
Inyo...................	940.84	19,449	19,937	13,358	4,145	800
Kern...................	38,995.91	806,117	193,288	129,503	....	....
Lassen and Los Angeles	4,766.20	98,526	1,934	1,296	....	....
Madera.................	1,083.11	22,390	758	508	....	....
Mariposa...............	17,724.31	366,394	5,040	3,377	....	....
Mendocino..............	.92	19	....	....	....	....
Monterey...............	30.23	625	4	3	....	....
Mono...................	16,384.52	338,698	19,628	13,151	....	....
Nevada.................	128,601.07	2,658,420	36,147	24,219	....	....
Orange and Placer......	27,762.71	573,906	49,753	33,334	200,000	38,600
Plumas.................	11,094.80	229,350	1,575	1,055	....	....
Riverside..............	214.40	4,432	360	241	....	....
Sacramento.............	47,727.94	986,624	5,433	3,640	....	....
San Bernardino.........	17,164.90	354,830	50,396	33,765	514,031	99,207
San Diego and San Luis Obispo..............	840.75	17,380	955	641	....	....
Santa Barbara..........	12.09	250	3	2	....	....
Shasta.................	39,626.09	819,144	648,482	434,483	22,477,304	4,338,121
Sierra.................	19,803.08	409,366	3,759	2,518	....	....
Siskiyou and Stanislaus	35,717.20	738,340	8,102	5,429	....	....
Trinity................	27,130.78	560,843	4,465	2,991	....	....
Tulare.................	.97	20	....	....	....	....
Tuolumne and Ventura.	50,294.28	1,039,675	12,651	8,476	....	....
Yuba...................	61,524.19	1,271,818	4,870	3,263	....	....
Total..............	906,182.36	18,732,452	1,220,641	817,830	28,726,448	5,544,205

Production of gold, silver, and associated metals in California in 1906, by counties—Con.

County.	Lead.		Zinc.		Grand total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Amador					$2,276,624
Butte					3,027,600
Calaveras					2,699,221
Del Norte					5,979
Eldorado					434,436
Fresno					93,496
Humboldt					48,533
Inyo	208,018	$11,857			45,464
Kern					935,620
Lassen and Los Angeles					99,822
Madera					22,898
Mariposa					369,771
Mendocino					19
Monterey					628
Mono					351,849
Nevada					2,682,639
Orange and Placer	100,000	5,700	206,000	$12,566	664,106
Plumas					230,405
Riverside					4,673
Sacramento					990,264
San Bernardino	30,700	1,750			489,552
San Diego and San Luis Obispo					18,021
Santa Barbara					252
Shasta					5,591,748
Sierra					411,884
Siskiyou and Stanislaus					743,769
Trinity					563,834
Tulare					20
Tuolumne					1,048,151
Ventura and Yuba					1,275,081
Total	338,718	19,307	206,000	12,566	25,126,360

The total tonnage of ore for the year is 2,556,053, which is 140,550 tons less than in 1905, although there was an increase in tonnage and value of concentrates, as the following table shows:

Tonnage and value of ore, concentrates, and old tailings in California in 1906, by counties, in short tons.

County.	Total ore sold or treated.	Increase or decrease compared with 1905.	Concentrates.		Old tailings treated.	
			Quantity.	Value.	Quantity.	Value.
Alpine		− 1				
Amador	579,599	− 70,094	11,281	$850,214		
Butte	682	− 376				
Calaveras	583,207	+ 35,235	10,039	473,295		
Del Norte	1,000	+ 1,000	50	2,012		
Eldorado	31,818	− 4,890	1,265	50,865		
Fresno	4,555	− 7,970				
Inyo	3,401	− 5,506	10	840		
Kern	146,076	−106,700	1	407		
Lassen and Los Angeles	17,692	− 9,411				
Madera	6,490	+ 1,110	47	1,165		
Mariposa	64,511	− 23,805	519	40,576		
Monterey and Modoc	13	+ 10				
Mono	28,599	+ 5,155	100	184,875	650	$4,660
Nevada	276,602	− 48,664	4,912	284,759		
Orange and Placer	22,832	− 1,107	430	31,376		
Plumas	21,040	− 10,415				
Riverside	124	− 629				
San Bernardino	37,271	+ 3,232				
San Diego	1,110	− 8,540				
Shasta	327,482	+113,446	152	13,091		
Sierra	75,545	+ 57,167	67	11,865	1,500	2,775
Siskiyou and Stanislaus	37,261	− 1,425	340	16,207		
Trinity	9,261	− 31,207	300	1,070		
Tulare	2	− 498				
Tuolumne	278,618	− 25,013	7,820	347,959		
Ventura	110	+ 110				
Yuba	1,152	− 764				
Total	2,556,053	−140,550	37,333	2,310,576	2,150	7,435
Increase (+) or decrease (−)			+8,914	+526,600	−8,512	−74,283

In the subdivision of tonnage into classes, the siliceous ores and lead ores show a reduction in quantity, but both copper and zinc ores increased. The average value of the 2,235,912 tons of siliceous ore treated was $5.05 per ton, which is $0.01 lower than in 1905, and the quantity was smaller. The following table shows these facts in detail:

Tonnage of ore sold or treated in California in 1906, by counties, in short tons.

County.	Siliceous ores.	Copper ores.	Lead ores.	Zinc-lead ores.	Total ore.
Amador	579,599				579,599
Butte	682				682
Calaveras	538,566	44,641			583,207
Del Norte	1,000				1,000
Eldorado	31,818				31,818
Fresno	555	4,000			4,555
Inyo	1,980	40	1,381		3,401
Kern	146,076				146,076
Lassen and Los Angeles	17,692				17,692
Madera	6,490				6,490
Mariposa	64,511				64,511
Monterey	13				13
Mono	28,599				28,599
Nevada	276,602				276,602
Orange and Placer	18,585	4,000		250	22,835
Plumas	21,040				21,040
Riverside	124				124
San Bernardino	33,830	3,141	300		37,271
San Diego	1,110				1,110
Shasta	65,094	262,388			327,482
Sierra	75,545				75,545
Siskiyou and Stanislaus	37,261				37,261
Trinity	9,261				9,261
Tulare	2				2
Tuolumne	278,618				278,618
Ventura	110				110
Yuba	1,152				1,152
Total	2,235,915	318,210	1,681	250	2,556,056
Increase (+) or decrease (−)	−232,156	+91,575	−219	+250	−140,550
Average value per ton in gold and silver	$5.05	$2.59	$7.03	$84.40	

Returns were received from 3,016 mines in California in 1906, of which 1,017 were producers. Of the latter, 383 were deep mines, the larger proportion, 357, being gold producers. The copper mines come next in number. Of placers, 634 report a product, including hydraulic, drift, dredge, and surface placer properties. Siskiyou County has the largest number of productive mines, 185, and has the largest number of both quartz and placer mines. The unproductive mines, numbering 1,999, are in process of development or being held by annual assessment work. The following table shows details by county:

Number of mines in California classified by chief product in 1906, by counties.

County.	Non-producing mines.	Gold placer mines.					Deep mines.						Total mines reporting product.
		Hydraulic.	Dredging.	Drift.	Surface.	Total.	Gold.	Silver.	Copper.	Lead.	Zinc-lead.	Total.	
Alpine	4												
Amador	70	4		4	6	14	11		1			12	26
Butte	105	5	15	12	24	56	7					7	63
Calaveras	140	2	2	4	6	14	32		2			34	48
Del Norte	8	6			3	9	1					1	10
Eldorado	105	1		8	21	30	31					31	61
Fresno	18				4	4	8		1			9	13
Humboldt	11	20			12	32							32
Inyo	85						6	3	1	6		16	16
Kern	113				1	1	33	2				35	36
Lassen and Los Angeles	18						3	2				3	3
Madera	30						5					5	5
Mariposa	70				1	1	24					24	25
Mendocino and Modoc	10				1	1							1
Monterey	6				1	1	2					2	3
Mono	48				1	1	6					6	7
Nevada	120	7		8	9	24	32					32	56
Orange	5										1	1	1
Placer	116	20		24	23	67	10		1			11	78
Plumas	150	16		11	45	72	6					6	78
Riverside	21						4					4	4
San Bernardino	73						11		3	1		15	15
Santa Barbara and San Diego	49				2	2	4					4	6
San Luis Obispo	1				1	1							1
Sacramento	7		3	3	2	8							8
Shasta	147	2		1	6	9	17		4			21	30
Sierra	97	13		19	17	49	10					10	59
Siskiyou and Stanislaus	135	100	2	6	36	144	41					41	185
Tehama													
Trinity	103	44		2	21	67	16					16	83
Tulare	6						1					1	1
Tuolumne	93	1		2	1	4	30					30	34
Ventura	5						1					1	1
Yuba	30	5	2		16	23	5					5	28
Total	1,999	246	24	104	260	634	357	7	13	7	1	383	1,017

The source of gold product by kinds of ore is shown in the following table.

Source of gold product of California by kinds of ore in 1906, by counties, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc-lead ores.	Total.	
Amador	1,398.76	107,946.93				107,946.93	109,345.69
Butte	145,614.41	320.73				320.73	145,935.14
Calaveras	10,981.95	65,689.52	2,868.35			68,557.87	79,539.82
Del Norte	190.84	96.75				96.75	287.59
Eldorado	2,163.96	18,721.75				18,721.75	20,885.71
Fresno	55.78	355.07				355.07	410.85
Humboldt	2,336.27						2,336.27
Inyo		891.50		49.34		940.84	940.84
Kern	76.19	38,919.72				38,919.72	38,995.91
Lassen and Los Angeles		4,766.20				4,766.20	4,766.20
Madera		1,083.11				1,083.11	1,083.11
Mariposa	2.42	17,721.89				17,721.89	17,724.31
Mendocino	.92						.92
Monterey	14.51	15.72				15.72	30.23
Mono	24.19	16,360.33				16,360.33	16,384.52
Nevada	12,771.53	115,829.54				115,829.54	128,601.07
Orange and Placer	22,732.04	4,595.29	387.00		48.38	5,030.67	27,762.71

Source of gold product of California by kinds of ore in 1906, by counties, in fine ounces—Continued.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc-lead ores.	Total.	
Plumas	5,785.55	5,309.25				5,309.25	11,094.80
Riverside		214.40				214.40	214.40
Sacramento	47,727.94						47,727.94
San Bernardino		17,029.89	135.01			17,164.90	17,164.90
San Diego and San Luis Obispo	253.48	587.27				587.27	840.75
Santa Barbara	12.09						12.09
Shasta	476.98	27,132.57	12,016.54			39,149.11	39,626.09
Sierra	5,732.73	14,070.35				14,070.35	19,803.08
Siskiyou and Stanislaus	17,123.64	18,593.56				18,593.56	35,717.20
Trinity	20,011.72	7,119.06				7,119.06	27,130.78
Tulare		.97				.97	.97
Tuolumne	649.68	49,644.60				49,644.60	50,294.28
Ventura and Yuba	60,672.79	851.40				851.40	61,524.19
Total	356,810.37	533,867.37	15,406.90	49.34	48.38	549,371.99	906,182.36

There were 27 counties in California reporting gold product from deep mines and 24 reporting output from placers of different kinds. The quartz gold amounted to $11,356,527 and that from the placers to $7,375,925. Of the deep-mine (or quartz) gold, $11,036,018 came from siliceous ores, but $318,489 was recovered in the treatment of copper ores, $1,020 from lead ores, and $1,000 from zinc ores. Calaveras County had the largest tonnage of ores, amounting to 583,207 tons, and Amador County produced the most concentrates, amounting to 11,281 tons, and yielding $850,214—this came from 577,599 tons of ore.

In the mother lode counties of Amador, Calaveras, Eldorado, Mariposa, and Tuolumne there were 131 producing deep mines and 63 placers that reported in 1906. Three of these were copper mines, 2 of which produced also gold and silver. There were produced in these 5 counties 1,537,761 short tons of ore, which yielded a total of $6,488,327, or an average of $4.22 per ton. The placers of these counties yielded $315,303, and the copper output was $957,984.

The following table shows the increase or decrease of gold output in the different counties of the State for the year 1906:

Increase and decrease in gold production in California in 1906, by counties.

County.	Increase.	Decrease.
Alpine		$360
Amador		159,785
Butte	$425,861	
Calaveras		136,251
Del Norte		814
Eldorado	46,150	
Fresno		26,968
Humboldt		1,929
Inyo		72,052
Kern		315,253
Lassen and Los Angeles		56,458
Madera		42,534
Mariposa		66,976
Mendocino		22
Modoc		26
Monterey		748
Mono	26,740	
Nevada		418,577

Increase and decrease in gold production in California in 1906, by counties—Continued.

County.	Increase.	Decrease.
Orange and Placer	40,671	
Plumas		40,642
Riverside		1,505
Sacramento	336,000	
San Bernardino		79,631
San Diego and San Luis Obispo		70,832
Santa Barbara		450
Shasta	112,406	
Sierra		102,007
Siskiyou and Stanislaus		74,146
Trinity		215,192
Tulare		3,942
Tuolumne		259,213
Ventura and Yuba	992,392	
Total	1,980,220	2,146,313
Total decrease		166,093

It is evident from this table that the quartz mining counties of the State generally did not produce as much gold in 1906 as in 1905, while those counties in which placer mining interests predominate show an increase in output. In 1905 the quartz gold (deep mines) amounted to $13,006,469 and in 1906 to $11,356,527, the reduction in output of gold from this source thus being $1,649,942. The placer gold in 1905 was $5,892,076 and in 1906 it was $7,375,925, an increase of $1,483,849 for the year. This comparison of the increase of placer gold with the decrease of quartz gold shows that the decrease for the year in gold in California was $166,093, as compared with 1905.

As to gold from placer mines, the total amount for the year was $7,375,925. Of this gold the dredges produced $5,098,359; the 246 hydraulic mines, $1,054,172; the 104 drift mines, $605,817, and the 260 surface placers, $617,577. Doubtless some of this latter output should have been rightfully credited to the hydraulic mines, but the returns were taken from the replies as received by the Survey office in San Francisco.

The importance of the dredging operations in California as affecting the annual gold output is shown in the following table:

Output of gold from dredging operations in California, in 1905 and 1906, by counties.

County.	1905.	1906.	Increase (+) or decrease (−).
Butte	$2,261,888	$2,768,782	+ $506,894
Calaveras	202,505	177,112	− 25,393
Sacramento	610,672	921,300	+ 310,628
Siskiyou	7,111	26,000	+ 18,889
Trinity	5,000		− 5,000
Yuba	188,967	1,205,165	+1,016,198
Total	3,276,143	5,098,359	+1,822,216

As is shown in the tables in this chapter, the drift mines of the State yielded $209,423 less and the surface placers $207,978 less in 1906 than in 1905, a total decrease of $417,401; but the hydraulic mines yielded $79,032 more than in 1905 and the dredges $1,822,218 more, so that the total increase from placers is $1,483,849, coming mainly from the dredge mining industry.

Of the total gold output of the State the deep mines yielded 64.3 per cent. Of the total placer mining output of the State the dredges yielded 69.2 per cent; the hydraulic mines, 14.3 per cent; the surface placers, 8.3 per cent, and the drift mines, 8.2 per cent. This shows that dredge mining now far exceeds in yield hydraulic, drift, and surface placer mining combined. The hydraulic, drift, and surface placers combined yielded $2,277,566, as compared with the dredge yield of $5,098,359, so that the dredges produced $2,820,793 more gold than all the other kinds of placer mining combined. The dredges produced 27.2 per cent of the total gold output of the State in 1906.

Butte County was for the first time in 1906 the largest producer of gold in the State, the amount being $3,016,747. Nevada County, for many years the leader, produced $2,658,420 in gold. Thus the stamps of Nevada County yielded to the dredge buckets of Butte County in supremacy of gold output for the year 1906.

The largest gold output in quartz mining was from Nevada County, $2,394,409; the largest gold output in dredge mining was from Butte County, $2,768,782; the largest gold output from drift mining from Placer County, $201,076; the largest gold output from hydraulic mines from Trinity County, $361,102; and the largest gold output from surface placer was from Placer County, $130,222.

The following table shows, by counties, the source of placer gold in California in 1906:

Source of placer gold in California in 1906, by counties.

County.	Hydraulic.	Drift.	Dredging.	Surface placers.	Total.
Amador	$5,625	$6,490		$16,800	$28,915
Butte	37,220	102,908	$2,768,782	101,207	3,010,117
Calaveras	21,207	22,144	177,112	6,554	227,017
Del Norte	3,145			800	3,945
Eldorado	300	18,846		25,587	44,733
Fresno				1,153	1,153
Humboldt	32,403			15,892	48,295
Kern				1,575	1,575
Mariposa				50	50
Mendocino				19	19
Monterey and Mono				800	800
Nevada	117,724	135,182		11,105	264,011
Placer	138,615	201,076		130,222	469,913
Plumas	12,280	6,355		100,963	119,598
Santa Barbara				250	250
San Diego and San Luis Obispo				5,240	5,240
Sacramento		48,824	921,300	16,500	986,624
Shasta	2,250	350		7,260	9,860
Sierra	47,904	46,397		24,205	118,506
Siskiyou	258,981	14,065	26,000	54,931	353,977
Trinity	361,102	2,000		50,577	413,679
Tuolumne	12,000	1,180		250	13,430
Yuba	3,416		1,205,165	45,637	1,254,218
Total	1,054,172	605,817	5,098,359	617,577	7,375,925
Increase (+) or decrease (—)	+79,032	−209,423	+1,822,218	−207,978	+1,483,849

As to silver, the total output of the State for 1906 was, according to returns from producers, $817,830, which is $167,821 more than in 1905. Of this silver $506,705 was derived from copper mining operations; $252,151 from siliceous ores; $28,082 from placer mines; $10,792 from lead ores, and $20,100 from lead-zinc ores. The increase was derived from the copper and zinc ores and the placers. The total deep-mine silver is $789,748, and the placer silver $28,082. The counties of Del Norte, Fresno, Inyo, Madera, Mariposa, Monterey, Nevada, Plumas, San Bernardino, San Diego, Sierra, Trinity, Tulare, and Tuolumne showed a combined decrease of $71,196 for the year, the largest deficit being in Inyo County. Those counties showing an increase of silver were Amador, Butte, Calaveras, El Dorado, Humboldt, Kern, Mono, Orange and Placer, Riverside, Sacramento, Shasta, Siskiyou and Stanislaus, Ventura and Yuba, the total increase being $339,017. The largest increase, $271,083, was in Shasta County, and was due to increased tonnage of copper ores worked during the year.

The source of the silver product, by counties, is given in the following table.

Source of silver product in California, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc.	Total.	
Amador	257	21,503				21,503	21,760
Butte	16,063	136				136	16,199
Calaveras	1,046	12,342	97,209			109,551	110,597
Del Norte	33	18				18	51
Eldorado	306	3,709				3,709	4,015
Fresno	12	112				112	124
Humboldt	355						355
Inyo		6,442		13,495		19,937	19,937
Kern	15	193,273				193,273	193,288
Lassen and Los Angeles		1,934				1,934	1,934
Madera		758				758	758
Mariposa		5,040				5,040	5,040
Mendocino							
Monterey	3	1				1	4
Mono	4	19,624				19,624	19,628
Nevada	2,110	34,037				34,037	36,147
Orange and Placer	3,284	6,469	10,000		30,000	46,469	49,753
Plumas	982	593				593	1,575
Riverside		360				360	360
Sacramento	5,433						5,433
San Bernardino		38,290	9,494	2,612		50,396	50,396
San Diego and San Luis Obispo	51	904				904	955
Santa Barbara	3						3
Shasta	92	8,817	639,573			648,390	648,482
Sierra	829	2,930				2,930	3,759
Siskiyou and Stanislaus	3,570	4,532				4,532	8,102
Trinity	2,584	1,881				1,881	4,465
Tulare							
Tuolumne	121	12,530				12,530	12,651
Ventura and Yuba	4,760	110				110	4,870
Total	41,913	376,345	756,276	16,107	30,000	1,178,728	1,220,641
Increase (+) or decrease (−)	+14,546	−230,816	+368,107	−37,370	+30,000	+129,921	+144,467

The copper mines of California yielded 28,726,448 pounds of that metal in 1906, valued at $5,544,204, an increase in quantity of 12,028,904 pounds and in value of $2,939,389. The increase in value of copper in Shasta County was $2,648,506; in Calaveras, $408,866; in San Bernardino, $91,001, and in Amador, $109; total increase in these counties, $3,148,482. Counties showing a decrease in output of copper were El Dorado, showing a decrease of $24,960; Fresno, $139,720; Inyo, $22,851; Mariposa, $1,956; Orange and Placer, $18,691; Plumas, $166, and San Diego, $749; total, $209,093. The total increase for the year in value of copper was therefore $2,939,389. The expansion of operations in Shasta County is entirely responsible for this marked increase in copper product, but lack of space prevents any review of the conditions there.

In lead there was a decrease in Inyo County of $9,186 in value for the year, and an increase of $5,700 in Orange and Placer counties, and of $1,750 in San Bernardino County. The total decrease was $1,736.

For the first time zinc ore was produced in California, the metallic value of the output being $12,566.

It is to be noted that, while the gold declined in value of output in California in the small sum of $166,093, and lead to the extent of $1,736, a total of $167,829, yet silver increased $167,821, copper $2,939,388, and zinc $12,566, a total of $3,119,775. This makes the value of the total output of California in these metals $25,126,359 for the year 1906, which is an increase over 1905 (with platinum omitted in both years) of $2,951,946. For this increase in value copper was mainly responsible.

PRODUCTION BY INDIVIDUAL COUNTIES.

AMADOR COUNTY.

Amador, which is one of the Mother Lode counties, shows a reduction in total output in 1906 of $158,035. The falling off in gold output was $159,785, but there was a small increase in silver and copper. The production of gold, silver, and copper in the county in 1905 was as follows: Gold, $2,420,161; silver, $12,938; copper, $1,560; total, $2,434,659; in 1906 it was gold, $2,260,376; silver, $14,579; copper, $1,669; total, $2,276,624.

In this county was the largest tonnage of siliceous ores in the State—579,599 tons—which is, however, more than 70,000 tons less than in 1905. Twelve deep mines report product, and some of these are worked at great depth. The vertical shaft of the Kennedy is 3,100 feet deep; the Argonaut shaft is 2,700 feet on the incline; and the shafts of the Central and South Eureka mines are 2,500 feet on the incline. The milling capacity of the county is 420 stamps. The principal producing mines are the Bunker Hill and Keystone Mining companies at Amador City; the Fremont Consolidated Mining Company (Gover) at Drytown; the Argonaut, Kennedy, Oneida, and Zeila Mining companies at Jackson; and the Central and South Eureka Mining companies at Sutter Creek. The Oneida at Jackson has been given up and will no longer be worked. The Wildman and Mahoney mines at Sutter Creek, former producers, have not been worked of late. The 579,569 tons of ore milled, yielded $2,230,620 in gold and $14,401 in silver. The concentrates in this ore, 11,281 tons, yielded $844,024 gold and $6,190 silver. There were also $841 in gold and $6 in silver from 30 tons of ore sent to smelter. There are 14 producing placers in the county, 4 of which are hydraulic, 4 drift, and the others surface. Their combined yield was $29,087, of which $28,915 was gold. None of them are large producers. The placers are located at Lancha Plana, Oleta, Pine Grove, and Volcano.

BUTTE COUNTY.

Butte County shows an increase of $435,861 in gold and of $4,265 in silver, a total increase of $430,126. The total yield of the county was $3,016,747 in gold and $10,853 in silver. This shows Butte to be now the leading gold producing county of the State, exceeding Nevada County, for many years the largest gold producer, by $358,327 for the year 1906. This is entirely due to the operation of the dredges at Oroville, the principal seat of the dredging industry in the State. Quartz mining is now of small importance, only 682 tons of ore having been worked in 1906, with a total yield of $6,721. These quartz mines are at Berry Creek and Lumpkin, and are all small. Placers of different kinds are worked at Bangor, Berdan, Berry Creek, Brush Creek, Cherokee, Clipper Mills, Enterprise, Forbestown, Inskip, Lumpkin, Orloff, Magalia, Nimshew, Oroville, Pentz, West Branch, and Yankee Hill. There are 56 producing placers, including 5 hydraulic mines, 12 drift mines, 24 surface placers, and 15 dredging operations. Some of these companies own several dredges. The hydraulic mines in this county yielded $37,220 in gold, the drift mines $102,908, the surface placers $101,207, and the dredgers $2,768,782.

The following table shows the output of gold from dredging operations at Oroville in the last few years, and the annual increase:

Production of gold by dredging in Butte County, Cal., 1903–1906.

Year.	Value.	Increase.
1903	$1,329,998	....
1904	1,632,507	$302,509
1905	2,261,887	629,380
1906	2,768,782	506,895
Total	7,993,174	1,438,784

The number of dredges is increasing in Oroville, but other parts of the State are also developing profitable dredging fields, so that interest is no longer confined to this county. Most of the dredges are now "landlocked;" that is, none of the waste material is allowed to escape into the rivers but is impounded or inclosed with walls of cobbles and rock thrown up by the tailings "stackers" of the dredges themselves.

CALAVERAS COUNTY.

Calaveras County showed a falling off of $136,251 in its gold output for the year, but it increased its copper yield by $408,866 and its silver yield by $10,261, a total increase of $282,876.

The production of gold, silver, and copper in the county in 1905 was as follows: Gold, $1,780,485; silver, $63,838; copper, $572,022; a total of $2,416,345; in 1906 it was: Gold, $1,644,234; silver, $74,099 copper, $980,888; a total of $2,699,221.

As predicted in the report for 1905, the copper output is rapidly increasing. Over two-thirds of the copper came from Campo Seco and the remainder from Copperopolis. Nearly 45,000 tons of ore were smelted in 1906. This copper ore yielded $59,294 in gold and $65,138 in silver, which accounts in some degree for the increase in silver in the county for the year. These mines have their own smelting plants at the properties. The siliceous ores from the quartz mines amounted for the year to 538,566 short tons, yielding $1,887,918 in gold and $74,971 in silver. There were 32 deep quartz mines which produced this ore. The increase in tonnage in the county for the year was 35,235 tons, including the copper ores. Of concentrates there were 10,039 tons, yielding $473,295. Calaveras had the largest tonnage of all the counties in the State in 1906, the quantity being 583,207 tons of ore.

The principal producing quartz mines are the Angels Quartz Mining Company, the Lightner Mining Company, and the Utica Mining Company at Angels; the Gwin Mine Development Company at Gwinmine; the Melones Mining Company at Melones, and the Sheep Ranch Gold Mining Company at Sheep Ranch. Most of the other quartz mines were comparatively small producers. The copper properties at Campo Seco belong to the Penn Chemical Works, while those at Copperopolis are operated by the Union Copper Company. There are 478 stamps in the county.

The placer yield of Calaveras was $227,017, the larger proportion of which was from dredging operations at Jenny Lind and Wallace. There is very little surface mining, but the hydraulic and drift mines are productive, there being 14 placers in all, including 2 dredge operations.

DEL NORTE AND HUMBOLDT COUNTIES.

These are exclusively placer counties on the northwest coast of the State. Del Norte County had an output of $5,978 for the year, a decrease of $817. Most of this is from hydraulic mines near Crescent City and Monumental. Humboldt County produced $48,533, which is $1,900 less than in 1905; of the total, $32,403 came from hydraulic mines and the rest from surface placers. The principal mining locality is Orleans, though a few mines are worked at Blocksburg, Chinaflat, Hoopa, Klamath, Orick, and Weitchpec. Only 2 beach sand mines reported product in 1906, these being at Gold Bluff.

ELDORADO COUNTY.

This county in 1906 yielded $434,436, an increase for the year of $21,915, the main increase being in gold. Of deep mines, 31 reported product. The ores produced were all siliceous; they amounted to 31,818 tons, which is a decrease from the previous year. These ores yielded, in addition to the free gold obtained in milling, 1,265 tons of sulphurets, which added $50,865 to the production. The principal producing quartz mines are the Union at El Dorado; the Beattie and Golden State at Georgetown, and the River Hill and the Sherman Mines Company near Placerville. In 1906 there were 31 deep producing mines in the county. Of placers there were 30, most of them surface, yielding altogether $44,733 in gold. These placers are at Fairplay, Fyffe, Garden Valley, Georgetown, Green Valley, Indian Diggings, Placerville, Rescue, Shingle, and Virner.

FRESNO COUNTY.

Fresno County yielded in 1906 $8,493 in gold, $83 in silver, and $84,920 in copper, a total of $93,496, which is a decrease from 1905 of $175,623. The falling off in copper alone was $139,720, which was due to the fact that the producing copper company shipped less ore than in 1905. Fresno has only 9 deep mines producing, of which 1 is copper, and there are but 4 small placers. These latter are at Dunlop, Pineridge, and Tollhouse. The quartz mines are at Auberry, Ockenden, and Trimmer, and the copper mine is situated near Clovis.

INYO COUNTY.

Inyo County produced in 1906 the sum of $19,449 in gold, $13,358 in silver, $800 in copper, and $11,857 in lead, a total of $45,464. The reduction in output for the year amounted to $141,843, a decrease being shown in each of the metals produced. The largest falling off is $72,052 in gold. In 1906 there were only 1 gold, 3 silver, 1 copper, and 6 lead deep producing mines. There were no producing placers. No deep mines in the county produced over $10,000. The mines which showed a yield are at Ballarat, Bigpine, Bishop, Darwin, Independence, Keeler, Laws, Lone Pine, and Tinemaha; but at few of these places was there more than one producing property. A large amount of prospecting is being done in this county in the regions near the Nevada boundary line, and not very much attention was given to the known mines as compared with former years.

KERN COUNTY.

This county produced $935,620 in 1906, as compared with $1,224,333 in 1905, a loss in output for 1906 of $288,713. The silver yield increased $26,540, but gold decreased $315,253. The reason for this falling off is in the decreased tonnage treated. In 1906 there were treated 146,076 tons of ore, which is less by 106,700 than the tonnage of 1905. With the exception of $1,585 from placers, the yield was entirely from deep mines. Of these 33 were gold producing, and 2 had silver as the predominating metal. In 1906 only 2 of these mines yielded over $100,000—the Yellow Aster at Randsburg and the Queen Esther at Mohave. The Exposed Treasure, at Mohave, a large producer in 1905, did not appear in the record for 1906. The Yellow Aster continues to be the most important mine in the county and the largest in southern California. Among other producers of note are the Zada, belonging to the Gold Peak Mining Company, at Amalie; the mines of the Arondo Gold Mining Company at Johannesburg; the Castle Rock at Piute; the Butte Lode Mining Company, the Little Butte Mining and Milling Company, the Sydney Annex, the Sunshine, and the Gold Coin mine of the Stanford Mining and Reduction Company, at Randsburg, and the Lida at Rosamond. The Randsburg district (including Johannesburg) was the most productive section of the county, having yielded a total of $619,556 for the year. The Mohave region came next with a total yield of $185,793, followed by Amalie district with an output of $66,918, and by Piute with $19,519. Other mines were productive at Bodfish, Havilah, Isabella, Kernville, and Rosamond.

LASSEN AND LOS ANGELES COUNTIES.

These 2 counties, though widely separated geographically, are combined in this review, as in one county there is only one productive mine, the yield of which would otherwise be made public. The total output of the two counties was $99,822 for the year, a falling off of $57,578. There were only 3 deep mines reporting product in the 2 counties, and no placers in either.

MADERA COUNTY.

There are only 5 producing mines in this county, all quartz, and their total output was $22,390 in gold and $508 in silver, a total of $22,898, as compared with $66,161 in 1905; the loss in yield for the year was therefore $43,263. The producing mines are at Coarsegold and O'Neals, the principal ones being the Texas Flat, the Ragsdale, and the Mud Springs.

MARIPOSA COUNTY.

Mariposa is one of the mother lode counties of the State. Its yield for the last two years was as follows: In 1905, gold, $433,370; silver, $4,085; copper, $1,956; total, $439,411; in 1906, gold, $366,394; silver, $3,337; total, $369,731—a decrease for the year of $69,680, the principal loss being in gold. The yield came from 24 deep mines and 1 unimportant placer. The falling off in yield was due to the reduced output of the principal mines. The ore treated amounted to 64,511 tons, which is 23,805 tons less than in 1905. Seventy mines reported no production for the year. By far the largest output was from the mines of the Mariposa Commercial and Mining Company at Mount Bullion and Bagby, known as the Mariposa Grant Mines, but their output was much less than in 1905. Other prominent producers are the Champion Mining Company, at Coulterville; the Ruth Pierce Mining Company and the Mount Gaines Mining Company, at Hornitos; the Tennessee and California Mining Company, at Indiangulch, and the Omparisa Mining Company, at Kinsley. Other quartz mines are being worked at Bear Valley, Mariposa, and Whitlock. Some copper mines are now being made productive in the county, but no output of that metal was reported in 1906.

MENDOCINO, MODOC, AND MONTEREY COUNTIES.

In these 3 counties there are only 2 producing placer mines and 2 quartz. The yield of the quartz mines was $326 and of the placers $321, the total yield of these counties being only $647 for the year.

MONO COUNTY.

Mono showed an increase of $26,740 in gold yield, of $3,562 in silver—a total increase of $30,302. The total yield for 1906 was $351,849, of which $338,698 was gold. Small placers at Bridgeport produced about $500, but all the rest of the output came from Bodie, Lundy, and Masonic, by far the larger proportion from the first-named district. There are very few producing mines in the county. There were 285,599 tons of ore treated, an increase of 5,155 tons for the year. In addition to the free gold, $184,875 came from concentrates, and 650 tons of tailings were treated, yielding $4,660. The gold was virtually all from siliceous ores. The Standard Consolidated Mining Company, at Bodie, is by far the largest producer in the county, as it has been for some years past. The Crystal Lake Gold Mining Company, at Lundy, is also a good producer. The Pittsburg Liberty Mining and Milling Company, at Masonic, made its first appearance as a producer in 1906, and is expected to make a large yield in 1907, as will also some other properties in the same district, where much development is now going on.

NEVADA COUNTY.

Nevada County has been the leading gold-producing county of California for many consecutive years, but in 1906 its gold output was exceeded by that of Butte County. It is still, however, the leading producer of gold from quartz mines. The production for the past two years was as follows: In 1905, gold, $3,076,997; silver, $24,842; total, $3,101,839. In 1906, gold, $2,658,420; silver, $24,219; total, $2,682,639.

These figures show a falling off for the year of $419,200, mainly in gold. Fifty-six mines reported product in this county, of which 32 were quartz and 24 placers. Of the latter, the 7 hydraulic mines yielded $117,724 in gold; the 8 drift mines, $135,182, and the 9 surface placers, $11,105—a total of $264,011 in gold from the auriferous gravels. The placer silver amounted to $1,414. The ores treated were all from gold mines and amounted to 276,602 tons, which is 48,664 tons less than reported the previous year, and this accounts for the lesser product of the year 1906. From this ore were derived 4,912 tons of concentrates, which yielded $284,759. The total quartz gold was $2,394,409, and the total quartz silver $22,805. This shows that the average value of the ores milled in the county was $8.74 per ton.

The most productive quartz mines in the State are in the Grass Valley district, which includes both the mines at Grass Valley and those of Nevada City. The returns for the last two years in this district from the quartz mines were as follows:

Production of Grass Valley and Nevada City Mines, Nevada County, Cal., 1905–6.

Year.	Grass Valley mines.			Nevada City mines.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
1905	$2,041,447	$10,483	$2,052,290	$440,236	$12,531	$452,767
1906	2,196,990	16,516	2,213,506	133,031	5,755	138,786
Increase (+), decrease (−)	+ 155,543	+ 5,673	+ 161,216	−307,205	− 6,776	− 313,981

Aside from the reduction in output of the gravel mines of the county, this table shows that the decrease in yield of gold for the year was largely in the mines around Nevada City. The two largest mines at that point were inactive during 1906 owing to litigation, but since that time operations have been resumed. The most productive gold quartz mine in the county—and in the State—is that of the North Star Mines Company at Grass Valley. Other producers at that place are the Brunswick Consolidated Gold Mining Company, the Bullion Consolidated Gold Mining Company, the Central Consolidated Mining Company, the Empire mines, the Sultana Mining Company, the Idaho-Maryland Mining Company, the Pennsylvania Consolidated Mining Company, the New York-Grass Valley Mining Company, and the Spring Hill Mining Company. At Nevada City the producers are the Glencoe and Freeman, the Gold Flat Mining Company, the Home Gold Mining Company, the Murchie Gold Mines Consolidated, and the Pittsburg.

At Graniteville are a few small producers, and others are at North Columbia, Rough and Ready, and Washington.

The largest producers among the auriferous gravel mines are the Esperance drift mine, at French Corral; the Liberty Hill hydraulic, at Lowell Hill; the Blue Tent Mining Company, at Nevada City; the North Bloomfield Mining Company and the Union Blue Gravel Mining Company, at North Bloomfield; the Waukeshaw Mining Company, at Relief; the Badger Hill or Cherokee, the Kate Hayes, the Eureka Lake, and the Yuba Canal Company, at North San Juan, and the Omega, at Washington.

ORANGE AND PLACER COUNTIES.

These two counties combined produced in 1906 \$573,906 in gold, \$33,334 in silver, \$38,600 in copper, \$5,700 in lead, and \$12,566 in zinc, a total of \$664,106. This was a total increase for the year of \$55,957. The copper output alone showed a decrease in value, the other metals all showing increases. Reports were received from 79 producers, of which 12 were deep mines. Of the placers, 20 were hydraulic, producing \$138,615; 24 were drift, producing \$201,076; and 23 were surface placers, producing \$130,222. The output from the drift mines was larger than in any other county, as was also that from surface placers. Doubtless some of these reported surface placers belong in the drift or hydraulic column, but they are classified according to returns received, as some of those who may have been hydraulicking on a small scale did not care so to report. The most productive drift mine in the State continues to be the Hidden Treasure, at Bullion, though the yield for 1906 was smaller than usual. Other prominent producers among the auriferous gravel mines are the Davis Mining Company, near Auburn; the Lost Camp, at Blue Canyon; the Acacia Gravel Mining Company, at Damascus; the Auburn Gold Mining Company and the Reamer Consolidated Mining Company, at Forest Hill; the Druid, the Indian Bar, the Indian Hill Consolidated Mining Company, the Indiana Hill, the Pacific, the Inskip, and the Uncle Abe, at Gold Run; the Dewey Consolidated Mining Company, the Gould, the McGeachin Placer Mining Company, and the Indian Canyon, at Iowa Hill; and the Yorktown and the Placer Gravel Mining Company, at Michigan Bluff. Smaller properties are also worked at these places and at Butchers Ranch, Colfax, Dutch Flat, Emigrant Gap, Towle, Weimar, Westville, and Yankee Jims.

Deep mines are worked at Orange, in Orange County, and at Auburn, Colfax, Gold Run, Ophir, Towle, Van Trent, and Westville, in Placer County. The largest producers in the latter county are the Three Stars, at Ophir; the Rawhide Consolidated Mining Company, at Towle; and the Dairy Farm mines of the American Smelter Securities Company, at Van Trent, which is a copper property.

PLUMAS COUNTY.

Although best known as a gravel mining section, the yield of gold from the 72 productive gravel mines in Plumas County was only about \$10,000 more than that from the 6 producing quartz mines. The output of gold and silver for the year was \$230,405, which is \$40,869 less than the county yield in 1905. There were 78 mines reporting product in this county in 1906, 72 of them placers. Of these latter, 16 are hydraulic properties, 11 drift, and the rest report as surface placers. The quartz mines report a tonnage of 21,040, which is less by 10,415 tons than in 1905. The quartz mines which produced this tonnage made a yield of \$109,752 in gold and \$397 in silver. The only prominent quartz producer is that of the Jamieson Mining Company at Johnsville, though smaller outputs are reported from mines at Buck, Genesee, Johnsville, and La Porte. These auriferous gravel mines yielded for the year under review $119,598, of which $12,280 was from hydraulic mines, $6,355 from drift, and $100,963 from surface placers.

As in the case of some other counties, much of the gold reported as surface placer was perhaps obtained by hydraulic process on a small scale. There are no specially large companies conducting operations in the auriferous gravels, the yield from that source coming from a number of small mines. The localities where the gravels are being hydraulicked, drifted, or sluiced are Crescent Mills, Cromberg, Eclipse, Genesee, Johnsville, La Porte, Longville, Lumpkin, Meadow Valley, Mohawk, Nelson Point, Quincy, Seneca, Spanish Ranch, and Taylorsville. While this county makes no output of copper at present, many mines of this metal are being opened near Genesee, Taylorsville, etc., and considerable work is under way. This is in view of the completion within a year of the new railroad line of the Western Pacific Company, which is now being built and which will afford transportation for the copper ores which are now too remote to be profitably moved.

RIVERSIDE, SANTA BARBARA, SAN DIEGO, AND SAN LUIS OBISPO COUNTIES.

Riverside County has a few small producing quartz mines at Banning, Mecca, Paloverde, and Perris, their total output for 1906 being $4,673, which is $1,319 less than in 1905.

Santa Barbara had a nominal output from beach sands at Point Sal, the product being less than in 1905.

San Luis Obispo and San Diego counties produced $18,021 in 1906, which is a decided falling off in yield, the amount in 1905 having been $95,048. The placers consist of small surface diggings at La Panza, in San Luis Obispo County, and of dry washing fields at Picacho, near the Colorado River, in San Diego County. The few producing quartz mines in San Diego County are at Julian and Picacho. The Golden Cross or Free Gold Mining Company at Hedges, the largest of the San Diego County mines, made no production in 1906, which accounts for the reduction in output.

SACRAMENTO COUNTY.

Sacramento County, which produced $990,264 in 1906, mainly gold, showed an increase for the year of $337,982, of which $336,000 was gold and $1,982 silver. There were only 8 producing properties in the county, all placers. By far the largest proportion of gold was derived from the dredging operations near Folsom, the rest being from drift mines in the Blue Ravine section and from surface placers at Folsom and Michigan Bar. Some exceptionally large dredges are now operating near Folsom, and very successfully. The gold yield from this source is increasing considerably over a quarter of a million dollars annually, the increase in 1905 over 1904 having been $220,134 and that of 1906 over 1905 having been $352,176. Large areas of available dredging ground are being purchased and additional dredges designed. The dredges in use are of the largest size.

SAN BERNARDINO COUNTY.

Although this county produced less gold and silver in 1906 than in 1905, the increase in copper and lead brought the county total $6,436 beyond that of the year 1905. The production of gold, silver, copper, and lead in 1905 and 1906 was as follows: In 1905, gold, $434,461; silver, $40,449; copper, $8,206; total, $483,116; in 1906, gold, $354,830; silver, $33,765; copper, $99,207; and lead, $1,750; total, $489,552.

The copper output increased by $91,001 and the lead by $1,750. There were 15 mines reporting product in the county, of which 11 were gold mines, 3 copper mines, and 1 a lead mine; and reports were received from 73 unproductive properties. The total tonnage of the county was 37,271, which was 3,232 tons more than in 1905. Of this tonnage, 33,830 tons were milled, and 3,441 tons of copper and lead ores were shipped to smelters. The milling ores yielded $352,039 in gold and $25,654 in silver. The most productive property is that of the Bagdad-Chase Gold Mining Company, at Steadman, and the next in order is that of the Standard Copper Company, at Cima. Other producers are the War Eagle Mining and Milling Company, at Bagdad; the Oriental, at Daggett; the Cocopah Copper Company, (Copper World), at Cima; the Brooklyn Mining Company, at Dale; and the Dry Lakes Mining Company and the Oro Grande, at Victorville. A very large amount of prospecting was in progress in 1906 in this county, and many mines are being opened and developed.

SHASTA COUNTY.

Shasta County shows the very remarkable increase for the year 1906 of $3,031,995, due to the resumption of active operations by the Mountain Copper Company and to the enlarged output of the Mammoth and other copper companies of the county. The record of the last two years is as follows:

Production of gold, silver, and copper in Shasta County, 1905–6.

Year.	Gold.	Silver.	Copper.	Total.
1905	$706,738	$163,400	$1,689,615	$2,559,753
1906	819,144	434,483	4,338,121	5,591,748
Increase	112,406	271,083	2,648,506	3,031,995

The county is thus shown to be by far the largest metallic producer in the State. It exceeds Butte County, the next largest producer, by $2,564,148, which is a remarkable record, and well illustrates the importance of copper mining as a productive industry. Of the 30 mines producing gold in the county, 17 are deep mines and 9 are placers, and their combined output is $819,144; yet the value of the copper from the 4 mines of that metal exceeds the gold by $3,518,977, which sum is, in itself, larger than the entire metallic output of any other county in the State.

The entire tonnage of the county for 1906 was 327,482 tons, yielding a total of $5,591,748. Of this tonnage 22,897 tons of ore were milled, yielding $277,705 in gold and $2,195 in silver, and in addition there were obtained 152 tons of concentrates, which yielded $12,874 in gold and $217 in silver. The output from milling ores was therefore $290,579 in gold and $2,412 in silver, a total of $292,991. From 304,585 tons of smelting ores the output was $518,705 in gold and $432,009 in silver, besides the copper. The copper ores worked amounted to 262,388 tons, yielding $4,338,121, aside from the gold and silver values. The quartz and smelting ores therefore produced a grand total in gold, silver, and copper of $5,581,826. The placers in the county only yielded $9,860 in gold and $62 in silver, a total of $9,922.

It should be understood that large quantities of siliceous ores, carrying gold and silver, are used as flux in the copper-smelting furnaces. In fact, one reason for the prosperous condition of the gold quartz mining industry in this county is that so many miners are working properties from which the ore is sold direct to the copper-smelting companies, the returns received being in proportion to the assay values. These smelting companies also obtain some ore from adjoining counties, and of late have purchased more or less in southern Oregon as well.

The most important producer in the county at present is the Mammoth Copper Mining Company, with smelters at Kennett. Other large copper producers are the Mountain Copper Company, with smelters at Keswick, Shasta County, and at Bulls Head Point, Contra Costa County; the Great Western Gold Company, with smelter at Ingot; and the Bully Hill Copper Mining and Smelting Company, with smelter at Winthrop. The quartz gold producers of prominence are the National, the Original Quartz Hill Mining Company, and the Utah and California Mining Company, at Buckeye; the Hazel Mining Company (Gladstone), the Brunswick Mining Company, and the Black Tom Gold Mines Company (Niagara), at French Gulch; the Midas Mining Company, at Knob; the Gambrinus and the Mad Ox, at Stella; and the Evening Star and the Reid, at Whitehouse. Outside of the copper companies, the largest producer in the county is the Hazel Mining Company, at French Gulch. The increase in tonnage in this county—113,446 tons—is the largest of all the counties in the State.

As to placer mines, 9 were productive, 2 of which were hydraulic, yielding $2,250; 1 was a drift mine, yielding a nominal amount; and 6 were surface placers, yielding $7,260; a total of $9,860.

SIERRA COUNTY.

Sierra County shows a falling off in output for the year of $107,802, of which $100,007 is gold. The total yield for the year 1906 was $411,884, as compared with $519,686 in 1905. The ore milled at the quartz mines amounted to 74,045 tons, yielding $276,315 in gold and $1,869 in silver. Concentrates of this ore gave 67 tons of sulphurets, containing $11,795 in gold and $69 in silver. In addition, there were worked 1,500 tons of old tailings, yielding $2,750 in gold and $25 in silver. The total tonnage of the county was 75,545, which is 57,167 tons more than in the 1905. The output of quartz properties in 1906 was $292,823 and in 1905 it was $389,855. This shows a decrease for 1906 from this source of $97,032, notwithstanding the greatly increased tonnage produced. The placers yielded $119,061 in 1906 and $129,431 in 1905, so the loss from placers was $10,370. The main loss for the year is thus to be accredited to the quartz properties, which must have worked much lower grade ore than previously. There were 10 quartz producers in the county in 1906, the one making the largest yield being the Croesus Mining Company, at Alleghany. Other large quartz producers are the Rainbow Gold Mining Company and the Tightner Consolidated Gold Mining Company, at Alleghany; the Empire Gold Mines (Gold Valley), near Downieville, and the Sierra Buttes Mining Company, at Sierra City. This latter mine has lately been reopened, after having been given up as worked out. The milling capacity has been greatly increased. The Tightner mine, at Alleghany, has of late been yielding phenomenally rich ore and has attracted the attention of numerous miners to the possibilities of the locality, so that many old mines are being reopened.

The placers of the county yielded $118,506 in gold and $555 in silver. Of the gold, $47,904 came from 13 hydraulic mines, $46,397 from 19 drift mines, and $24,235 from 17 surface placers. The most productive placer is that of the Bellevue Mining Company (drift), at La Porte; and other large producers are the Golden Star (hydraulic), at Alleghany, and the Depot Hill, also a hydraulic mine. Hydraulic, drift, and placer mines of more or less importance are producing at Alleghany, Downieville, Forest, La Porte, Gibsonville, Goodyear Bar, Pike, Port Wine, Scales, Sierra City, St. Louis, and Table Rock. With the exception of those named as larger producers, these all make a comparatively small annual yield, though there are many of them.

STANISLAUS AND SISKIYOU COUNTIES.

These two counties produced $743,769 in 1906, as against $816,906 in 1905, so that a decrease of $73,637 is shown for 1906. In Stanislaus County there is only 1 producing quartz mine, near Knights Ferry, for which reason the county is combined with Siskiyou. Siskiyou County itself has 184 producing mines, large and small, which is 101 more than any other county in the State, the next highest being Trinity, with 83. Of these 184 mines, 40 are gold-quartz producers. Of the 144 placers, 100 are hydraulic, 2 are dredging, 6 are drift, and 36 are surface placers. These placers produced $258,981 in gold form hydraulic mining, $14,065 from drifting, $26,000 from dredging, and $54,931 from surface work. The silver from the placers amounted to $2,392. The placers producing $10,000 or over are the Crapo & Knudsen hydraulic, at Forks of Salmon, the Oregon Gold Mining and Water Power Company hydraulic, at Happy Camp, the Free Trade and Myers hydraulic, at Sawyer's Bar, and the Yreka Creek Gold Dredging Company (dredge) at Yreka, this latter being the most productive property among those working the auriferous gravels. Those companies producing below $10,000 but above $5,000 for the year, are the Salmon River Hydraulic Gold Mining and Ditch Company, at Cecilville; the Bloomer hydraulic, and the Nordheimer Mining Company hydraulic, at Forks of Salmon; the Lucky Bob drift mine, at Gottville; the Pennsylvania hydraulic, at Happy Camp; the J. Soares & Co. hydraulic, at Hawkinsville; the Daggett hydraulic, at Oak Bar; the Andrew Martin hydraulic, and the Poorman's Bar hydraulic, at Scott Bar; and the Sunrise Placer hydraulic, at Yreka. The localities suitable for gravel mining in this county are many and are at Black Bear, Callahan, Cecilville, Etna, Elliot Creek, Forks of Salmon, Fort Jones, Gazelle, Gottville, Greenview, Hamburg, Happy Camp, Hawkinsville, Henley, Hilts, Hornbrook, Nolton, Oak Bar, Oro Fino, Sawyer's Bar, Scott Bar, Seiad Valley, Somes Bar, Walker, and Yreka. The most productive quartz mine in the county is the Morrison at Greenview;

and other large producers are the Helena Gold Mining Company, at Callahans; the Advance, the Highland Mining Company, and the Taylor Lake Mining Company, at Etna Mills; the Golden Eagle, at Fort Jones; the Squaw Creek Mining Company (Dewey), at Gazelle; the Consolidated Gold Run mine, at Gilta; the Stevens-Ball, at Rollin; the Lucky Bob, at Snowden; and the Mono Mining Company (Punch Creek), near Yreka.

The gold from quartz ores in the two counties amounted to $384,363 and the silver from the same ores to $3,037.

TRINITY COUNTY.

Trinity County shows the material falling off in its gold product of $215,192, as compared with that of 1905, and there was also a small reduction in its silver output. In this county mining auriferous gravels is the predominating industry. Of a gold output of $560,843 in 1906, the sum of $413,679 came from placer operations; the yield of quartz gold was only $147,164. The gravel mines therefore yielded $266,515 more gold than the quartz properties. There are 67 gravel mines reporting product. Of these, 44 are hydraulic mines and yielded $361,102 in gold; 2 are drift mines, yielding $2,000, and 21 are surface placers, with a production of $50,577. The county has the largest output from hydraulic mining of all the counties in the State. Its 44 mines of this character yielded over $100,000 more than the 100 hydraulic mines of Siskiyou County, which comes next in rank in this class of mining. In these 2 counties there are no restrictions upon hydraulic mining such as exist in the counties in the drainage basin of the Sacramento and San Joaquin rivers, where the tailings are impounded. The most productive and largest hydraulic mine in the State is that of the La Grange Mining Company near Weaverville. Other large producers in this State are the Hupp hydraulic mines, at Weaverville, and the combined Chinese mines at the same place; the Bennett hydraulic, at Douglas City; the Sykes hydraulic, at Trinity Center; the Chapman & Fisher hydraulic and the Burger hydraulic, at Junction City; the Butler Mining Company (Old Unity) and the combined Chinese mines, at Minersville. All these mentioned made an output of over $10,000 each in 1906. Other gravel mines are worked at Big Bar, Burnt Ranch, Burns, Carrville, Dedrick, Denny, Dorleska, Hayfork, Helena, Lewiston, Junction City, Minersville, Trinity Center, and Weaverville.

The yield of silver from these gravel mines was only $1,731, and the yield of silver from the quartz mines of the county was $1,250. There are no very large quartz mining operations in the county, and the yield from this source appears to be decreasing. The tonnage for the year 1906 was only 9,261, a falling off of 31,207 tons for the year. Only siliceous ore was mined. About 300 tons of concentrates were worked. The principal quartz producers are the Five Pines, at Trinity Center; the Brown Bear Mining Company, at Deadwood; the Globe, at Dedrick; the Bullychoop Company, near the Shasta County line, and the Oro Grande, at Carrville. Other smaller quartz operations are conducted at these points and at Coleridge, Denny, Dorleska, Douglas City, and Lewiston.

No copper is yet produced in the county, but several mines of this metal are being opened or developed.

TUOLUMNE AND TULARE COUNTIES.

Tuolumne County produced in 1906 the sum of $1,039,675 in gold and $8,476 in silver, a total of $1,048,151. This is $259,213 less in gold and $3,046 less in silver than the output of 1905. The quartz mines yielded $1,026,245 in gold and $8,395 in silver, and the gravel mines yielded $13,430 in gold and $81 in silver. This result was obtained by the operation of 30 deep gold mines and 4 gravel or placer mines. The total tons of ore treated amounted to 278,618 short tons, which is a decrease of 25,013 tons from 1905, and accounts for the lower output in 1906. From this ore were obtained 7,820 tons of concentrates, valued at $347,959. Only the counties of Amador and Calaveras exceeded this county in the output of concentrates, and these same counties, with Shasta added, were the only ones exceeding Tuolumne in total tonnage of ore treated.

The most productive quartz mine in the county is the Rawhide, at Jamestown; and the next in order of output is that of the Eagle-Shawmut Mining Company, at Chinese Camp. Other producers of over $10,000 are the Big Casino Mining Company and the Longfellow Consolidated Mining Company, at Big Oak Flat; the Northfork Development Company (Mohican) and the Spring Gulch, at Carters; the Confidence Consolidated Mines Company, at Confidence; the Clio Mining Company, at Jacksonville; the Harvard Mines Company, at Jamestown; the Black Oak Mining Company, at Soulsbyville; and the Jumper Gold Syndicate, at Stent.

The only placer producer of note is the Gold Nugget hydraulic mine, of Columbia.

Tulare County made merely a nominal output, which was $4,303 less than in 1905.

VENTURA AND YUBA COUNTIES.

These counties have 29 producing mines, 6 being quartz and 23 placer mines, all, with the exception of one, being in Yuba County. An increase in output is shown of $992,392 in gold and of $2,511 in silver, a total of $994,903. This is the largest increase of gold for any county in the State for 1906, and was entirely due to the dredging operations near Marysville, on the Yuba River. At the time of the previous annual report the large dredging machines in the river had just started, but they have been continuously at work during 1906. Since then other dredges have been installed, and the output of gold will be materially increased in the near future. Hydraulic and surface placer operations are being successfully conducted at Brownsville, Rackerby, Smartsville, Strawberry Valley, Wheatland, and Woodleaf; but the bulk of the gold output comes from the dredges near Marysville. There are also some quartz operations at Browns Valley and Dobbins, but none of them are of great importance as yet. Since the year 1906 closed some larger operations in quartz mining have been inaugurated.

COLORADO.

By Chester Naramore.

PRODUCTION.

Reports received from producing mines in Colorado in 1906 show that the output of the State was 1,122,814.17 fine ounces of gold, valued at $23,210,629, a decrease of 87,720.56 fine ounces, or $1,813,344, as compared with 1905. On the other hand, there were 12,216,830 fine ounces of silver reported, valued at $8,185,276, a gain in quantity of 717,523 fine ounces and in value of $1,239,695. The average price per fine ounce of silver in 1906 was 67 cents against 60.4 cents in 1905.

Reports were received from 664 mines in 33 counties, as compared with 513 mines from 24 counties in 1905, but in most cases the gains represent small intermittently active placer diggings or properties being developed. There were 38 placers in active operation—15 more than in 1905. The 626 deep mines, an increase of 151 mines, produced 2,648,923 tons of ore, or 144,836 more tons than were mined in 1905.

There was a falling off in the quantity of lead and copper produced, especially the latter, but the increased prices paid for these metals resulted in a gain in the total value of each. The zinc product increased, as is shown in the following table.

There was a slight falling off in average metallic value per short ton of all ores from $17.37 per ton in 1905 to $16.51 per ton in 1906.

Production of gold, silver, and associated metals in Colorado in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	1,210,534.73	$25,023,973	1,122,814.17	$23,210,629	−87,720.56	−$1,813,344
Silver....do....	11,499,307	6,945,581	12,216,830	8,185,276	+ 717,523	+ 1,239,695
Copper [a]....pounds..	6,336,366	988,473	5,720,929	1,104,139	− 615,437	+ 115,666
Lead....do....	111,585,060	5,244,498	104,102,269	5,933,829	− 7,482,791	+ 689,331
Zinc....do....	83,150,445	4,905,876	86,965,308	5,304,884	+ 3,814,863	+ 399,008
Total....	....	43,108,401	....	43,738,757	....	+ 630,356

[a] Note that these copper figures are those returned by the producers, both in 1905 and 1906. The smelter returns—9,404,830 pounds—were used in the 1905 report, but it is thought proper to use the mines returns in this place, even if they should fall behind the actual output on account of small percentages of copper in certain ores which can not be definitely placed.

Production of gold, silver, copper, lead, and zinc in Colorado in 1906, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ozs.*		*Fine ozs.*	
Boulder....	44	5,528	9,131.72	$188,769	21,923	$14,688
Chaffee....	16	14,134	2,804.05	57,965	54,609	36,588
Clear Creek....	71	64,774	25,626.81	529,753	652,796	437,373
Conejos....	1	85	71.30	1,474	748	501
Costilla....	2	28	20.60	426	....	....
Custer....	12	3,543	789.39	16,318	79,480	53,252
Delta....	1	....	1.88	39	....	....
Dolores....	8	2,242	454.64	9,398	34,290	22,974
Douglas....	1	....	.20	4	....	....
Eagle....	16	15,986	2,494.27	51,561	94,912	63,591
Fremont....	3	1,010	3.72	77	79	53

Production of gold, silver, copper, lead, and zinc in Colorado in 1906, by counties—Con.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ozs.*		*Fine ozs.*	
Garfield	2	....	2.66	$55	3	$2
Gilpin	90	114,662	53,981.74	1,115,902	242,478	162,460
Gunnison	20	31,103	4,233.05	87,505	70,798	47,435
Hinsdale	16	7,086	1,185.68	24,510	87,940	58,920
Jefferson	1	5	....	....	....	....
Lake	61	672,055	73,016.30	1,509,381	3,890,338	2,606,526
La Plata	8	7,757	14,702.62	303,930	121,711	81,546
Larimer	1	460	43.73	904	1,136	761
Mesa	1	....	22.89	473	15	10
Mineral	13	126,164	7,713.14	159,445	1,150,318	770,713
Montezuma	1	....	4.02	83	....	....
Montrose	1	....	5.51	114	3	2
Ouray	23	48,468	47,996.66	992,179	916,256	613,892
Park	16	10,072	19,110.53	395,050	144,815	97,026
Pitkin	27	203,400	56.69	1,172	2,131,374	1,428,021
Rio Grande	2	70	415.06	8,580	152	102
Routt	8	....	336.24	6,951	42	28
Saguache	7	999	368.99	7,628	737	494
San Juan	26	196,438	43,545.96	900,175	690,076	462,351
San Miguel	21	386,735	118,411.84	2,447,790	1,672,522	1,120,590
Summit	39	34,050	6,761.55	139,773	107,752	72,194
Teller	105	702,069	689,500.73	14,253,245	49,527	33,183
Total	664	2,648,923	1,122,814.17	23,210,629	12,216,830	8,185,276

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Boulder	3,539	$683	47,491	$2,707	....	....	$206,847
Chaffee	349,466	67,447	1,227,019	69,940	717,703	$43,780	275,720
Clear Creek	235,375	45,427	3,307,001	188,499	1,755,805	107,104	1,308,156
Conejos	....	....	....	....	....	....	1,975
Costilla	....	....	....	....	....	....	426
Custer	2,725	526	115,960	6,610	....	....	76,706
Delta	....	....	....	....	....	....	39
Dolores	199,379	38,480	118,229	6,739	22,506	1,373	78,964
Douglas	....	....	....	....	....	....	4
Eagle	130,233	25,135	307,755	17,542	1,065,082	64,970	222,799
Fremont	....	....	....	....	568,508	34,679	34,809
Garfield	....	....	....	....	....	....	57
Gilpin	638,002	123,134	510,791	29,115	....	....	1,430,611
Gunnison	....	....	248,737	14,178	328,180	20,019	169,137
Hinsdale	63,621	12,279	753,950	42,975	30,475	1,859	140,543
Jefferson	3,150	608	....	....	....	....	608
Lake	2,092,735	403,898	47,456,964	2,705,047	71,702,721	4,373,866	11,598,718
La Plata	445	86	2,228	127	....	....	385,689
Larimer	41,331	7,977	....	....	....	....	9,642
Mesa	....	....	....	....	....	....	483
Mineral	....	....	13,038,333	743,185	3,562,737	217,327	1,890,670
Montezuma	....	....	....	....	....	....	83
Montrose	....	....	....	....	....	....	116
Ouray	297,741	57,464	5,025,385	286,447	10,377	633	1,950,615
Park	14,399	2,779	966,193	55,073	....	....	549,928
Pitkin	....	....	17,951,674	1,023,245	3,673,755	224,099	2,676,537
Rio Grande	....	....	....	....	....	....	8,682
Routt	....	....	....	....	....	....	6,979
Saguache	....	....	49,141	2,801	....	....	10,923
San Juan	1,549,663	299,085	4,515,317	257,373	584,476	35,653	1,954,637
San Miguel	70,725	13,650	7,158,189	408,017	....	....	3,990,047
Summit	27,120	5,234	1,301,912	74,209	2,942,983	179,522	470,932
Teller	1,280	247	....	....	....	....	14,286,675
Total	5,720,929	1,104,139	104,102,269	5,933,829	86,965,308	5,304,884	43,738,757

The mining industry in Colorado suffered from several temporary hindrances during 1906 which materially reduced the quantity of metals marketed, but the increased prices received brought greater total returns. A larger number of active mines and an increased tonnage show that the industry is still in a very flourishing condition in spite of the fact that several of the State's largest mines made a diminished output, owing to accidents. Widespread increased activity in exploitation and development work in the larger camps augur well for a greater production in 1907. An almost universal demand from all portions of the State for more miners, and an absence of all labor troubles indicate improved conditions.

Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Colorado in 1905 and 1906, by counties.

County.	Total tons of ore sold or treated.		Number of mines producing (including placers).	
	1906.	(+) increase or (−) decrease.	1905.	1906.
	Short tons.	*Short tons.*		
Boulder	5,528	− 4,049	31	44
Chaffee	14,134	+ 726	15	16
Clear Creek	64,774	+ 5,999	49	71
Conejos	85	+ 73	1	1
Costilla	28	+ 28	....	2
Custer	3,543	− 1,012	4	12
Delta	....	....	....	1
Dolores	2,242	− 1,584	5	8
Douglas	....	....	....	1
Eagle	15,986	+ 3,937	9	16
Fremont	1,010	+ 1,010	....	3
Garfield	....	....	....	2
Gilpin	114,662	− 68,211	66	90
Grand	....	− 12	1	....
Gunnison	31,103	+ 25,522	18	20
Hinsdale	7,086	+ 2,045	10	16
Jefferson	5	− 10	4	1
Lake	672,055	+ 23,591	61	61
La Plata	7,757	+ 2,095	4	8
Larimer	460	+ 460	....	1
Mesa	....	....	....	1
Mineral	126,164	+ 34,826	10	13
Montezuma	....	....	....	1
Montrose	....	....	....	1
Ouray	48,468	− 50,498	14	23
Park	10,072	+ 3,327	19	16
Pitkin	203,400	+ 95,473	25	27
Rio Grande	70	+ 70	....	2
Routt	....	....	2	8
Saguache	999	+ 503	4	7
San Juan	196,438	− 7,701	20	26
San Miguel	386,735	+ 95,397	19	21
Summit	34,050	− 2,880	34	39
Teller	702,069	− 14,289	88	105
Total	2,648,923	+144,836	513	664
Average total value per ton	....	....	$17.37	$16.51

Number of mines in Colorado, classified by chief product, in 1906, by counties.

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				18	1	19	*a* 4		2			44
Chaffee	2					1	*ab* 4	*c* 3	*d* 2	1	*d* 3	16
Clear Creek		4		4	4	24	6	3	12	3	11	71
Conejos						1						1
Costilla						2						2
Custer				1	5	1	1		2	2		12
Delta		1										1
Dolores					1		*e* 3	*f* 1	*d* 2	1		8
Douglas		1										1
Eagle				1		5	4	1	2	2	*d* 1	16
Fremont				1	1						1	3
Garfield		2										2
Gilpin		2		8		43	28	5	4			90
Gunnison					1	7			6	4	*g* 2	20
Hinsdale						3	2	4	4	1	*d* 2	16
Jefferson							*a* 1					1
Lake		3		3	8	7	2	*h* 3	12	17	*di* 6	61
La Plata						5	1	1	1			8
Larimer							1					1
Mesa		1										1
Mineral					4	2			2	1	*j* 4	13
Montezuma		1										1
Montrose		1										1
Ouray					1	3	9		7	1	2	23
Park	2	1		1	5	4		1	2			16
Pitkin				1					1	22	3	27
Rio Grande						2						2
Routt		6	2									8
Saguache						5			1	1		7
San Juan						*e* 6	6	*c* 6	*d* 4	2	2	26
San Miguel	1	1		4		7	1	1	3	3		21
Summit	6		1	6		1	1		11	1	*g* 12	39
Teller				105								105
Total	11	24	3	153	31	148	74	29	80	62	49	664

a One copper mine.
b One copper-silver-zinc mine.
c One silver-copper-lead mine.
d One gold-silver-zinc-lead mine.
e One silver-copper mine.
f One gold-silver-copper-lead-zinc mine.
g Two zinc mines.
h Two gold-silver-copper-lead-zinc mines.
i One zinc mine.
j Four gold-silver-lead-zinc mines.

The gold-mining industry of Colorado during 1906 was seriously hampered in Teller, Ouray, and San Juan counties, but made substantial gains in San Miguel, Lake, Chaffee, Clear Creek, Gunnison, and La Plata counties. Thirty-two counties made returns, including 6 in which only small quantities of placer gold were recovered. This is a gain of 8 counties as compared with 1905. Teller, San Miguel, Lake, and Gilpin counties each exceeded the million-dollar mark, while Ouray and San Juan counties each produced over $900,000.

The siliceous and dry ores, representing 67 per cent of the total tonnage of the State, were the source of more than 96 per cent of the gold production. The remaining 4 per cent was derived from copper, lead, lead-zinc, zinc, and copper-lead ores and the placer mines.

Gold from copper ores increased from 3,884.13 fine ounces to 9,185.58 fine ounces, and was derived principally from Gilpin and San Juan counties, but also in large quantities from Clear Creek, Eagle, Hinsdale, and Ouray counties. There were 19,679.77 fine ounces of gold saved from lead ores in 1906, as compared with 31,667.99 ounces in 1905 and with 70,641 ounces in 1904. Lake, Clear Creek, Ouray, San

Miguel, and Park counties were the chief producers. In addition, 335.41 fine ounces were saved from copper-lead ores, of which Gilpin County furnished the bulk. Eagle and Summit counties produced 594.58 fine ounces of gold from zinc ores, as compared with 1,846.39 fine ounces in 1905. Gold in lead-zinc ores increased from 3,047.55 to 11,077.88 fine ounces, of which Mineral and Lake counties furnished the larger portion.

The placer production increased in Chaffee, Summit, Park, and Routt counties, but fell off in Jefferson and San Miguel counties. Small quantities of placer gold were also recovered in Clear Creek, Delta, Douglas, Garfield, Gilpin, Lake, Mesa, Montezuma, and Montrose counties. One large dredge was working in Summit County, and 2 small dredges were digging in Routt County. Hydraulic mines were active in Summit, Chaffee, and Park counties. The remaining placer production resulted from small sluicing and panning operations.

Source of gold product in Colorado in 1906, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Lead-zinc ores.	Copper-lead ores.	
Boulder		8,801.22	4.26	326.24				9,131.72
Chaffee	1,481.48	196.89	35.60	674.83		373.26	41.99	2,804.05
Clear Creek	75.85	20,296.46	798.00	4,011.53		386.92	58.05	25,626.81
Conejos		71.30						71.30
Costilla		20.60						20.60
Custer		780.92	4.98	3.49				789.39
Delta	1.88							1.88
Dolores		363.40	79.48	8.57			3.19	454.64
Douglas	.20							.20
Eagle		1,596.33	356.09	142.27	394.55		5.03	2,494.27
Fremont		3.72						3.72
Garfield	2.66							2.66
Gilpin	26.99	48,233.97	5,033.18	567.58			120.02	53,981.74
Gunnison		4,077.14		155.91				4,233.05
Hinsdale		646.10	267.37	217.74		.39	54.08	1,185.68
Jefferson								
Lake	64.92	65,878.50		4,568.95		2,503.93		73,016.30
La Plata		14,640.21		1.36			61.05	14,702.62
Larimer			43.73					43.73
Mesa	22.89							22.89
Mineral		117.55		336.11		7,259.48		7,713.14
Montezuma	4.02							4.02
Montrose	5.51							5.51
Ouray		43,569.29	518.24	3,898.49		2.27	8.37	47,996.66
Park	487.81	17,394.09		1,225.00			3.63	19,110.53
Pitkin		56.69						56.69
Rio Grande		415.06						415.06
Routt	336.24							336.24
Saguache		365.75		3.24				368.99
San Juan		41,009.72	2,046.88	200.90		288.46		43,545.96
San Miguel	85.43	115,229.93		3,096.48				118,411.84
Summit	(a)	6,055.50	1.77	241.08	200.03	263.17		6,761.55
Teller		689,500.73						689,500.73
Total	2,595.88	1,079,321.07	9,189.58	19,679.77	594.58	11,077.88	355.41	1,122,814.17

a Placer gold included with siliceous ore, to hide individual production.

The silver output of Colorado totaled 12,216,830 fine ounces, valued at $8,185,276, a gain in quantity of 717,523 fine ounces and in value of $1,239,695. This increase should be accredited in the main to Ouray, San Miguel, Mineral, and Park counties, and in a less degree to Custer, Eagle, Gunnison, Hinsdale, and La Plata counties. Large decreases were reported from Pitkin, Lake, Summit, and Gilpin counties, and smaller decreases from Boulder, Chaffee, Clear Creek, Dolores, and San

Juan counties. The principal silver-producing counties of Colorado in 1906 rank according to output as follows: Lake, Pitkin, San Miguel, Mineral, Ouray, San Juan, and Clear Creek. An increased tonnage of silver-lead ores in Ouray County resulted in a gain of 609,850 fine ounces of silver.

Considering the source of the silver product by kinds of ore, it is found that 52 per cent of the total output, or 6,351,861 fine ounces, were derived from siliceous ores, as compared with 6,107,559 ounces in 1905. The large increase of silver produced from copper ores (from 55,388 to 317,336 fine ounces) was due to the reduction of greater quantities of silver-bearing pyritic ores from San Juan, Ouray, and Hinsdale counties.

From lead ores over 28 per cent of the total silver output, or 3,436,204 fine ounces of silver, were saved, as against 3,883,827 ounces in 1905. In addition, a small quantity (36,015 fine ounces) was won from copper-lead ores. Zinc and lead-zinc ores furnished 2,073,818 fine ounces, as compared with 1,451,625 fine ounces in 1905. This product measures, in a way, the gain in preparing by concentration and separation this class of ore for market; it makes valuable by separation outputs of ore which were previously of little value.

Source of silver product in Colorado in 1906, by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Total.
		Siliceous or dry ores.	Copper ores.	Lead ores.	Zinc ores.	Lead-zinc ores.	Copper-lead ores.	
Boulder		17,738	6	4,179				21,923
Chaffee	273	3,396	3,226	15,194		27,799	4,721	54,609
Clear Creek	15	463,330	3,957	86,051		99,143	300	652,796
Conejos		748						748
Costilla								
Custer		77,356	100	2,024				79,480
Delta								
Dolores		10,134	15,705	3,451			5,000	34,290
Douglas								
Eagle		44,173	22,064	14,933	10,609		3,133	94,912
Fremont		79						79
Garfield	3							3
Gilpin	6	216,217	11,670	9,785			4,800	242,478
Gunnison		55,260		11,550	2,188	1,800		70,798
Hinsdale		11,189	34,055	33,760		300	8,636	87,940
Jefferson								
Lake	9	1,981,900		1,137,672	27,210	743,547		3,890,338
La Plata		119,508		336			1,867	121,711
Larimer			1,136					1,136
Mesa	15							15
Mineral		899,813		161,521		88,984		1,150,318
Montezuma								
Montrose	3							3
Ouray		198,663	45,014	667,494		227	4,858	916,256
Park	107	33,929		108,079			2,700	144,815
Pitkin		362,198		786,068		983,108		2,131,374
Rio Grande		152						152
Routt	42							42
Saguache		389		348				737
San Juan		328,057	179,797	160,392		21,830		690,076
San Miguel	79	1,449,598		222,845				1,672,522
Summit	1,044	28,507	606	10,522	18,000	49,073		107,752
Teller		49,527						49,527
Total	1,596	6,351,861	317,336	3,436,204	58,007	2,015,811	36,015	12,216,830

The quantity of copper reported from the producers amounted to only 5,720,929 pounds—less by 615,437 pounds than were reported in 1905, but owing to a gain of 3.7 cents per pound in the average price for 1906 over that of 1905 the total value was greater by $115,666.

These figures represent the number of pounds of copper for which the miner received some pay. The smelter output is somewhat in excess of this figure, since much of the ores from Colorado contain smaller quantities of copper than are paid for by the buyers. This metal brings less returns to the miners of Colorado than any of the five metals here considered. Excepting a few small mines whose total output is negligible, there are no copper mines proper in the State, and almost the entire output is derived from ores carrying greater values in the other metals. In a few mines, especially in Chaffee, Dolores, Ouray, and San Juan counties, copper forms the principal value in the ore, but not the entire value. In this connection it is noteworthy that Lake County produced 2,092,735 pounds, or nearly 37 per cent, of the total output of the State, yet there were no ores which could be classed as copper ores. The principal copper-producing counties according to output in 1906 were Lake, San Juan, Gilpin, Chaffee, Ouray, Clear Creek, Dolores, and Eagle. Of these, only Lake, San Juan, and Chaffee counties made diminished outputs.

As was the case with copper, the lead fell off greatly in quantity, dropping 7,482,791 pounds below the figures of 1905, but increased prices raised the total value $689,331. Greater returns were received from the mines of Boulder, Clear Creek, Custer, Eagle, Gunnison, San Miguel, Mineral, Ouray, and Park counties. The combined gains of the last three counties totaled 5,418,000 pounds. The mines of Chaffee, Dolores, Gilpin, Hinsdale, Saguache, Summit, Lake, Pitkin, and San Juan counties lessened their output. The aggregate decreases made by the last 3 counties amounted to 11,669,000 pounds. Counties producing more than a million pounds of lead in 1906, arranged according to output, were Lake, Pitkin, Mineral, San Miguel, Ouray, San Juan, Clear Creek, Summit, and Chaffee.

The ores of Lake and Pitkin counties occur largely as replacements in limestone; they produced 65,408,638 pounds of lead in 1906, while the balance of the State's production, or 38,693,631 pounds, was chiefly from ores occurring in fissure veins.

In accounting for a smaller lead output, in connection with a greater silver production, it is noted that decreases in lead were made by the same counties which fell off in silver production, with the exception of Boulder and Clear Creek. Generally speaking, the falling off in the State total of lead was caused by lime-replacement ores averaging comparatively higher in silver and lower in lead than in 1905. Furthermore, there was a decreased quantity of lead ores and an increased quantity of silver-bearing siliceous ores, poor in lead. In view, however, of the prevailing high prices of these metals, the reduced production of lead and copper is difficult of explanation further than is given in the reasons assigned for the diminished tonnages in the individual county descriptions which follow, including shortage of cars, labor, and mills—the last due to fire and snow in the San Juan region.

Zinc shows the substantial gain of 3,814,863 pounds in quantity and of $399,008 in value, the total for 1906 being 86,965,308 pounds, valued at $5,304,884. This quantity must not be taken to represent actual figures of spelter produced, as a portion of Colorado zinc and zinc-lead ores are never reduced to spelter, but are converted directly into pigments. Therefore, these figures indicate, as closely as could be estimated (by subtracting 25 per cent from the assay value of ores shipped to smelters), the quantity of zinc (spelter) which would have been produced from Colorado ores had none been used for other purposes. This method of recording the zinc output is used in an effort to place the metal on a plane for comparison with the lead and copper productions. A small percentage of lead is also used in paint manufacture, but it is likewise listed as metallic lead in this report. In future reports an attempt will be made to separate approximately the ores used for pigments from those smelted for zinc, but the difficulties of such a separation are considerable. In many cases the mine owner may, indeed, not know for what purpose the ore is used.

Colorado is second only to Missouri as a producer of zinc, but in the latter State zinc is the primary metal sought, while in Colorado, with few notable exceptions, the zinc occurs as a by-product in the ores of other metals. Until late years the zinc content detracted from the value of the ore and often made it unsalable; but with the advent of successful separating and concentrating mills, accompanied by advanced prices, the zinc rapidly became an asset, and in the large silver-lead camps of Colorado—especially Leadville—it aided materially in the recovery of these districts from the depression which followed the demonetization of silver. The following counties showed increased production of zinc: Chaffee, Fremont, Hinsdale, Lake, Mineral, and San Juan, while diminished outputs were recorded from Clear Creek, Dolores, Eagle, Ouray, Pitkin, and Summit counties. The gains made by Mineral and Lake counties total nearly 8,000,000 pounds, while the combined decreases of Eagle, Dolores, and Pitkin counties amounted to nearly 5,000,000 pounds. Lake County (Leadville), with a production of 71,702,721 pounds and a gain of 6,846,688 pounds, is accredited with over 82 per cent of the State's total output, and more than nine-tenths of the total increase of zinc.

The smelters of Colorado had a successful year. Technically, the most interesting feature was the adoption of the Huntington-Heberlein roasting process at the different plants of the American Smelting and Refining Company. In September the refining plant of the Boston and Colorado Smelting and Refining Company, at Argo, near Denver, was destroyed by fire and has not been rebuilt, but the matte has been shipped to the American Smelting and Refining Company's refinery at Omaha. This leaves the State of Colorado without plants in operation for the refining of lead bullion or the bessemerizing of copper matte. Considerable construction work has been in progress at the Ohio and Colorado Smelting Company's plant at Salida. The Grand Junction smelter made an unsuccessful run during the year, principally on ores from Eagle and Ouray counties. At Silverton the Ross Mining and Milling Company resumed smelting operations at the Kendrick and Gelder pyritic smelter on ores from their own mines and some custom ores. In Ouray County the Saratoga pyritic smelter ran part of the summer.

The following list gives the smelting plants in Colorado in 1906:

List of Colorado smelting plants in 1906.

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	Ross Mining and Milling Co.
Grand Junction [b]		Grand Junction Smelting Co.
Pearl [b]		National Mining and Milling Co.
Ouray	Saratoga	Continental Smelting and Reduction Co.

[a] Zinc ores. [b] Pyritic smelting.

Subdivision of tonnage of crude ore sold or treated in 1906 in Colorado, by counties, in short tons.

County.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc.	Lead-zinc ores.	Copper-lead ores.	Total.
Boulder	5,278	9	241				5,528
Chaffee	301	6,249	3,150		3,869	565	14,134
Clear Creek	46,734	455	11,483		5,802	300	64,774
Conejos	85						85
Costilla	28						28
Custer	3,380	25	138				3,543
Delta							
Dolores	132	1,933	97			80	2,242
Douglas							
Eagle	2,511	3,185	192	10,078		20	15,986
Fremont	10			1,000			1,010
Garfield							
Gilpin	111,559	1,449	1,054			600	114,662
Gunnison	30,267		245	491	100		31,103
Hinsdale	3,672	301	2,872		10	231	7,086
Jefferson		5					5
Lake	201,878		210,404	9,039	250,734		672,055
La Plata	7,708		7			42	7,757
Larimer		460					460
Mesa							
Mineral	42,836		6,624		76,704		126,164
Montezuma							
Montrose							
Ouray	39,129	1,838	7,416		51	34	48,468
Park	6,434		3,588			50	10,072
Pitkin	21,843		43,155		138,402		203,400
Rio Grande	70						70
Routt							
Saguache	958		41				999
San Juan	166,080	15,505	2,309		12,544		196,438
San Miguel	371,047		15,688				386,735
Summit	18,600	17	870	11,316	3,247		34,050
Teller	702,069						702,069
Total	1,782,609	31,431	309,574	31,924	491,463	1,922	2,648,923
Average recovered value per ton in gold and silver.	$14.90	$12.82	$8.75	$1.60	$3.21	$16.38	$11.81

PRODUCTION BY INDIVIDUAL COUNTIES.

BOULDER COUNTY.

The precious metal output of Boulder County for 1906 shows another large decrease. There were produced 9,131.72 fine ounces of gold, valued at $188,769—a loss in value of $72,832; and 21,923 fine ounces of silver, valued at $14,688—a decrease of 48,998 fine ounces. The small copper production was increased by over one-half of the 1905 output, and there was a small lead production amounting to 47,491 pounds, valued at $2,707.

With 44 producing mines, a gain of 13 mines, the total tonnage dropped to 5,528 short tons, a trifle more than one-half the tonnage of 1905, but the average value per ton increased from $31.81 to $37.42. This resulted from the fact that several properties shipped only the higher grade ore and withheld the lower grade for treatment in mills not then completed. The increased mining for tungsten at Nederland is also responsible, in a measure, for the diminished gold and silver production, in that the high price of tungsten during 1906 made it more profitable and attractive to the miners of Boulder County.

The completion of several important mills for the handling of low-grade ores gives promise of a somewhat larger production during 1907.

Central district.—This district, located about Jamestown, with 5 producing mines (2 more than in 1905), increased its metal output from $5,168 to $19,213. The Wano group, of the Monarch Consolidated Gold and Copper Mining and Smelting Company, was the principal producer. The development in this mine includes a 190-foot shaft and a 500-foot tunnel. The production was derived from a preliminary run from the new 50-ton roaster and cyanide mill. The Grand Central and Big Blossom mines made some small shipments of high grade ore which was taken out in development work in two tunnels, one 770 feet and the other 800 feet long. Other producers include the Smuggler, the Rip Van Dam, and the Red Spruce mines.

Gold Hill district.—This district, which includes Gold Hill, Rowena, Salina, and Sunshine, was the most active during 1906. Fifteen mines produced 2,351 tons, an increase of 6 mines and a decrease of 14 tons; but the total value increased $7,799. The Belle group, Cash-Birkin, Corona and Black Cloud, Ingram, Inter Ocean, Lucky Star, Richmond, and Slide mines were the chief producers. The Black Cloud mine is developed by a 200-foot tunnel, 3,000 feet of drifts on the vein and 300 feet of winzes, and is equipped with a 30-ton amalgamating and concentrating mill, using rolls and Huntington mill. Several other properties reported development work for 1906.

Grand Island district.—In the southwestern corner of the county the Grand Island district increased the number of shipping mines from 2 to 5, but the tonnage and value decreased about one-half. The Boulder County mine has a 350-foot shaft and 3,200-foot crosscut tunnel, and is equipped with a 10-stamp amalgamation and concentration mill. The U. S. Gold Corporation has spent four years in developing its properties and expect to begin shipping on a much larger scale during 1907. The Highland Mary Company is pushing its drainage and transportation tunnel, which will aid in opening up several adjoining properties.

Magnolia district.—There was increased activity in Magnolia district, including the Cash mine, the Fortune and New Year, and the Hereafter and Mountain Lion groups. Ore from the Cash mine is handled by the new cyanide plant after roasting.

Sugar Loaf district.—The Sugar Loaf district was second in importance as a producer during 1906, having fallen off to about one-half of the totals for 1905. The Livingston mine did not operate its 10-ton cyanide plant, but shipped directly to samplers. The Clinton Mining and Milling Company was the leading producer of the county in 1906, but did not equal its total for 1905. A few other properties are being developed.

Ward district.—There was a slight improvement in conditions in the Ward district last year. The Big Five Tunnel, Ore Reduction, and Transportation Company operated the Columbia, the Dew Drop, and the Ni Wot mines. This company has a 100-ton concentrating mill. The Golden Slipper Mining and Milling Company carried on extensive mill tests. The Myrtle Mining Company suffered a severe loss in the destruction of its cyanide plant by fire. In addition, several properties were actively developing.

CHAFFEE COUNTY.

Metallic production of Chaffee County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	1,566.28	$32,378	75,265	$45,460	379,722	$59,237
1906	2,804.05	57,965	54,609	36,588	349,466	67,447
Increase (+) or decrease (−)	+1,237.77	+25,587	−20,656	−8,872	−30,256	+8,210

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	1,250,302	$58,764	315,495	$18,614	$214,453
1906	1,227,019	69,940	717,703	43,780	275,720
Increase (+) or decrease (−)	−23,283	+11,176	+402,208	+25,166	+61,267

In 1906 Chaffee County made substantial gains in the production of gold and zinc, but the silver, copper, and lead returns show a falling off. In the case of copper and lead the increased market price for a decreased quantity caused a gain in total value. The gold output amounted to $57,965 as against $32,378, while the silver output diminished from 75,265 fine ounces to 54,609 fine ounces, valued at $36,588. The zinc production was more than doubled, reaching 717,703 pounds, valued at $43,780.

From the same number of deep mines (14) as in 1905 there were mined 14,134 short tons of ore, averaging $15.97 per ton in value, and $4.51 in gold and silver values. This is an increase of 726 tons and $1.10 in average value, but a slight decrease in precious metal values.

The placer product of Granite district was doubled, and some placer work was done in the Turret district.

Chalk Creek district.—There was renewed activity and shipments from 2 gold mines in the Chalk Creek district. The J. A. J. Milling Company resumed operations at the Mary Murphy mine, and the Baalbec Company worked its property. The values from this district were mainly in gold, lead, and zinc.

Cleora district.—Large shipments of copper ores, carrying values in silver and zinc, were made from the Sedalia mine in the Cleora district, 6 miles north of Salida. This mine has about 3,000 feet of tunnels and is erecting a 50-ton Wilfley concentrating mill.

La Plata or Winfield district.—This district, 15 miles west of Granite, continued small shipments of silver ores.

Monarch district.—Monarch district, including the mines in the vicinity of Monarch and Garfield, produced over 65 per cent of the values derived from the deep mines of Chaffee County. Increases were made in tonnage, and in gold, copper, and zinc production; but a decreased quantity of silver and lead reached the market. The Colorado Mines Exploration Company worked through tunnels the famous Madonna mine, the largest producer. The Lilly mine was operated by the Taylor Mountain Mining Company, and produced copper ore containing some lead and silver. The mine is opened by a 386-foot shaft and a 1,500-foot tunnel. A complete surface equipment includes a 7,200-foot aerial tramway. Other shipping mines include the properties of the Vega Consolidated Mining Company, and the Fairplay, the Garfield, and the Shamrock mines.

Riverside district.—On Mount Harvard, in the Riverside district, northwest of Buena Vista, Messrs. Leonhardy & Son have run the Harvard Tunnel in 400 feet on the vein and have made some shipments of gold, silver, copper, and lead ores.

Turret district.—The mines of this district were operated rather intermittently during 1906, but maintained a fair total output. The principal producers were the Independence, the Vivandiere, and the Copper King lode mines, and the Browns Canyon placer mine.

CLEAR CREEK COUNTY.

Metallic production of Clear Creek County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	24,366.42	$503,698	692,437	$418,232	235,669	$36,764
1906	25,626.81	529,753	652,796	437,373	235,375	45,427
Increase (+) or decrease (−)	+1,260.39	+26,055	−39,641	+19,141	−294	+8,663

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	3,270,211	$153,700	1,869,995	$110,330	$1,222,724
1906	3,307,001	188,499	1,755,805	107,104	1,308,156
Increase (+) or decrease (−)	+36,790	+34,799	−114,190	−3,226	+85,432

The total value of metallic production from Clear Creek County in 1906 amounted to $1,308,156, a gain of $85,432 over the output of 1905. This value was derived from 64,774 short tons of ore mined from 67 deep mines, with the exception of $1,578 produced by 4 placer mines, as compared with 58,775 tons of ore extracted from 46 deep mines and 3 placers, which produced $1,908 in 1905.

The gold product of 25,626.81 fine ounces, valued at $529,753, was a gain of $26,055. The silver production of 652,796 fine ounces, valued at $437,373, represented a decrease in quantity of 39,641 fine ounces, but an increase in value of $19,141. Likewise, there were 294 pounds less copper produced, but the total value increased $8,663. The lead output made a substantial gain in quantity as well as in value, while the zinc production decreased in both quantity and value.

The average value per ton of ore was $20.14 against $20.77 in 1905, and the average gold and silver values dropped from $15.65 to $14.91.

The activity in the mining industry of this county was greater during 1906 than this comparison of figures indicates, but much of it was expended in development work. Many tunnels with their laterals are exposing ore reserves in nearly all the county's many districts. It is estimated that more than 20 miles of tunnel work have been completed as parts of tunnel schemes totaling 100 miles, and it has been stated that 90 per cent of the development work has been accomplished by means of tunnels. In the spring work was resumed in the Newhouse tunnel, and by the end of the year the breast had been advanced 2,165 feet, making the total length 17,208 feet. Some of the other tunnel enterprises include the Hoosac, in 1,000 feet, with 3,500 feet to bore; the Freeland, 5,100 feet in and 3,500 feet to run; the United Gold Mining, Milling and Tunnel Company's tunnel, in 830 feet, to be 3,000 feet long; the Central tunnel of the Big Five Company; the Lucania and the Banner tunnel, all in Idaho district and boring toward Gilpin County. The Seeman tunnel, in Lincoln district, is in 2,300 feet. Besides those mentioned later in district descriptions of Upper Clear Creek, the Rockford tunnel, in Trail district, and the Honest John tunnel should be noted.

There was a notable increase in the number of properties using electrical power throughout the county.

Idaho district.—This district embraces the mines in the vicinity of Idaho Springs, including Banner, Coral, Lower Fall River, Payne's Bar, Spanish Bar, and Virginia subdistricts. Compared with the production from the corresponding territory during 1905, there were large decreases in tonnage and in output of gold, silver, and zinc, but the copper and lead totals were nearly doubled. A large portion of the ore is extracted from property tributary to the Newhouse tunnel. The ores are gold-silver-bearing sulphides of lead and copper and occur in fissure veins.

The principal producing mines of this section in 1906 included the Consolidated Gem mines, the Silver Age and Franklin, the Little Mattie group, the Sun and Moon group, the Shafter, the Stanley mines, the Metropolitan, and the mines of the Big Five Tunnel Company. Few of the mines have their own reduction plants, but there are many large custom mills centrally located at Idaho Springs.

Griffith district.—Griffith district includes the mines about Georgetown and Silver Plume, and the producing mines of Queen's district are merged with Griffith district in this report. The output from this section amounted to $2,326 in gold, 190,705 fine ounces of silver, 741,580 pounds of lead, and 1,352,559 pounds of zinc, with a total value of $254,874.

There was a decided decrease in the production of all five metals from this section during 1906. Though more mines were shipping, the outputs of the individual mines, including the larger ones, were considerably smaller in nearly all instances. The large decrease in the lead produced in 1906 makes zinc second to silver in value.

The Frostburg-Mendota mine shipped an increased tonnage, but it was of somewhat lower grade and was derived entirely by concentrating ore from old stopes and dumps. The Dives-Pelican and Seven-Thirty mines are opened by shafts and tunnels, and are equipped with a 200-ton concentrating mill. The Colorado Central mine of the Aliunde Consolidated Mining Company is developed by a 600-foot shaft and by 3 tunnels—the Marshall tunnel, 1,800 feet; the Equator tunnel, 1,500 feet, and Ocean Wave tunnel, 4,000 feet long. The Whiting Mining and Milling Company, operating the Terrible and the Dunderberg lodes, has a vertical shaft 525 feet deep and a 700-foot tunnel, and the surface plants include a 150-ton concentrator with jigs and tables. The Scotia mine was operated a portion of the year. This is opened by a 2,500-foot tunnel, and is equipped with a 50-ton concentrator. A number of other mines made some small shipments, and still others spent the entire year in active development work and in erecting mills, as was the case with the Griffith Mines Company, whose property is opened by a 700-foot shaft and a 12,000-foot tunnel. Including the Kelly tunnel, the Democrat Mountain Mining, Milling, and Tunnel Company have 15,000 feet of shafts, tunnels, and levels. This company completed a 50-ton concentration and separation plant.

Argentine district.—This district, the scene of much development work for the past few years, greatly increased its output, which amounted to $51,116 in gold, 50,485 fine ounces of silver, 10,119 pounds of copper, 623,739 pounds of lead, and 302,000 pounds of zinc, with a total value of $140,869. The Waldorf Mining and Milling Company was the heaviest shipper. Development work includes 3 tunnels—the Stevens, 2,200 feet; the Tobin, 2,400 feet, and the Argentine, 5,000 feet long. The company has two concentrators—one of 100 tons and one of 125 tons capacity. The Pulaski mine is opened by a 355-foot tunnel. The Santiago mine, owned by the Santiago Consolidated Mining, Milling, and Tunnel Company, is developed by 5 tunnels, respectively, 75, 500, 600, 800, and 700 feet long. A 50-ton concentrating plant has been erected. The Josephine Mining and Milling Company and the Key West Mining Company also operated their properties. The East Argentine Mining Company has driven its adit tunnel 1,800 feet, and a crosscut tunnel 1,900 feet. Much development work was accomplished in the great Vidler tunnel under Argentine Pass.

Jackson district.—The Jackson district, southwest of Idaho Springs, had an increased gold and silver production, but a decreased lead output. There were increased shipments from the Black Eagle mine, which is developed by a 550-foot shaft. Other producing mines include the Beaver mine, owned by the Sterling Mines and Tunnel Company, the Gold Leaf mine, and the Doret mine.

Trail district.—The trail district, or the Lamartine-Freeland section, also reports a larger production than in 1905. The Gum Tree mine is opened by a 600-foot shaft, a 250-foot tunnel, and about 5,000 feet of levels. The Champion mine was closed a portion of the year, awaiting the advent into its proximity of the Rockford tunnel for cheaper drainage and ore transportation. The Brighton, the Old Stag, the Solid Muldoon, and the Teller mines were also included among the producers.

Upper Union district.—The Upper Union district, or Empire section, also made a considerable gain in production for 1906. The Specie Payment Gold Mining Company had a successful year. The development work now includes a 600-foot shaft and 2,600 feet of tunneling. The Gold Dirt mine is developed by a 3,300-foot tunnel which connects with the bottom of a 515-foot shaft. The Pioneer mine has a 300-foot vertical shaft, 360 feet of crosscut tunneling, and about 400 feet of drifts. Other active mines include the Silver Mountain, the Mint, and the Gold Fissure mines.

Montana District.—In the Montana district about Dumont, the Jo Reynolds mine was worked through a 3,500-foot adit, which connects with old shafts and levels. The ore is handled in a 40-ton concentrating plant.

CONEJOS, COSTILLA, AND RIO GRANDE COUNTIES.

There was a decreased production from the mines of Ute district, about Platoro, in the northwest corner of Conejos County. Ore shipped from this section must stand the cost of a 45-mile wagon haul to Monte Vista, the nearest railroad point. Likewise, some of the higher grade gold and silver ores of Summitville district, Rio Grande County, were hauled 28 miles northeast to Del Norte for shipment. A number of properties report small amounts of development and exploitation work during the year.

The mines of Grayback district, at Russell, in the northeastern corner of Costilla County, made a small gold production in 1906.

CUSTER COUNTY.

Metallic production of Custer County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905	1,205.43	$24,918	32,159	$19,424	2,500	$390	....	....	$44,732
1906	789.39	16,318	79,480	53,252	2,725	526	115,960	$6,610	76,706
Increase (+) or decrease (−)	−416.04	−8,600	+47,321	+33,828	+225	+136	+115,960	+6,610	+31,974

There was increased activity in the mines of Custer County during 1906. With 12 producing mines (8 more than in 1905) the total value of the gold, silver, copper, and lead production increased from $44,732 to $76,706. There was a slight decrease in gold, but the silver output more than doubled in quantity and nearly trebled in value. The quantity of copper showed a slight gain, and a good production of lead was reported.

The famous old Bull Domingo mine, which has been flooded since 1899, was unwatered during 1906, and the old workings were found in good condition, so that it will probably add considerably to the silver and lead totals of this county for 1907. The Bassick mine was the principal gold producer last year. It is developed by an 1,800-foot shaft and a 390-foot tunnel. The largest producer in the county and the source of much of the silver output was the Bismuth mine, owned by the Preston Gold Mining and Milling Company. Some of the other shippers were the Wet Mountain and the Silver Cliff group, the King of the Carbonates, the Pocahontas, and the Custer City, all located in the Hardscrabble district, in the center of the county.

In Delta, Douglas, Garfield, Mesa, Montezuma, and Montrose counties small quantities of placer gold and silver were recovered by individuals working along the streams at odd times.

DOLORES COUNTY.

Metallic production of Dolores County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1905	1,681.81	$34,766	76,526	$46,222	119,821	$18,692
1906	454.64	9,398	34,290	22,974	199,379	38,480
Increase (+) or decrease (−)	−1,227.17	−25,368	−42,236	−23,248	+79,558	+19,788

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	840,319	$39,495	1,500,000	$88,500	$227,675
1906	118,229	6,739	22,506	1,373	78,964
Increase (+) or decrease (−)	−722,090	−32,756	−1,477,494	−87,127	−148,711

With the exception of copper, the metal production of Dolores County fell off greatly during 1906, and the total value dropped from $227,675 to $78,964. The idleness of the mines of Lone Cone district, 16½ miles northwest of Rico, accounts for the decrease in gold and silver. The 1906 output was derived from the Pioneer district, about Rico, where shipments were made from 8 properties, as against 4 in 1905. The tonnage amounted to only 2,242 short tons, a decrease of 1,584 tons. A remarkable increase in copper production, coupled with large decreases in the other 4 metals, made the total value of this metal nearly equal to the combined values of the others. Shipments from this section have generally been restricted to the higher grade ores, and large bodies of refractory zinc blende ores, also carrying values in silver, lead, copper, and gold, have been left because of the absence of a suitable method of concentration and separation. It is reported that this problem has been solved by an Australian flotation method, and that a mill is to be erected during 1907. If a successful plant is evolved Rico will rapidly become one of Colorado's foremost zinc producers.

Increased shipments were made from the Wellington mine, which is opened by a 1,037-foot tunnel. The ore is iron pyrites, with copper pyrite, and contains only 2 per cent of silica. The Morning Star mine shipped heavy galena ore, high in lead and silver value and low in gold. Three tunnels aggregate 1,300 feet of development work. The Rico-Aspen group, the Pro Patria, the Swansea-Newman mines, the Gold Anchor, and the Iron Rod are included among the shippers. The mines of this section are all within 2 miles of the railroad.

EAGLE COUNTY.

Metallic production of Eagle County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	2,268.34	$46,891	46,487	$28,078	29,331	$4,576
1906	2,494.27	51,561	94,912	63,591	130,233	25,135
Increase (+) or decrease (−)	+225.93	+4,670	+48,425	+35,513	+100,902	+20,559

Metallic production of Eagle County, Colo., in 1905 and 1906—Continued.

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	156,723	$7,366	2,915,025	$171,986	$258,897
1906	307,755	17,542	1,065,082	64,970	222,799
Increase (+) or decrease (−)	+151,032	+10,176	−1,849,943	−107,016	−36,098

This table shows a moderate gain in gold and large increases in the production of silver, copper, and lead, but the great falling off in the zinc output diminishes the total value of the metallic product in 1906 to $222,799. With 16 shipping mines (7 more than in 1905) the tonnage increased 3,937 short tons, amounting to 15,986 tons. The average value per ton fell from $21.49 in 1905 to $13.94 in 1906, while the average value in gold and silver increased from $6.22 to $7.21 per ton.

Battle Mountain district.—The greater portion of the output was derived from the Battle Mountain district, including the mines at Red Cliff and Gilman. Most of the mines are opened by tunnels and the ores are trammed down the steep sides of Eagle River Canyon to loading stations on the railroad which follows the bottom of the gorge. There is a pressing need in this district for a concentrating plant to handle the lower grade ores, which will not pay to market in the crude state.

The Pittsburg-Gold-Zinc Company shipped an increased tonnage from its Spirit and Iron Mask properties. The Pursey-Chester mines resumed shipping last year, and a portion of their ores was sold to the Grand Junction smelter, during its operation. A 1,300-foot tunnel enters the property on an incline of about 11 degrees. A smaller quantity of ore was taken out from the First Chance and Pine Martin group, which is developed by tunnels, ranging from 30 to 1,200 feet in length. A small quantity of very high grade silver ore was sent out from the Wyoming Valley mine. Shipments were also made from the Champion, the Whipsaw, the Ground Hog group, the Alpine, the Little May, the Last Chance, and the E. R. T. and E. K. Y. mines.

Fulford district.—In the Fulford district, 18 miles southeast of Eagle Station, the Lucy mine is the principal producer. The free milling ore is reduced in a 10-stamp mill, while the copper ore is stored on the dump.

Holy Cross district.—In this district, the French Mountain Mining Company treated ores from the Grand Trunk and the Pelican mines in a cyanide mill. Development work was carried on in other mines in all 3 of these districts.

FREMONT COUNTY.

Fremont County produced $77 in gold, 79 fine ounces of silver, and 568,508 pounds of zinc, valued at $34,679. This was derived from 1,010 tons of ore extracted from 3 mines. Of the zinc, approximately 112,500 pounds were converted to spelter, and the remainder, or 456,000 pounds, was used in the manufacture of mineral paint.

Currant Creek district.—At Micanite, in the north central part of the county, the Isabella mine, owned by W. H. Murray & Son, is opened by a 300-foot vertical shaft.

Canyon district.—Mr. E. E. Smith has two mines in the Canyon district: The Bonanza, developed by a 150-foot shaft and a 100-foot tunnel, produces copper ore carrying gold and silver, while the Wolfram mine has produced tantalite and columbite from surface workings.

Greenhorn district.—Very little mining was done in this district, which is located south of Canyon.

GILPIN COUNTY.

Metallic production of Gilpin County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	70,145.33	$1,450,033	340,901	$205,904	512,276	$79,915
1906	53,981.74	1,115,902	242,478	162,460	638,002	123,134
Increase (+) or decrease (−)	−16,163.59	−334,131	−98,423	−43,444	+125,726	+43,219

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	519,841	$24,433	191,574	$11,303	$1,771,588
1906	510,791	29,115	....	....	1,430,611
Increase (+) or decrease (−)	−9,050	+4,682	−191,574	−11,303	−340,977

The production of the mines in Gilpin County showed a falling off from the high totals reached in 1905 in all metals except copper, which made a very pronounced gain. There were 114,662 tons of ore produced in 1906, a decrease of 68,211 tons, as compared with 1905; but the average value per ton increased from $9.69 to $12.48. This is accounted for by an increased tendency on the part of the lessees and operators to sort the ore more carefully than has been the custom in the past. There were 90 producing mines—a gain of 24—indicating a more general activity in the county. This, coupled with the large amount of development work reported by the different properties, seems to promise an increased output for 1907.

This statement applies in a good measure to the northern districts, including Pine Creek, Boulder Park, Perigo, and Rollinsville sections, tributary to the Moffat road. The year also witnessed the installation of much mining machinery and the erection of several mills.

Gilpin County shares with Clear Creek the benefit to be derived from the resumption of work on the great Newhouse tunnel, as well as from the advent of the other tunnels now being bored from the Clear Creek side. Many prominent lodes are opened at great depth and drained by the Newhouse tunnel, which is now under Quartz Hill, in Gilpin County, and will eventually connect with the Eureka shaft, above Central City.

Central district.—Gold, silver, and copper ores predominate in the Central district, and the principal operating mines include the Mackey-Burroughs, the Ralls County, the Nemeha, the Carr, and the Roderick Dhu. The last has 2 shafts, one 281 feet and the other 557 feet.

Eureka district.—There was a considerable decrease in production from the Eureka district during 1906. The Concrete, the Gunnell group, the Eureka, and the Spur Daisy were active. The Gunnell properties have been put in shape and will aid materially in enlarging the 1907 totals for this section, which will be the terminal end of the Newhouse tunnel.

Gregory district.—The famous Gregory lode—the first discovered in Colorado, which is still being worked in the O'Neill mine—gives this district its name. This section in output is second only to Russell district, and contains many of the mines which have brought prominence to Gilpin County. The largest report comes from the Fifty Gold Mines Company, which has consolidated a number of the most important properties, including the Gregory group, the Cooke, the Fiske, the Bobtail, and others. This company operates an 80-stamp plate amalgamation and concentration mill at Black Hawk. A greatly reduced tonnage was shipped to the smelters from the Running Lode mine, which is opened by a 1,350-foot shaft and 8,000 feet of tunnels. Increased productions were made from the O. K. mine, by the Aztec Mines Company, and from the O'Neill mine, by the Ontario-Colorado Gold Mining Company. Other shipping properties include the Banta Hill mines, the New National tunnel, the Chicago-Carr, and the Americus mines.

Quartz district.—Last year there was a diminished output from this district, which furnished nearly two-thirds of the entire lead production of the county. The principal shippers were the Hayseed tunnel, the Herbert Spencer, the San Juan, and the Tucker mines. The last-named mine began operations late in the year. The California mine, which has the deepest shaft in the county—2,300 feet—was idle because of water, and is awaiting the Newhouse tunnel to drain it.

Nevada district.—A greatly decreased production was reported from the Nevada district, though more mines were shipping, including the Alps, the Forks, the Kirk, and the Kansas-Burroughs. The last-named mine operated but two months, and is responsible for most of the decrease.

Russell district.—Russell district produced $711,715 in gold; 155,197 fine ounces of silver, valued at $103,982; 342,486 pounds of copper, valued at $66,100, and a small quantity of lead, or over 63 per cent of the gold and silver and more than half the copper produced in the county. This district was first to be benefited by the big tunnel, which is directly responsible for a large percentage of the rapidly increasing output. The Old Town, the largest producer in the county, the Addudell, the Pewabic, the Pittsburg, the Church, the Chase, the Saratoga, and the East Notaway mines were the chief shippers during 1906.

Northern districts.—These districts are still in the development stage, and most of the active properties are confining their efforts to this end. The Pine district made an increased production. The Evergreen Gold and Copper Mines Company and the Boston-Occidental Mining Company reported some production. The former company is reported to have developed a good body of high-grade copper ore. At Apex cyanide tanks are being added to the Mackey mill. The Independent district also made a much larger production, and many permanent and substantial improvements were installed at the various mines. The Perigo, the Six Day, and the Penobscot mines of Rollinsville were also producing during 1906.

GRAND COUNTY.

There was no production from Grand County in 1906, but development work was reported from a number of localities. In the La Plata district, in the extreme southern end of the county, the Williams Fork Mining and Milling Company have a 750-foot tunnel on the Bob Tail claim, and the Luella Mines and Milling Company report 1,400 feet of tunnels and drifts.

In the Harmon district, at the foot of Mount Audubon, near the Boulder County line, the Monarch-Smuggler Mining and Reduction Company and the Monarch Consolidated Gold Mining and Milling Company are each carrying on extensive development work on copper mines.

Other sections reporting activity include the Blue Ridge district, southeast of Sulphur Springs; Byers Peak district, near Frazer; and Red Gorge district, 12 miles southwest of Kremmling.

GUNNISON COUNTY.

Metallic production of Gunnison County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	1,362.05	$28,156	53,649	$32,404	50,500	$7,878
1906	4,233.05	87,505	70,798	47,435		
Increase (+) or decrease (−)	+2,871.00	+59,349	+17,149	+15,031	−50,500	−7,878

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	219,809	$10,331	101,559	$5,992	$84,761
1906	248,737	14,178	328,180	20,019	169,137
Increase (+) or decrease (−)	+28,928	+3,847	+226,621	+14,027	+84,376

The year 1906 was a very prosperous one for the mineral interests of this county, increases being made in the production of all the metals except copper. The total value of the precious metals doubled, while the gold output more than trebled. The second year of zinc shipments shows a healthy increase. Returns were received from 20 mines, as against 18 in 1905; the tonnage shows a gain in quantity and decrease in value per ton, due to the increased amount of siliceous ore of milling grade handled by the mills of the Gold Brick section last year. Seven widely separated districts contributed to the 1906 total, as compared with 10 in 1905.

Cochetopa district.—The Maple Leaf mine was the chief producer in the Cochetopa district, which is located near Sillsville.

Elk Mountain district.—In this district, east of Crested Butte, the Augusta mine was the principal shipper. This company, the Jim Blaine Mining Company, and the Black Queen Gold Mining Company, were all developing their holdings by tunnels on the veins.

Rock Creek and Crystal River districts.—The Rock Creek district, lying just southeast and on the far side of Snow Mass Mountain, from Aspen, made a greatly increased silver and zinc output. The Pitkin and the Lead King mines, operated by the Lanyon Zinc Company, made the bulk of the production from this section. Test lots were also sent out from the Success group, which is a new property being opened up. In the Crystal River section, the North Pole Mining Company confined its energies to development work. The completion of the railroad from Redstone to Marble will mean much to these districts.

Tin Cup district.—This district covers a large territory, extending north and west from Tin Cup as far as Dorchester. Shipments were reported from 4 more mines than in 1905, and included a larger tonnage and a greater production of gold, silver, and lead. The Enterprise and the X-10-U-8 mines shipped from the vicinity of Dorchester. The former mine is developed by three tunnels, respectively, 800, 1,600, and 6,600 feet long, and is equipped with a 200-ton concentrating mill. From the Tin Cup region, the Blistered Horn tunnel, the Gold Cup, and the West Gold Hill mines reported productions. The last named property is opened by an inclined shaft and equipped with a 70-ton cyanide mill; the Blistered Horn has a concentrating plant.

Gold Brick district.—The Gold Brick district, extending north from Ohio City, took first rank in the county in the production of gold and lead, as well as in total output in 1906. Many tunnels are being driven in this section, accompanied by renewed development work on several properties. The Raymond Consolidated Mines Company are proceeding with 2 separate enterprises, the larger of which includes a 2,206-foot crosscut tunnel and 2,552 feet of drifts on veins. The company operated a 20-stamp plate amalgamating mill with 8 concentrating tables. The Cortlandt and the Grand Prize mines were also producers.

Quartz Creek district.—This district extends west from the Gold Brick district to the Chaffee County line, and includes the town of Pitkin. The production fell off somewhat and was derived, in the main, from the Citizen and the Maid of Athens mines.

Tomichi district.—Tomichi district embraces the mines around Whitepine—just across the line from the Monarch district in Chaffee County. A decreased output is reported for 1906; it was obtained from the Victor, the Potosi, and the holdings of the Akron Mining Company. Other properties were actively developing.

HINSDALE COUNTY.

Metallic production of Hinsdale County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	580.07	$11,991	54,419	$32,869	84,485	$13,180
1906	1,185.68	24,510	87,940	58,920	63,621	12,279
Increase (+) or decrease (−)	+605.61	+12,519	+33,521	+26,051	−20,864	−901

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	767,681	$36,081	2,085	$123	$94,244
1906	753,950	42,975	30,475	1,859	140,543
Increase (+) or decrease (−)	−13,731	+6,894	+28,390	+1,736	+46,299

With 16 producing mines as against 10 in 1905, Hinsdale County increased its output from 5,041 short tons to 7,086 tons, and raised the total values from $94,244 to $140,543. The average value per ton advanced from $18.70 to $19.83. The greater values are mostly due to the precious metals, as the gold output more than doubled and the silver increased $26,051. Diminished quantities of copper and lead were marketed, but the zinc savings were much larger. Hinsdale is one of the last of the silver-producing counties in the State to recover from the setback received by the demonetization of that metal. But the year 1906 witnessed a considerable amount of improvement in the way of mill construction, power plant installation, and mine development, which will tend still further to increase production in 1907.

Galena district.—Galena district includes the mines in the vicinity of Capitol City and Henson, from 4 to 5 miles west of Lake City. It was the source of the greater portion of the base metal production of the county and showed a much larger gold output than for 1905. Lead and copper-lead ores predominated. A much larger tonnage was shipped from the Highland Chief mine, a large percentage being concentrated in the Hinsdale Tunnel and Reduction Company's 100-ton concentrating mill at Capitol City. The Planet Mining and Reduction Company also made an increased output. The equipment includes a 50-ton concentrating plant with crusher, rolls, and jigs. The Hidden Treasure, the Wyoming, and the Yellow Medicine were among the shippers. The Hanna Mining and Milling Company remodeled and enlarged its Moro mill. The equipment now includes rolls, Huntington mills, tables, slimers, and a settling system, while a Blake-Morscher machine cares for the zinc concentrates. The year 1906 also saw the completion of the hydro-electric power plant of the Capitol City Power and Milling Company.

Lake district.—Lake district, 4 miles south of Lake City, had 8 producing mines in 1906, an increase of 5. Most of the ores would be classed as siliceous, but there were also some lead, copper, and lead-zinc ores. The silver values were greater than the combined values of the other four metals. The producing properties of this section included the Carson Mining and Reduction Company's St. Jacob mine and the Emerald Isle, Independence, Golden Fleece, Pelican, and Armitage mines. A cyanide plant operated for a time during 1906 on the tailings dump of the Golden Fleece mine. The Dupre Mining Company produced some gold and silver from the Isolde mine at Whitecross, in the Park district.

JEFFERSON COUNTY.

The small output of copper from Jefferson County was shipped for test purposes. Above Morrison, in the copper belt along the foothills, a small amount of development work was carried on at the following properties: The Augusta lode, the Dispatch Copper and Gold Mining Company's claims, the F. M. D. lode, and the Young Sampson and Qualla lodes, on Deer Creek, and the Anna L. claim, at Critchell. The dredges near Golden were not operated during 1906.

LAKE COUNTY.

Metallic production of Lake County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	57,101.87	$1,180,401	4,033,762	$2,436,392	3,105,710	$484,491
1906	73,016.30	1,509,381	3,890,338	2,606,526	2,092,735	403,898
Increase (+) or decrease (−)	+15,914.43	+328,980	−143,424	+170,134	−1,012,975	−80,593

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	51,162,040	$2,404,616	64,856,033	$3,826,506	$10,332,406
1906	47,456,964	2,705,047	71,702,721	4,373,866	11,598,718
Increase (+) or decrease (−)	−3,705,076	+300,431	+6,846,688	+547,360	+1,266,312

Lake County again shows a substantial gain in mineral output for 1906, aggregating a total value of $11,598,718—greater by $1,266,312 than in 1905. In part, this increase is due to the increased price of silver and the base metals.

Large gains were reported in gold and zinc; decreased quantities of silver, lead, and copper were recovered. With the same number of producing mines as in 1905 (61), there were 672,055 short tons of ore mined, as compared with 648,464 in 1905, while the average value per ton advanced from $15.93 to $17.26.

Lake County has been a producer for 28 years, and ranks second only to Teller in tonnage and total value of metallic product; it is the leadnig county in silver, lead, copper, and zinc. In fact, almost one-third of the silver, nearly 37 per cent of the copper, over 45 per cent of the lead, and more than 82 per cent of the zinc produced in Colorado during 1906 must be accredited to Lake County. The above tonnage of crude ore was divided, according to metallic content, into nearly equal quantities of lead-zinc ores (250,734 tons), lead ores (210,404 tons), and dry or siliceous ores (201,878 tons), with a small quantity (9,039 tons) of zinc ores. The dry or siliceous ores, which constituted but three-tenths of the total tonnage of the county, were the source of nine-tenths of the gold produced and of over one-half of the silver output. The rest of the silver was derived from lead and lead-zinc ores.

The oxidized ores of Leadville include (1) iron oxides, sometimes carrying manganese and generally a few ounces of silver; (2) lead carbonate ores, with 10 to 12 per cent of lead, chiefly derived from the downtown district. Oxidized zinc ores do not occur.

The bulk of the Leadville ores consist of heavy sulphide ores with but little gangue material, and a large quantity of them are shipped crude. They include (1) pyrite ores, containing a little copper, gold, and silver; (2) a limited quantity of high-grade lead sulphide ores, which are shipped crude and average from 8 to 12 per cent lead, 10 to 12 per cent zinc, 27 per cent iron, and 5 per cent silica; (3) low-grade zinc blende and pyrite ores, with from 20 to 25 per cent zinc; (4) mixed low-grade sulphide ores, containing from 7 to 8 per cent lead, 18 per cent zinc, and 25 per cent iron. The last two classes are concentrated.

In addition, there are dry siliceous ores containing much silica and silver, a little gold, and from 2 to 3 per cent lead. The small quantities of high grade gold ores mined usually consist of a mixture of sulphides, and often contain native gold.

Heretofore almost the entire production has been from the California district about Leadville, but some little activity was reported from the Harrington district, north of Leadville, near the Eagle County line, and from the Twin Lakes district, in the southern end of the county.

The production would have been much larger had the mines been supplied with cars to handle their ores.

The zinc industry is deserving of special mention in that it represents a gain of nearly 7,000,000 pounds and of half the county's increase in total value. The 1906 zinc product was worth more than the combined gold and silver output. Previous to 1898 zinc was a small factor in Leadville's mineral industry, inasmuch as there were only small quantities which were of shipping grade. The concentrating mills, in which the crushed ore or middlings from the concentrating tables are further separated by electro-magnetic machines, have succeeded in making a marketable product by raising the zinc content from 18 and 20 per cent in the raw ore to 25 and 45 per cent in the concentrates. There were 9,000 tons of crude zinc ores of shipping grade produced, and less than 1,000 tons in which no other values were saved. Thus practically the entire zinc output was derived from the concentration and separation of iron-zinc or lead-zinc ores, which occur largely as a mixture of pyrite, zinc blende, and galena, usually carrying values in silver and often a small quantity of gold.

The American Zinc Extraction Company's mill, located near the mouth of the Yak tunnel, is a custom plant of 250 tons capacity, in which the ores are crushed in jaw crushers, sampled, dried in an automatic drier, recrushed, and fed to International magnetic sep, arators. The resultant products are zinc concentrates and pyrite-the latter carrying most of the precious metal values. This company buys ores with as low as 20 per cent zinc content.

The Damascus mill uses electrostatic separators, and handles much of the second-grade product from the A. Y. and Minnie concentrator.

The Adams or Wolftone mill doubled its capacity during 1906 by adding 3 Huntington mills and 13 tables. This makes the capacity approximately 200 tons a day. By means of the tables and a system of settling tanks, two classes of zinc and lead concentrates are produced. The A. Y. and Minnie mill, of 150 tons capacity, uses similar methods. The Boston and Arizona plant was also in operation. A considerable quantity of Leadville middlings is reconcentrated at the plant of the Colorado Zinc Company in Denver. A large tonnage of low-grade sulphides is also handled at the concentrators of the Empire Zinc Company, near Canyon.

The Arkansas Valley plant of the American Smelting and Refining Company, located on the southern outskirts of Leadville, treated the larger portion of the ores of the district, the zinc ores excepted.

Leadville interests have been instrumental in building up the Ohio and Colorado Company's smelter at Salida, and during 1906 the plant received a greatly increased tonnage from Lake County.

The foremost shipper in Colorado of both tonnage and values in 1906 was the Iron Silver Mining Company, operating the Moyer, Murphy, Dome, Tucson, Douglas, and other mines. This company is one of the multi-metal producers, all five metals, gold, silver, copper, lead, and zinc, and also iron ore, being mined. During 1906 the sinking of the Tucson shaft was completed, and development work has been steadily progressing since.

The famous Little Johnny mine of the Ibex Company continues to be the chief source of Leadville's gold production, and, as in earlier days, extremely rich gold-vein matter, including metallics, is occasionally extracted. It is reported that more than 400 lessees were at work for this company in 1906.

The Yak tunnel, Leadville's great drainage adit, was the center of increased activity and production during the year. Besides furnishing electrical power, transportation, and drainage facilities to many large mines, the company added to its already extensive holdings, and accomplished much exploitation and development work. In addition, the power plant was enlarged and improvements were made in the mill of the American Zinc Extraction Company, a subsidiary company.

An increased tonnage of somewhat lower grade ore was mined by the Midas Mining and Leasing Company in the downtown district. The properties are developed by 3 deep shafts—the Penrose, 960 feet; the Coronado, 790 feet, and the Northern shaft, 600 feet.

A 450-foot vertical shaft opens the A. Y. and Minnie mine, which made a slightly decreased output in 1906. This property is equipped with a 150-ton concentrating mill.

The Western Mining Company's holdings on Carbonate Hill are developed by the Wolftone shaft, 1,170 feet deep; the Adams shaft, 810 feet deep, and the Castleview, 800 feet deep. Surface improvements include the Adams 200-ton concentrating mill, connected with the Wolftone shaft by a tunnel which facilitates the handling of ore and water

The Nisi Prius Consolidated Mining Company continued its large production of silver-lead-bearing iron ores.

Increased shipments to the Salida smelter were reported from the Big Chief and the New Monarch mines.

The Morning Star mine produced about the same tonnage of silver-lead ore, but of a higher grade than in 1905, and the Evening Star made an increased output. Other prominent producing mines included the Fannie Rawlings, the Adelaide, the Boreel, the Fryer Hill, the Highland Chief, and the Sunday.

LA PLATA COUNTY.

The year 1906 brought considerable increased activity to the mining interests of La Plata County, both as to production and as to active preparation for mining during 1907. There was a gain of $76,965 in value of the product of 1906 over that of 1905. The gold increased from $251,940 to $303,930, and the silver from 93,258 fine ounces, valued at $56,328, to 121,711 fine ounces, valued at $81,546. Only 445 pounds of copper were reported, a falling off of 2,478 pounds, but 2,228 pounds of lead were marketed in 1906, and none the year before. These products were obtained from 7,757 short tons of ore from 8 mines, as compared with 5,662 tons from 4 mines in 1905. The value per ton averaged very high for both years—$54.53 in 1905 and $49.72 in 1906.

California district.—The greater portion of the output of La Plata County was from the California district, where the ores are high-grade tellurides, with some free gold as well as some silver present. This district centers about La Plata, approximately 15 miles northwest of Durango, the smelter town of southwestern Colorado, where the Durango plant of the American Smelting and Refining Company smelts most of the ores of the San Juan counties.

A branch line of railroad has been completed to the May Day mine, the largest producer in this district. The property is developed by crosscut tunnels. The Durango Girl and the Valley View mines are two other important shippers. The former property is being developed by 2 tunnels, measuring 380 feet and 700 feet, respectively. Some very high-grade ore was shipped from the Valley View mine, near Hesperus. The Boren Gulch mine, exploited by 8 short tunnels, sent out some sample lots of rich gold ores. The production of the Bonnie Girl mine resulted from a month's test run of its new 50-stamp plate amalgamation mill. Shipments were also reported from the Gold Dollar and the Little La Plata mines.

Needle Mountain district.—The Bullion Mountain Mining Company made a small production from its Ætna mine in the Needle Mountain district, west of Needleton, near the San Juan County line.

LARIMER COUNTY.

Mining activity in this county is confined to the district surrounding Pearl, near the Wyoming County line, where the National Mining and Milling Company has a small copper matte furnace.

A number of mines report some development and exploitation work. Like the Encampment district in Wyoming, across the State line, this section is awaiting the advent of better transportation facilities.

MINERAL COUNTY.

Metallic production of Mineral County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905	8,812.09	$182,162	814,189	$491,770	10,576,146	$497,079	2,513,457	$148,294	$1,319,305
1906	7,713.14	159,445	1,150,318	770,713	13,038,333	743,185	3,562,737	217,327	1,890,670
Increase (+) or decrease (−)	−1,098.95	−22,717	+336,129	+278,943	+2,462,187	+246,106	+1,049,280	+69,033	+571,365

A substantial gain in the production from Mineral County was made in 1906 over 1905. A moderate decrease in gold and large increases in silver, lead, and zinc resulted in a total gain of $571,365. Thirteen mines produced 126,164 short tons of ore, as against 91,338 tons from 10 mines in 1905. The average value per ton was raised from $14.44 to $14.98. This county ranks third as a producer of lead-zinc ores, being surpassed by Lake and Pitkin counties. During 1906 approximately 49,460 short tons of carbonate ore were shipped crude, from which there were recovered 436.66 fine ounces of gold, equivalent to

$9,378; 1,061,334 fine ounces of silver, valued at $711,094, and 635,545 pounds of lead, valued at $36,226, or a total of $756,698, and an average value per ton of $15.30. The sulphide ores represented about 60 per cent of the tonnage of the county in 1906, the total being 76,704 short tons of crude ore, which were reduced to approximately 8,500 tons of concentrates for shipment. These concentrates yielded 7,259.48 fine ounces, or $150,067 in gold; 88,984 fine ounces of silver, valued at $59,619; 12,402,792 pounds of lead, valued at $706,959, and the entire production of zinc, amounting to 3,562,737 pounds, valued at $217,327. This gives a total value of $1,133,972 for the sulphide ores, equivalent to $14.78 a ton for the crude ore and, approximately, to $133 a ton for the concentrates. Two of the properties shipped concentrates which assayed more than 70 per cent of lead and a zinc concentrate which averaged more than 50 per cent of zinc.

The mines are centered about Creede and Amethyst, in the north central part of the county. The Creede United Mines, including the Big Kanawha, had a somewhat smaller production than in 1905. The ore is mined by means of a 1,500-foot shaft and about 2 miles of tunnels and is concentrated in a 250-ton plant. The Amethyst mine is opened by a 1,060-foot inclined shaft and is equipped with a 100-ton concentrating mill. Both of these mills produce lead and zinc concentrates. The Solomon and the Ridge and Mexico mines produced very rich lead and zinc concentrates from sulphide ores carrying some gold and silver. The former has a 75-ton and the latter a 50-ton concentrating mill.

Among the shippers of crude ores increased production of silver-lead ore was reported by the Commodore and of silver ore by the Bachelor mine, which is developed by a tunnel 1,450 feet long. The Del Monte Leasing Company shipped silver-lead ores carrying some gold from the properties of the New York and Chance Mining Company, the Volunteer Mining Company, and the Last Chance Mining and Milling Company. The New York and Chance Leasing Company also made a production from the New York and Chance mines. Each of the following mines made a silver output: the Corsair, with a 250-foot shaft and a 1,500-foot tunnel, the Mollie S., and the Eunice mines. The old Champion, also a silver mine, was erecting an aerial tram in 1906.

OURAY COUNTY.

Metallic production of Ouray County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	112,872.52	$2,333,282	306,406	$185,069	52,333	$8,164
1906	47,996.66	992,179	916,256	613,892	297,741	57,464
Increase (+) or decrease (−).	−64,875.86	−1,341,103	+609,850	+428,823	+245,408	+49,300

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	2,491,808	$117,115	48,267	$2,848	$2,646,478
1906	5,025,385	286,447	10,377	633	1,950,615
Increase(+) or decrease (−).	+2,533,577	+169,332	−37,890	−2,215	−695,863

Aside from the loss of the Camp Bird mill and the necessary closing of this great mine, the year 1906 was a prosperous one for Ouray County, since there was a large increase in the combined production of other mines as compared with like figures for 1905. Twenty-three mines in 1906 produced 48,468 short tons of ore, as compared with 98,966 tons from 14 mines, an increase of 9 mines, but a decrease of 50,498 tons, or more than one-half. The large falling off in gold and the small decrease in zinc were in a measure compensated by large gains in silver, copper, and lead. There were 39,129 short tons of siliceous ores and 7,416 tons of lead ores mined in this county in 1906. Nearly 91 per cent of the gold and about 21 per cent of the silver was won from siliceous ores, while almost 73 per cent of the silver and only 8 per cent of the gold was derived from the lead ores.

Sneffels district.—This district was the source of over 86 per cent of Ouray County's total production in 1906 and of over 93 per cent in 1905, and it includes the two largest producing mines in the county.

The Camp Bird mine, situated on the west side of Imogene basin, was practically idle for seven months in 1906. The mill at Sneffels was destroyed by a snowslide and fire on March 17, but a new mill of larger capacity was immediately started on the old site, and by November 1 was running in full blast. The new plant is a 60-stamp, plate amalgamating and concentrating mill, with a capacity of 250 tons per day, and with a cyanide mill to treat the tailings. The mine is developed by two crosscut tunnels to the vein, one 750 feet and the other 2,600 feet long, and by three underground shafts 300 feet, 900 feet, and 937 feet deep, respectively. In addition, there are several miles of drifts and crosscuts. According to the published returns from this mine, the output was $901,608—equal to about 40 per cent of the 1905 total.

The Revenue Tunnel Mines Company was also a heavy producer last year, and the Atlas Mining and Milling Company reported greatly increased production. This company has drifted 1,300 feet on the vein, driven a 2,100-foot tunnel, and equipped the property with a 10-stamp plate amalgamating and concentrating mill. The San Pedro Gold Mining Company made a trial mill run in addition to much active development work. The main tunnel has been driven 2,857 feet, in addition to 6 drifts on the veins.

Red Mountain district.—The production of the Red Mountain district for 1906 amounted to $14,506 in gold, 35,326 fine ounces of silver, 241,824 pounds of copper, and 143,087 pounds of lead, with a total value of $93,003. This is a decreased quantity of gold, silver, and lead, but a greatly increased copper product. With 8 producing mines, twice as many as in 1905, the tonnage and total values show a large falling off. This does not indicate less activity in this district during the year, since there was an increased amount of tunnel and general development and exploitation work, especially noticeable in the large number of tunnels being bored.

The Red Mountain Railroad, Mining and Smelting Company made heavy shipments from the Genesee and Yankee Girl properties to the Ross Mining and Milling Company at Silverton. A 5,000-foot tunnel opens the Genesee, 1 mile north of Red Mountain, and the Yankee Girl is developed by a 4,000-foot bore, $1\frac{1}{2}$ miles north of Red Mountain. The ore is a fairly high-grade copper ore carrying some silver, lead, and a small quantity of gold.

Increased quantities of silver-lead ores, with some gold, were shipped from the Gold Lion mines, which are operated through one 7,000-foot and one 1,000-foot tunnel. The Guadaloupe mine began producing silver and gold bearing copper ore. The Barstow Mining and Milling Company, at Ironton, made a reduced output in 1906. The mine is developed by two adit tunnels aggregating 4,000 feet in length, and by a 500-foot shaft, and is equipped with a 40-stamp plate amalgamation and concentration mill. The National Belle and Oom Paul Kruger mines also reported productions.

The Treasury Tunnel Mines Corporation spent the year in development work, and now has a 5,025-foot tunnel and a 729-foot drift on the vein. Their equipment includes a 20-stamp plate amalgamating and concentrating mill.

Uncompahgre district.—This district, located about the town of Ouray, with 11 operating mines, as compared with 6 in 1905, made a slight gain in tonnage and large increases in silver, copper, and lead, with a diminished gold and zinc production. The total value more than trebled, due principally to the great increase in silver, from 26,569 fine ounces to 178,994 fine ounces. The Neodesha silver mine was a material aid in establishing the total for 1906. Crude lead-silver ore was produced from the Mineral Farm mine. Shipments of crude silver-gold-copper ores were made from the American Gold Mining Company, on whose properties about 33,000 feet of tunnel work has been done in the last 20 years. Other producers included the Trout and Fisherman, the Newsboy, the Black Girl, the Mother Cline, and the Rose and Mickey Breen mines.

The production of the Uncompahgre district in 1906 was: Gold, 1,064.38 fine ounces, $22,003; silver, 178,994 fine ounces, $119,926; copper, 47,819 pounds, $9,229; lead, 265,105 pounds, $15,111; zinc, 10,377 pounds, $633; total, $166,902.

PARK COUNTY.

Metallic production of Park County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905	15,521.95	$320,867	49,202	$29,718	12,199	$1,903	543,303	$25,535	$378,023
1906	19,110.53	395,050	144,815	97,026	14,399	2,779	966,193	55,073	549,928
Increase	3,588.58	74,183	95,613	67,308	2,200	876	422,890	29,538	171,905

In Park County substantial increases were reported in the production of gold, silver, copper, and lead, as well as in the tonnage. The latter amounted to 10,072 short tons, as compared with 6,745 tons in 1905, while the average value per ton was lowered from $55.63 to $54.60. The quantity of silver nearly trebled and the lead production more than doubled. Of gold, 17,394 fine ounces were won from siliceous ores and 1,225 fine ounces from lead ores, while the latter furnished 108,079 fine ounces of silver as against 33,929 fine ounces from the siliceous ores.

The placer output amounted to $10,084 in gold and 107 fine ounces in silver, nearly four times as much as in 1905. The number of producing mines, including placers, fell from 19 to 16.

Buckskin district.—There was a diminished tonnage and quantity of precious metals mined in this district, northwest of Alma, but greater quantities of copper and lead were reported. The Sweet Home, the Cleveland group, the Paris, and the Wyandotte mines shipped from this section. Copper-lead ores carrying gold and silver were sent out from the Sweet Home. Development work exposed considerable ore in the Wyandotte. The production from the Paris mine was reduced in their 20-stamp plate amalgamating and concentrating mill. All of these mines are opened by tunnels.

Consolidated Montgomery District.—In this section, north of Alma, more gold, but less silver and lead, were obtained from a much smaller tonnage than in 1905. The Ling Star mine, developed by a series of tunnels aggregating 3,000 feet, was worked by lessees in 1906. Pinnacle and Our Fritz mines made small shipments. Activity on the Dolly Varden was confined to development work.

Horseshoe district.—Increased quantities of silver-lead ores were obtained from the Cameron mine in the Horseshoe district, west of Fairplay.

Mosquito district.—More than 95 per cent of the deep-mine production and practically all of the placer production was derived from the Mosquito Creek section. Larger clean-ups than in 1905 were reported from the hydraulic mines below Alma, and the tonnage from the deep mines almost doubled. The largest producer in the county was the London mine, which increased its output somewhat in 1906. The Alma Mining Company, made a greatly increased output. This company was the heaviest producer of silver and lead in the county during 1906. The Clipper Consolidated Mining Company and the London Fault Mining Company also contributed to the silver totals of the district. The latter company operated the New York mine, which is opened by a 600-foot tunnel.

Hall's Gulch district.—Rich silver ores were extracted from the Rainbow mine in Hall's Gulch, in the upper northwest corner of the county, near the Clear Creek County line, while development work on this and the Old Cornet mines was continued by tunneling.

Tarryall district.—A little placer work was done in the Old Tarryall district, above Como, and some development work on low-grade gold deposits was carried on near Hartzell, on the Midland Railroad.

PITKIN COUNTY.

Metallic production of Pitkin County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	12.00	$248	2,469,520	$1,491,590	41,276	$6,439
1906	56.69	1,172	2,131,374	1,428,021	....	....
Increase (+) or decrease (—)	+44.69	+924	—338,146	—63,569	—41,276	—6,439

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	22,386,142	$1,052,149	5,268,091	$310,817	$2,861,243
1906	17,951,674	1,023,245	3,673,755	224,099	2,676,537
Increase (+) or decrease (—)	—4,434,468	—28,904	—1,594,336	—86,718	—184,706

The metallic production from Pitkin County in 1906 shows a considerable decrease in all metals except gold, which increased from \$248 to \$1,172. There were 27 producing mines—2 more than reported in 1905—which produced a total of 203,400 short tons, with an average value of \$13.11 per ton.

Pitkin County ranks second to Lake County in the production of silver, lead, and zinc. Owing to the increased price of these metals, the relatively small falling off in value makes the large decrease in quantity less apparent, especially of lead and zinc. The former decreased 4,434,468 pounds and the latter 1,594,336 pounds, as compared with 1905. Last year's production was largely confined to the Roaring Fork district, about Aspen, in the center of the county. The ores of this section are chiefly argentiferous sulphides—galena and zinc blende. Some native silver is still encountered, but very little, if any, gold or copper is ever met with in the mines about Aspen.

Of the silver product, 983,108 fine ounces, or 46 per cent, was derived from lead-zinc ores, which constituted 68 per cent of the total tonnage mined and averaged about 7 ounces in silver to the crude ton. Lead ores, forming 21 per cent of the tonnage, averaged more than 18 ounces to the ton crude, and produced 786,068 fine ounces, or about 37 per cent of the silver output. The remaining 362,198 fine ounces, which formed 17 per cent of the county total, were derived from dry ores, which averaged about 16½ ounces to the ton and made up less than 11 per cent of the tonnage mined in the county.

Twenty-two of the 27 producing mines in this county during 1906 would be classed as silver-lead mines, 3 as silver-lead-zinc, 1 as gold-silver-lead, and 1 as a small gold mine.

More than one-half of the crude ore mined in Pitkin County in 1906 was concentrated, and in addition, a large tonnage of zinc slimes was shipped from a pond where they had accumulated from the concentration of Smuggler ores for several years, when zinc was a detriment to the ore.

The Smuggler Mining Company was the largest producer in the county. Nearly 90 per cent of its ore is concentrated in its 400-ton mill, about 6 tons of raw ore producing 1 ton of concentrates. In addition, this company shipped crude lead ores and lead-zinc ores and zinc slimes carrying silver and low lead values. A small quantity of silver metallics was extracted during 1906.

The Bushwhacker mine, opened by 8,500 feet of tunnel work, concentrated a portion of its ore at the Hunter Creek mill. Development work on the Argentum-Juaniata consists of a 560-foot tunnel, an 1,120-foot incline, and laterals from the latter. The values are almost wholly in silver.

Shipments of silver-lead ore from the Aspen mine were of a slightly lower grade than in 1905. Decreased tonnage and decreased quantity of silver and lead, but much larger quantity of zinc were reported.

A diminished output was made from the Percy La Salle mines, both by the operators of the Percy La Salle Mining and Power Company and by the Keystone Leasing Company. This large property is exploited by a 1,400-foot inclined shaft, a 4,000-foot tunnel, and a 1,000-foot raise from the tunnel, as well as by extensive drifts and levels. In past years the product of this mine has occasionally been treated in the Mollie Gibson concentrating mill, but the ore was shipped crude during 1906.

In the Spar Consolidated, increased shipments netted a greater number of fine ounces of silver but a smaller quantity of lead than in 1905. Operations on this property are carried on through a 3,000-foot tunnel. Other prominent producers include the Homestead, the Millinee, and the Mineral Farm mines. The latter has an inclined shaft 600 feet below the Cowenhoven tunnel and 6,000 feet from its portal.

In the Lincoln district, in the southeast corner of the county, the Ruby Mining and Development Company shipped an increased tonnage and erected a 50-ton concentrating plant, equipped with a crusher, rolls, Huntington mill, and tables. The mine is opened by a 2,500-foot tunnel. The State road now being built from Aspen into Lincoln gulch should mean much to the mining interests of this formerly isolated region.

At Ashcroft, 12 miles south of Aspen, in the Columbia district, the management of the Tam O'Shanter-Montezuma mines report a year of active development, by which much silver-lead-zinc ore was blocked out.

ROUTT COUNTY.

There was but little change in the production of gold and silver from Routt County in 1906. The entire output was derived from placers, and amounted to 336.24 fine ounces of gold, valued at $6,951, an increase of $46 over 1905, and 42 fine ounces of silver, valued at $28, a gain of 12 ounces. Much attention has been drawn to the lode mines of this county, and during 1906 considerable exploitation and development work was done by individuals in the various districts along the eastern side of the county, especially in the region about Steamboat Springs, Hahns Peak, and the new Slavonia district, on the west slopes of Mount Zirkel.

Hahns Peak district.—The Iowa-Hahns Peak Gold Mining Company built a dredge on the Iowa placers and had just begun digging when the cold weather forced them to shut down for the winter. Small placer operations won a few ounces from the Hahns Peak and Elk River Canal and Placer Mining Company's holdings.

Lay district.—The Lay or Jack Rabbit district includes a large area north of the town of Lay, from which encouraging reports have been received as to the extensive placer gravels. The Blevin dredge, 8 miles north of Lay, was operated about 50 days during 1906 and won a large part of the gold credited to this county. These deposits are supposed to be reconcentrated Tertiary gravels, as no primary gold deposits are known to exist anywhere near this section.

Four Mile district.—A small quantity of bullion was saved from the placers of Four Mile district, just south of Baggs, in northern Routt County.

SAGUACHE COUNTY.

A decrease from $13,112 to $10,923 occurred in the value of the metallic output of Saguache County in 1906, but the gold increased from $699 to $7,628. The silver output dropped from 4,401 fine ounces, valued at $2,658, to 737 fine ounces, valued at $494; the lead from 203,797 pounds, valued at $9,578, to 49,141 pounds, valued at $2,801, and the small copper production fell off entirely. The output was derived from 999 short tons, from 7 mines, as compared with 496 tons and 4 mines in 1905.

Baca Grant district.—In this district, about Crestone, the San Luis Valley Leasing and Mining Company was the principal producer. The development work of this company includes 3 tunnels totaling 1,000 feet in length and 2 vertical shafts amounting to 635 feet. The ore is handled by a 10-stamp mill.

Blake district.—Slightly increased shipments of silver-lead ore were reported from the M. E. G. and the Mountain Lion mines at Villa Grove in the Blake district. The Steel Canyon group is equipped with a 100-ton concentrating mill.

Kerber Creek district.—In the Kerber Creek district the Rawley mine, the largest producer in the county for 1905, was closed on account of labor difficulties.

SAN JUAN COUNTY.

Metallic production of San Juan County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	50,840.74	$1,050,971	750,844	$453,510	1,675,858	$261,434
1906	43,545.96	900,175	690,076	462,351	1,549,663	299,085
Increase (+) or decrease (−).	−7,294.78	−150,796	−60,768	+8,841	−126,195	+37,651

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	8,045,126	$378,121	248,627	$14,669	$2,158,705
1906	4,515,317	257,373	584,476	35,653	1,954,637
Increase (+) or decrease (−).	−3,529,809	−120,748	+335,849	+20,984	−204,068

The metallic product from the mines and mills of San Juan County for 1906 shows a decrease in quantity of all the metals except zinc, which more than doubled its output of 1905. The gold figures were less by 7,294.78 fine ounces and $150,796, and 60,768 fine ounces less of silver were reported. Copper decreased in quantity 126,195 pounds, but gained in value $37,651. San Juan County ranks second only to Lake County as a producer of copper in Colorado. The falling off in the value of the lead product was equal to the combined decreases of the other 3 metals, and was in a large measure due to the reduced tonnage from the Silver Lake mines. Twenty-six mines produced a total of 196,438 short tons of ore, with an average total value per ton of $9.95, compared with 204,139 short tons, with an average total value per ton of $10.57, in 1905. The siliceous ores amounted to 166,080 short tons, equal to nearly 85 per cent of the total tonnage, and were the source of 41,010 fine ounces, or over 94 per cent, of the gold product, and of 328,057 fine ounces, or less than 47 per cent, of the silver output. The remainder of the silver was won from copper, lead, and lead-zinc ores.

The year 1906 was very successful, notwithstanding the mishaps and hindrances which befell some of the larger producers. An unusually severe winter retarded mill construction and ore shipments in the early months, and snowslides destroyed the Green Mountain mill, as well as damaging some other properties. On April 20 the big concentrating mill of the Silver Lake Company was destroyed by fire.

The bursting of a water main temporarily crippled the plant of the Animas Power and Water Company at Rockwood, and thus deprived some of the mines and mills of their chief source of power, thereby curtailing their production.

San Juan County is primarily a milling county, as the great bulk of the ores average between $8 and $12 a ton. There were 14 active mills in 1906, some of large capacity, and others were being erected or remodeled.

Animas district.—The Ross Mining and Milling Company handled a good tonnage in their 150-ton matting smelter at Silverton, principally on gold and silver bearing copper ores from their own property—the Champion mine—as well as on custom ores from other mines. A greatly reduced output was made from the Silver Lake Mines Company owing to the burning of their mill. This mill was replaced by a 300-ton concentrating mill, the product of which carries lead and copper returns, as well as precious-metal values. In 1907 this plant will also handle ores from the Aspen mine, from which during 1906 only the higher grade crude ore was shipped to the Durango smelter. The Old Hundred Mines Company, in Cunningham Gulch, has rapidly become one of the county's heavy producers. The values are mostly in gold, with the remainder about equally divided among silver, lead, and copper. Three tunnels, respectively 56, 416, and 700 feet long, open the property. One of the tunnels will tap the vein at a depth of 2,700 feet. The surface equipment includes a 40-stamp mill with tables and vanners. The first half of the year was given up to development work, and the production was made during the latter months.

The Gold Tunnel and Railway Company have an 18,000-foot tunnel and a 100-ton concentrating plant. The Iowa Gold Mining and Milling Company resumed operations in their 150-ton concentrator on silver-lead ore from the Royal Tiger mine late in December, 1906, after an idleness of several years. The Hamlet mine is developed by 5 crosscut tunnels ranging in length from 100 to 800 feet. The mine is equipped with a concentrating mill. Other shippers include the Contention Mining Company, the Detroit and Colorado Mining Company, and the San Juan Smelting and Reduction Company.

King Solomon Mountain district.—The Dives Leasing Company and the Shenandoah No. 3 Leasing Company continued shipments to the Durango smelter.

Eureka district.—The great Gold King mine added another successful year's production, in addition to much development work, which now includes a 700-foot shaft and a 5,000-foot tunnel, which will cut the vein 900 feet below the present workings.

The Gold Prince mines, operated under the same management, did not begin producing at full capacity until the first of the present year, because of the noncompletion of their new steel 100-stamp mill at Animas Forks, 15 miles northeast of Silverton. The capacity is 500 tons per day, and the treatment includes stamp crushing, plate amalgamation, tube-mill regrinding, and concentration, followed by magnetic separation. The ores include sulphides of lead, zinc, iron, and copper carrying gold and silver values. The plant should materially aid in increasing the county's output for 1907.

The famous Sunnyside mines, connected with the mill at Eureka by a 3-mile aerial tramway, continued to be one of the county's largest producers. The Grand Mogul mine, connected by aerial tram with the new 200-ton concentrating mill at Gladstone, was an important addition. The mine is developed by 3 tunnels aggregating about 20,000 feet in length, and the mill is equipped with 40 stamps, Card and Wilfley tables, and Blake electro-magnetic zinc separators. An increased production was reported from the Silver Wing mine by the Eureka Exploration Company, which also owns the Ridgeway mine.

SAN MIGUEL COUNTY.

Metallic production of San Miguel County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905	82,810.89	$1,711,853	1,275,079	$770,148	17,721	$2,764	6,970,152	$327,597	$2,812,362
1906	118,411.84	2,447,790	1,672,522	1,120,590	70,725	13,650	7,158,189	408,017	3,990,047
Increase (+) or decrease (−)	+35,600.95	+735,937	+397,443	+350,442	+53,004	+10,886	+188,037	+80,420	+1,177,685

The year 1906 was a banner year for San Miguel County, the leading county of the San Juan district and one of Colorado's principal producers, ranking third to Teller and Lake counties in tonnage, production of silver, and total value of metallic output and second only to Teller in quantity of gold. The output of 118,411.84 fine ounces of this metal, valued at $2,447,790, is greater by $735,937 than in 1905. Of silver there were 1,672,522 fine ounces saved, a gain of 397,443 fine ounces in quantity and of $350,442 in value. More than four times as much copper was reported, and the quantity of lead increased 188,037 pounds. The total gain in value amounted to $1,177,685, or over 41 per cent. With 21 producing mines, as compared with 19, there were mined 386,735 short tons of ore, as against 291,338 tons in 1905, and there was a slight advance in total value per ton, from $9.58 to $10.31.

The ores of this county have been classified as siliceous (or dry ores), of which there were 371,047 short tons, and as lead ores, of which class there were 15,688 tons. The siliceous ores amounted to 96 per cent of the total tonnage and were the source of 98 per cent of the gold and 87 per cent of the silver. The results of the placer cleanups during 1906 were insignificant as compared with 1905.

Upper San Miguel district.—This district, about Telluride, made the major portion of the production of the county. Each of the 3 large mines of this section report substantial increases in their outputs.

The Tom Boy Gold Mines Company made its entire extraction from the Argentine group, which is exploited by 18,948 feet of drifts, 3,269 feet of raises, and 1,684 feet of shafts. This company's 350-ton plate amalgamating mill is equipped with sixty 1,050-pound stamps and with thirty-six 6-foot Frue vanners. The ores were principally in gold with some lead and a comparatively small amount of silver.

The Smuggler-Union Mining Company operated their property through lessees. A 6,600-foot tunnel and 2 shafts, one 665 feet and the other 1,250 feet deep, develop this mine. The ore is reduced in 2 stamp mills, aggregating 140 stamps, followed by amalgamating plates, bumping tables, vanners, cyanide treatment for sands, and a canvas plant to handle the slimes. The values are about equally divided between gold and silver.

The Liberty Bell mine more than doubled the quantity of ore handled in its very efficient 300-ton, 80-stamp amalgamating mill, the operation of which is followed by tube mills and tank cyanide treatment of sands and vacuum filters for slimes. Mine developments include a 200-foot and a 2,600-foot tunnel and several miles of drifts.

Increased shipments were made by the Alta mine, which operates a 20-stamp concentrating mill, and by the Columbia-Menona Mining and Milling Company. The Mammoth Mining Company erected a 10-stamp plate amalgamating and concentrating mill, but were only able to operate a short time before closing down for the winter. Several other properties report some development work.

Metallic production of Upper San Miguel district, San Miguel County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.		Lead.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905......	76,171.64	$1,574,607	890,459	$537,837	1,923	$300	4,976,234	$233,883	$2,346,627
1906......	112,176.07	2,318,885	1,495,332	1,001,873	70,342	13,576	6,639,803	378,469	3,712,803
Increase (+) or decrease (−)....	+36,004.43	+744,278	+604,873	+464,036	+68,419	+13,276	+1,663,569	+144,586	+1,366,176

Iron Springs district.—A diminished total output was made by the mines in the section about Ophir. The Carbonero Mining Company reported shipments of silver-bearing galena, as well as lead carbonate ores, in 1906. Two tunnels on the vein, respectively 850 and 1,200 feet in length, develop the property. The Butterfly-Terrible Gold Mining Company handled a reduced tonnage last year. Other shippers included the New Dominion Gold Mining Company, operating on the south slope of Silver Mountain; the Ophir Consolidated Mining Company, and the Suffolk Mining and Milling Company. Each of these concerns is equipped with concentrating mills. Shipments were also made from the Favorite, the American-Frenchman, and the Santa Cruz mines.

Lower San Miguel district.—A small quantity of ore was shipped from the Commercial group, near Sawpit, before the mine was sold to the National Mining and Milling Company, which company also owns the Gertrude mines, on which a 10-stamp mill has been erected.

SUMMIT COUNTY.

Metallic production of Summit County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	(a)	(a)	209,356	$126,451		
1906	6,761.55	$139,773	107,752	72,194	27,120	$5,234
Increase (+) or decrease (−)	+6,761.55	+139,773	−101,604	−54,257	+27,120	+5,234

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	2,181,660	$102,538	3,320,237	$195,894	[b] $424,883
1906	1,301,912	74,209	2,942,983	179,522	470,932
Increase (+) or decrease (−)	−879,748	−28,329	−377,254	−16,372	+46,049

[a] Gold output of 1905 combined with that of Park and Jefferson counties.
[b] 1905 total for silver, copper, lead, and zinc.

There was a decreased production of all metals except copper in Summit County in 1906. The gold output amounted to 6,761.55 fine ounces, equivalent to $139,773. The silver total of 107,752 fine ounces decreased by 101,604 fine ounces. A small quantity of copper was reported from the Snake River section. The lead and zinc totals show very large decreases. Thirty-nine mines produced, including 7 placers, as compared with 34 mines, of which 6 were placers, in 1905. The tonnage from the deep mines was less by 2,880 short tons, amounting to 34,050 tons, with an average total value per ton of $12.25.

A review of the year's progress in the different mining activities reveals considerable successful exploitation and development work. Increased activity is reported from both dredging and hydraulicking fields.

Breckenridge district.—The tonnage from this section is made up of gold and silver bearing lead and zinc ores. Among the mines in this district which produced ores carrying lead are the following: The Jessie mines, which are now operated by the Jessie Consolidated Mines Company. The mine workings embrace 3 tunnels aggregating nearly 3 miles in length, and the property is equipped with a 40-stamp plate amalgamating and concentrating mill. Some production was made during development work on the Atlantic Cable mine, which is opened by a 500-foot tunnel. A 3,100-foot tunnel develops the Gold Dust-Puzzle mines. The Blue Flag Gold Mining Company purchased the West Laurium mine and erected a 50-ton concentrating mill. Developments include a 1,250-foot tunnel and 1,000 feet of drifts and crosscuts. The Germania, the Morning Star, the Dunkin, the Little Tommie, the Carbonate, the Pacific, the Senator, and the Silver King mines were also active.

From the Wellington mine shipments of lead-zinc ores carrying gold and silver were made to the Colorado Zinc Company's plant in Denver. Similar ores were shipped from the Bullion King mine. A heavy production of crude ore averaging about 50 per cent zinc was made from a new shoot in the Country Boy mine by the Lanyon Zinc Company. The Sallie Barber mine also produced zinc ore. The Old Union Mining and Milling Company milled gold-and-silver-bearing zinc ore in their 100-ton concentrating plant. The mine is developed by two vertical shafts, one 250 and the other 315 feet deep, and by a 1,700-foot tunnel, as well as by drifts and levels.

The operations of the Reliance dredge on French Creek and the Banner and the Buffalo hydraulic mines resulted in a successful year. Smaller clean ups were made on 4 other placers in this section. Increased production as well as continued development is expected during 1907 in the placer mines of this county.

Montezuma district.—This district, just southwest and over the divide from the Argentine district in Clear Creek County, was the center of considerable development and the source of the copper output of Summit County in 1906. The Pennsylvania mines were the chief producers. They have driven 4 crosscut tunnels and erected a 60-ton concentrating mill. The Fisherman group, the Rothschild, the Braganza, and the Clarion mines were also active.

Ten Mile district.—The output of the Ten Mile district amounted to \$16,993 in gold, 34,554 fine ounces of silver, 408,000 pounds of lead, and 600,115 pounds of zinc, with a total value of \$110,007. The Kokomo section enjoyed a prosperous year during 1906, in that nearly every mine showed increased activity either in mine or surface development. The Summit Mining and Smelting Company's mill (commonly spoken of as the Wilfley mill) was the scene of a considerable amount of experimental work in connection with the installation of a Wilfley furnace to prepare low-grade pyritic ore by roasting for cheap concentration. The mill equipment includes rolls, furnace, Ding electro-magnetic separators, and tables. The mine is developed by 2 inclines totaling more than 2,000 feet and by a 1,500-foot tunnel.

Heavy shipments of gold and silver bearing lead-zinc ores were resumed in November, 1906, from the Nettie B. mine by the Uhtoff Mining and Tunnel Company; and iron ore carrying gold and silver and some lead ore was shipped from the Michigan group. The Breene properties are equipped with a 100-ton concentrating plant, and a 250-ton plant was being erected by the Kimberly Consolidated Mines Company.

TELLER COUNTY.

Metallic production of Teller County, Colo., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		
1905	745,542.17	\$15,411,724	49,449	\$29,867			\$15,441,591
1906	689,500.73	14,253,245	49,527	33,183	1,280	\$247	14,286,675
Increase (+) or decrease (−)	−56,041.44	−1,158,479	+78	+3,316	+1,280	+247	−1,154,916

The total value of the metallic production from the Cripple Creek district in 1906 was less by \$1,154,916 than in 1905. The gold amounted to \$14,253,245, a decrease of \$1,158,479, and the silver to 49,527 fine ounces, valued at \$33,183, an increase in quantity of 78 ounces and in value of $3,316. In 1906, 1,280 pounds of copper were reported. One hundred and five mines made a total production of 702,069 short tons of ore which averaged $20.35 to the ton, as against 88 mines, 716,358 tons, and $21.56 per ton in 1905. This total included a relatively small amount of gold and silver recovered from old tailings by the larger mills handling Cripple Creek ores.

These figures do not necessarily represent the values which reached the market as bullion in 1906, but the amount of values in the ores extracted from the mines of Teller County and either reduced or disposed of by sale during 1906. Therefore, any stock of 1906 ores held over by the smelters or mills to be reduced in 1907 would cause a smelter report to show the actual bullion produced to be less than the production shown in a mines report. Ordinarily this discrepancy tends to balance itself from year to year, but toward the end of 1906 a very considerable quantity of ore which was not milled till 1907 was awaiting the completion of several plants.

The total decrease of $1,154,916 was wholly caused by a falling off of $2,429,764 in the combined production of 4 of the largest mines. Therefore, excluding these 4 mines, there was a gain of $1,304,848 in production from the other mines of the district.

Other than a small production reported from the Copper Mountain section, the entire output was derived from the Cripple Creek district proper. The history and technology of the gold deposits, as well as the geology and mineralogy of the district, including detailed descriptions of the mines, can be found in a recently published report of the Geological Survey.[a] The production was affected in a measure by the misfortunes which overtook some of the companies during 1906. Early in May a fire destroyed the shaft house, engine room, boiler shop, and blacksmith shop at shaft No. 1 of the Portland Company; and in driving a drift on the 1,000-foot level of the El Paso Company's mine a heavy flow of water was struck which filled the workings to the level of the El Paso tunnel. The Dorcas mill, at Florence, was destroyed by fire early in the year, and there was a delay in the completion of the new reduction plant of the Golden Cycle Company.

Throughout the year harmony existed between miner and operator. The leasing system was rather generally in vogue, and only a few large mines, including the Portland, the Strong, and the Cresson, were operated entirely on company account.

The question of drainage remained a serious problem in 1906 and led to the organization of the Cripple Creek Drainage and Tunnel Company and the pledging of sufficient funds to complete the long bore. The intermediate tunnel plans were adopted, and work began on May 11, 1907. The adit was started in Gatch Park, at an elevation of 8,020 feet, or 723 feet lower than the El Paso tunnel, the lowest present drainage adit. It is expected that it will take two years to reach the present main water course, 15,550 feet from the portal; then the tunnel will be driven forward to the Vindicator shaft, a total length of 27,190 feet, equivalent to 5 miles and 790 feet.

Considerable interest relative to the question of milling the lower grade ores was manifested during 1906. Not only have several attempts been made from time to time to operate small mills at a

[a] Lindgren, Waldemar, and Ransome, F. L. Geology and gold deposits of Cripple Creek district: Prof. Paper U. S. Geol. Survey No. 54, 1906.

profit about the district, but the year 1906 found a number of the largest companies attacking the problem.

The foremost new mill enterprise was the Golden Cycle's 700-ton roasting and cyanide plant, at Colorado City, in which the refractory ore was roasted in 100-ton furnaces. Unforeseen difficulties postponed the starting of this big plant till toward the end of February, 1907, and later (July) it was destroyed by fire. This will affect the production of the district for 1907.

The Portland Mining Company erected a 300-ton cyanide plant at Colorado City to treat the tailings from their chlorination plant, and have been carrying on experimental work to discover the most suitable cyanide method to replace their present chlorination mill. A very small quantity of custom ore, from mines other than the Portland, was treated in 1906, but more oxidized ore will be purchased from time to time to mix with the more refractory ores of the Portland mine.

The large chlorination and cyanide mill of the Dorcas Mining, Milling, and Developing Company, at Florence, was destroyed by fire in March, 1906. This was a custom mill, treating Cripple Creek ores.

The Economic chlorination mill, at Victor, was operated a portion of the year, but closed down, and was burned early in 1907. The Jo Dandy Company purchased the old cyanide mill of the Cripple Creek Cyanide Company, at Gillett, which they dismantled, moved to Raven Hill, and remodeled into a 250-ton modern plant. McDougal roasters were installed.

There was also some activity among the smaller nonroasting cyanide plants in the district.

The Isabella Mines Company erected a 300-ton cyanide mill during 1906 to treat the lower grade ores from their properties as well as from the dump, but the plant was only run experimentally in 1906. Two small mills on Squaw Mountain—the Home Run, of 25 tons capacity, and the Santa Rita—were run at intervals during the year. The Dexter and Sioux Falls plants were idle, and the Los Angeles mill was destroyed by fire. Work was resumed in the small 100-ton mill of the Cripple Creek Homestake Company by the Ironclad Milling Company. The larger mill of the former company was closed. A 50-ton cyanide mill was operated on the El Paso dump. The Little Giant mill was rebuilt, in Pony Gulch, 3 miles south of Cripple Creek. The Wishbone Milling Company also erected a small new cyanide mill on Spring Creek, and began operations in the spring of 1907. The Blue Flag Company's new mill was also started in 1907. During 1906 the Vindicator Company erected a testing mill in the Old Lillie shaft house at Independence, and made extensive tests preparatory to erecting a large plant. Tests extending over a long period on ore from the Independence dump led this company to decide to erect a large cyanide plant at their mine, above Victor, during 1907.

According to the printed annual report of the company, the great Portland mine, the banner producer of the camp, made a total output of 103,614 short tons of ore, valued at $1,932,083. This represents a decrease of 5,619 tons and nearly half a million of dollars in value as compared with 1905. This is accounted for by the closing of shaft No. 1 for 40 days by a fire on May 6, which destroyed the surface equipment about the shaft. The average total value per ton was lowered by the company's shipping 11,348 tons of low-grade oxidized ore for fluxing purposes at the mill. The grand total production from this famous mine from April 1, 1894, to December 31, 1906, amounted to 775,110 short tons, with a gross value of $25,034,411; it netted $7,147,080 in dividends. With two years of high-grade ore reserves in sight, exclusive of low-grade rock, the outlook for an increased production in 1907 is very bright. Total development work includes 71,950 feet of drifts, 99,832 feet of crosscuts, 10,843 feet of raises, 4,314 feet of winzes, and 11,513 feet of sinking, the aggregate being 37 miles and 3,092 feet of workings.

The Golden Cycle mine continued its heavy shipments. A 1,200-foot shaft opens the main workings. During 1906 this company completed a 700-ton cyanide mill at Colorado City for the treatment of custom ores as well as the product of their own holdings.

The Vindicator Company's annual report reveals a successful year, regardless of the fact that the Hull City shaft was practically idle for a month, pending repairs to the shaft and hoisting engines. The production amounted to 27,396 short tons, with a gross value of $935,614. This represents an increase of about 3,300 tons and of $42,489. The ore averaged about $34 per ton. This mine is to be the terminal end of the great drainage tunnel, but 200,000,000 gallons of water were pumped during 1906. The holdings of the company are opened by 18 shafts, two of which are 1,200 feet deep. The development to January, 1907, aggregated a little over 23¼ miles.

The Independence mine, of the Stratton's Independence (Limited), made a greatly reduced production, which amounted to only $956,479, but the grade of the ore remained very high, better than $41 to the ton. The mine is opened by a shaft 1,400 feet in depth, but only the upper levels are worked. The property is operated largely by lessees, with a small amount of company work. Experiments were begun to ascertain the best way of working the great dump of low grade ore on the property.

The El Paso Consolidated Company's exploitation work on the 1,000-foot levels was bringing most gratifying results when on March 26 a heavy flow of water was encountered, and in less than 4 hours the mine was flooded to the 600-foot level, where the water flows out of the El Paso tunnel. For the remainder of the year mining and developing were necessarily confined to ground above the tunnel level. Nevertheless a good production was made for the year, amounting to more than 22,000 tons (in the 11 months covered by the company's annual report), valued at $801,447. This property will be one of the first to be drained by the new tunnel.

The annual report of the Findley Consolidated Mining Company shows a greatly decreased output, amounting only to 5,220 short tons of ore, containing $115,837 in gold values, less than one-fourth of the total for 1905. This resulted from the company spending the year in development work until the new mill of the Golden Cycle Company, at Colorado City, should be completed. In an endeavor to facilitate the handling of lower grades of ore, this company combined with the Vindicator Company in experimental work during the year, seeking to determine a process to be used in a large mill to be built jointly by the two companies.

The Granite Gold Mining Company absorbed the Dillon Gold Mining Company, as it had previously done with the Gold Coin and Monument companies. This gives the Granite Company a large holding on Battle Mountain and makes it one of the most important concerns of the entire district.

An increased total production was made by lessees from the various holdings of the Stratton Estate, and the Strong mine also made a larger output.

The Elkton Company, as in the case of the El Paso, have limited their operations to the reserves above the present water level to save pumping costs till the new tunnel shall care for the large quantities of water. A somewhat decreased tonnage was shipped during 1906, but there was an increase in average value of the ore.

The Work Mining and Milling Company reports a greatly increased output from the Morning Glory and the Little Clara mines, which are worked by seven sets of lessees.

Large gains in production were made in each of the following mines: The Cresson, of the Bull Hill Mining and Development Company, the Mary McKinney, the Forest Queen, the Isabella, the Ophir, the Pointer, the Anchoria-Leland, and the Doctor Jack Pot.

Other prominent producers of 1906 include the Ajax, the Gold Sovereign, the Gold Dollar, the Jo Dandy, and the United Gold mines. The latter are now under the same general management as the Golden Cycle properties. Development on the Ajax includes a 1,230-foot vertical shaft, 600 feet of tunneling, and between 7 and 8 miles of drifts.

A small quantity of ore was taken from the Modoc mine during one of the regular shipments, which carried a low percentage of copper.

The following table gives the production of the Cripple Creek district from 1891 to 1906:

Production of the Cripple Creek district, Colorado, 1891–1906. [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	1906	14,253,245	49,527
1898	13,507,244	68,195			
1899	15,658,254	82,520	Total	168,584,331	811,807

[a] Figures for 1891–1903 from reports of the Director of the Mint; figures for 1904, 1905, and 1906 from reports of the United States Geological Survey.

IDAHO.

By V. C. Heikes.

PRODUCTION.

The gold and silver production of Idaho for the calendar year 1906 as reported by 287 producers, including 176 placers, was $7,191,706. Of this total the gold yield was 55,587.73 ounces, valued at $1,149,100, and the silver was 9,018,815 ounces, which at the commercial price was valued at $6,042,606. There was an increase in both metals, the gold to the extent of $73,482 and the silver 339,722 ounces.

During 1906 the tonnage of ore mined, milled, and smelted amounted to 1,787,673 short tons, valued at $23,342,463, an average of $13.05 per ton for gold, silver, copper, lead, and zinc. Of this value the ore averaged 45 cents in gold and $3.37 in silver, an average total value for gold and silver of $3.82 per ton. The comparison of these figures with corresponding ones for 1905 shows that the value of the metal output increased $3,954,780; the ore tonnage increased 118,635 short tons; and the value per ton increased from $11.62 in 1905 to $13.05 per ton in 1906, a gain of $1.43 per ton, due largely to the lead, copper, and silver contents of the ore. In 1905 the average gold value of the ore was 44 cents per ton, and the silver value was $3.14, or a total value for both metals of $3.58 per ton.

The statement of production for 1905 and 1906, valued at each year's average commercial prices, is as follows:

Production of gold, silver, and associated metals in Idaho in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.......fine ounces..	52,033	$1,075,618	55,587.73	$1,149,100	+ 3,554.73	+ $73,482
Silver............do....	8,679,093	5,242,172	9,018,815	6,042,606	+ 339,722	+ 800,434
Copper........pounds..	7,321,585	1,142,167	9,558,913	1,844,870	+2,237,328	+ 702,703
Lead.............do....	259,812,428	12,211,184	255,014,446	14,535,823	−4,797,982	+2,324,639
Zinc..............do....	1,228,449	72,479	2,065,597	126,001	+ 837,148	+ 53,522
Total............	....	19,743,620	....	23,698,400	....	+3,954,780

The production of metalliferous ores in Idaho in 1905 was 1,669,038 short tons, valued at $11.62 per ton; in 1906 it was 1,787,673 short tons, valued at $13.05 per ton, a gain of 118,635 tons and of $1.43 per ton.

GOLD.

The gold yield amounted to 55,587.73 ounces, valued at $1,149,100 in 1906, as against 52,033 ounces, valued at $1,075,618, in 1905, an increase of 3,554.73 ounces in quantity and of $73,482 in value. The greater part of the gold production in 1906 was produced at gold and silver mills, treating 57,933 tons of ore, from which was extracted bullion containing $522,919 in gold, an average value per ton of $9.03. From 1,534,497 tons of ore at concentrating mills, 225,247 tons of concentrates were saved, valued at $192,793 in gold, an average value per ton of 86 cents. There were shipped to smelter 173,045 tons of crude ore having a total value of $79,907 in gold, an average value of 46 cents per ton.

The additional yield of gold was caused by a number of new placer operations in several counties, notably at Pierce, in Nez Perce County, but also in other counties. There was a decrease in the total gold derived from siliceous ores, but substantial increases from this class of ore were made in the following counties: Ada, Blaine, Custer, Lemhi, Nez Perce, and Shoshone.

The gold from copper ores increased in Custer, Lemhi, and Shoshone counties, as did that from lead ore; in Blaine and Shoshone counties the lead concentrates are estimated to contain an average gold value of 25 cents per ton. This value is not reported by producers, for the reason that no allowance is made by the smelting companies for gold below a certain amount.

In the table of production by kinds of ore in 1905 and 1906, it is shown that the gold was won largely from siliceous ore, but that it decreased 1,046.94 ounces, as did the gold from copper-lead-zinc ores 9 ounces, and from the lead-zinc ores 18.60 ounces. Increases are recorded in gold from placers, 629.62 ounces; from copper ore, 1,683.40 ounces; from lead ore, 2,313.17 ounces; and from copper-lead ore, 3.08 ounces. From Snake River placers a total of $22,326 was recovered in 8 counties. This represents a decrease of $4,692 from the figures of 1905.

In the following tables will be found the yield of gold from different kinds of ore by counties for 1906, and a comparison of totals for 1905 and 1906:

Source of gold production in Idaho by kinds of ore in 1906, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.			Total.
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	
Ada and Bannock	60.12	1,220.12						1,280.24
Bingham	255.01	6.67						261.68
Blaine	110.34	345.00		201.15			1.35	657.84
Boise	6,660.83	4,418.20						11,079.03
Canyon	51.79							51.79
Cassia	161.13					1.40		162.53
Custer	669.48	2,933.03	1,844.28			2.68		5,449.47
Elmore	1,196.38	5,197.57						6,393.95
Fremont								
Idaho	3,371.01	4,902.54						8,273.55
Kootenai								
Latah	36.65							36.65
Lemhi	1,346.98	3,671.94	101.58	4.00				5,124.50
Lincoln	137.27							137.27
Nez Perce	1,860.54	513.86						2,374.40
Oneida	193.70							193.70
Owyhee	103.97	9,388.86						9,492.83
Shoshone	621.28	637.27	405.00	2,470.02			56.05	4,189.62
Washington	263.14		165.54					428.68
Total	17,099.62	33,235.06	2,516.40	2,675.17		4.08	57.40	55,587.73

The following table shows the production of gold in Idaho in 1905 and 1906, with increase or decrease:

Production of gold in Idaho in 1905 and 1906, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Mixed ores.			Total.
					Copper-lead-zinc ore.	Copper-lead-ore.	Lead-zinc ore.	
1905	16,470.00	34,282.00	833.00	362.00	9.00	1.00	76.00	52,033.00
1906	17,099.62	33,235.06	2,516.40	2,675.17		4.08	57.40	55,587.73
Increase (+) or decrease (−)	+629.62	−1,046.94	+1,683.40	+2,313.17	−9.00	+3.08	−18.60	+3,554.73

SILVER.

The silver yield amounted to 9,018,815 ounces, valued at $6,042,606, in 1906, as against 8,679,093 ounces, valued at $5,242,172, in 1905, an increase of 339,722 ounces in quantity and of $800,434 in value. The greatest quantity, 6,762,197 ounces, came from 1,534,497 tons of ore sent to concentration mills, which produced 225,247 tons of concentrates, averaging 30 ounces per ton. From 173,045 tons of crude ore shipped to smelters 2,026,785 ounces were produced, an average of 12 ounces silver per ton; and from bullion produced by gold and silver mills 226,168 ounces were produced from 57,993 tons of ore, an average of 4 ounces per ton. Shoshone County had the greatest increase due entirely to producers in the Coeur d'Alene region, which is credited with 7,944,338 ounces. Of this quantity, lead ore contained 7,415,995 ounces, copper ore 478,349 ounces, lead-zinc ore 47,034 ounces, siliceous ore 2,827 ounces, and placers 133 ounces. Owyhee County, ranking second in production of silver, is credited with 737,578 ounces, all of which was secured from siliceous ore, but on account of remodeling the mill of one of the large producers a decrease was recorded of 108,464 ounces from 1905. Blaine County produced 184,337 ounces, and derived most of it from lead ore, 165,932 ounces; lead-zinc ore 18,140 ounces, siliceous ore 265 ounces. The greatest decrease was 169,824 ounces, principally in lead ore, caused by the closing of active operations in the Minnie Moore mine. Silver increased in placers, copper ore, lead ore, and lead-zinc ore, and decreased in all other kinds of ore, as shown by the table of production for 1905 and 1906, as follows:

Source of silver production in Idaho by kinds of ore in 1906, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead-zinc ore.	Copper-lead-ore.	Lead-zinc ore.	Total.
Ada and Bannock	23	542						565
Bingham								
Blaine		265		165,932			18,140	184,337
Boise	1,663	3,246						4,909
Canyon	2							2
Cassia	2					14		16
Custer	306	2,953	74,974	825		3,678		82,736
Elmore	227	5,625						5,852
Fremont			200					200
Idaho	597	8,332						8,929
Kootenai		2,308						2,308
Latah	4							4
Lemhi	129	1,604	1,120	33,600				36,453
Lincoln	53							53
Nez Perce	446	279						725
Oneida	5							5
Owyhee	10	737,568						737,578
Shoshone	133	2,827	478,349	7,415,995			47,034	7,944,338
Washington	65		9,480	260				9,805
Total	3,665	765,549	564,123	7,616,612		3,692	65,174	9,018,815

The following table shows the production of silver in Idaho in 1905 and 1906, with increase or decrease:

Production of silver in Idaho in 1905 and 1906, by kinds of ore, in fine ounces.

Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
1905	3,482	861,637	486,450	7,277,408	24,743	5,910	19,463	8,679,092
1906	3,665	765,549	564,123	7,616,612	....	3,692	65,174	9,018,815
Increase (+) or decrease (−)	+183	−96,088	+77,673	+339,204	−24,743	−2,218	+45,711	+339,722

COPPER.

The greatest yield of copper in Idaho continues to come from the Coeur d'Alene region in Shoshone County. The output of this county increased from 5,225,606 pounds, valued at $815,194, in 1905, to 6,393,940 pounds, valued at $1,234,030, in 1906, an increase of 1,168,334 pounds in quantity and of $418,836 in value. Custer County followed with an increase from 685,484 pounds, valued at $106,935, in 1905, to 2,815,286 pounds, valued at $543,350, in 1906, an increase of 2,129,802 pounds in quantity and of $436,415 in value. Washington County is on a gradual decline. Lemhi and Fremont counties have been added to the list of producers with important outputs of copper, which promise to become an important item another year.

LEAD.

The lead produced in Idaho decreased from 259,812,428 pounds, valued at $12,211,184, in 1905, to 255,014,446 pounds, valued at $14,535,823, in 1906, a decrease of 4,797,982 pounds in quantity and an increase of $2,324,639 in value. The lead output is credited almost entirely to the Coeur d'Alene region in Shoshone County, which produced 252,022,196 pounds, valued at $14,365,265, in 1906. The next largest producer was Blaine County, Lemhi County following.

ZINC.

The output of zinc during 1906 came almost entirely from Shoshone County. A small portion of the total output came from Blaine County, which in former years led in production. The shipment of zinc concentrates from Shoshone County is estimated to have resulted in the production of 2,054,998 pounds of spelter. The zinc production increased in Shoshone County from 144,000 pounds, valued at $8,496, in 1905, to 2,054,998 pounds, valued at $125,355, in 1906, an increase in quantity of 1,910,998 pounds and of $116,859 in value. In Blaine County the production decreased from 1,084,449 pounds, valued at $63,983, in 1905, to 10,599 pounds, valued at $646, in 1906, a decrease of 1,073,850 pounds in quantity and of $63,337 in value.

ANTIMONY.

Several carloads of mineral bearing this metal were shipped from the Coeur d'Alene region in Shoshone County to New York, as noted in the report on this metal. Antimony deposits of importance are located near Warren in Idaho County and near Ketchum in Blaine County.

MINING INDUSTRY IN IDAHO IN 1906.

Continuing the brilliant records made in 1905 of the increased yield in copper and zinc, the production of 1906 places Idaho among the large producers of these two metals. It stands already at the head of all the States in the production of lead. A number of new producing mines have been added to the list of shippers during the past year and nearly all of the old mines have increased their production.

Among the milling operations the installment of finer grinding and sizing machinery among the mills in the Coeur d'Alene district in Shoshone County, and the use of the tube mill and filter press for cyanide mills in the West View district of Boise County, proved important events in milling practice.

During the year the tailing question in the Coeur d'Alene district was settled by the installation of an elevating system capable of handling 3,000 tons of tailings per day. The bed of the South Fork will be cleared of the deposit of tailings, and other deposits in the tributary creeks will be shipped to the new dumping grounds.

The principal lead-silver producer in Blaine County, the Minnie Moore mine, suspended operations early in the year.

There was a lack of labor in Idaho, especially in the Coeur d'Alene district. Labor of all classes was in demand at good wages. It is estimated that in the Coeur d'Alene district 3,000 men were employed by the mining companies. Announcement was first made by the Bunker Hill and Sullivan Company, and finally adopted by all other companies on August 1, agreeing to use the eight-hour schedule for all miners working underground.

The fuel shortage affected principally the mines in the Coeur d'Alene district, as well as in other parts of the State where wood for steam and water for power were not entirely depended upon. Several companies at Mullan and Wardner were obliged to suspend operations in October for the reason that neither coal or sufficient electrical power from Spokane were available to operate the necessary machinery. Some of the companies began the use of oil for fuel.

No railroad building of importance was carried on in the mining camps of the State, but several reports have been received that a line of railroad would be extended from some point on the Oregon Short Line Railway in Fremont County, Idaho, to the lead mines in the Junction district of Lemhi County; also that a line of railroad, which was surveyed several years ago, is to be built from the Oregon Railroad and Navigation Company's station at Kingston up North Fork and Pritchard creeks to Murray, in Shoshone County.

The tables in the following sections of this report 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 production, are given by counties for the year in the table which follows:

Production of gold, silver, copper, lead, and zinc in Idaho, in 1906 by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
Ada and Bannock	1,280.24	$26,465	565	$378		
Bingham	261.68	5,409				
Blaine	657.84	13,599	184,337	123,506		
Boise	11,079.03	229,024	4,909	3,289		
Canyon	51.79	1,071	2	1		
Cassia	162.53	3,360	16	11	420	$81
Custer	5,449.47	112,650	82,736	55,433	2,815,286	543,350
Elmore	6,393.95	132,174	5,852	3,921		
Fremont			200	134	34,000	6,562
Idaho	8,273.55	171,030	8,929	5,982		
Kootenai			2,308	1,546		
Latah	36.65	758	4	3		
Lemhi	5,124.50	105,932	36,453	24,424	40,000	7,720
Lincoln	137.27	2,838	53	36		
Nez Perce	2,374.40	49,083	725	486		
Oneida	193.70	4,004	5	3		
Owyhee	9,492.83	196,234	737,578	494,177		
Shoshone	4,189.62	86,607	7,944,338	5,322,706	6,393,940	1,234,030
Washington	428.68	8,862	9,805	6,570	275,267	53,127
Total	55,587.73	1,149,100	9,018,815	6,042,606	9,558,913	1,844,870

County	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Ada and Bannock					$26,843
Bingham					5,409
Blaine	1,737,605	$99,043	10,599	$646	236,794
Boise					232,313
Canyon					1,072
Cassia	6,440	367			3,819
Custer	64,205	3,660			715,093
Elmore					136,095
Fremont					6,696
Idaho					177,012
Kootenai					1,546
Latah					761
Lemhi	1,144,000	65,208			203,284
Lincoln					2,874
Nez Perce					49,569
Oneida					4,007
Owyhee					690,411
Shoshone	252,022,196	14,365,265	2,054,998	125,355	21,133,963
Washington	40,000	2,280			70,839
Total	255,014,446	14,535,823	2,065,597	126,001	23,698,400

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 1905 and 1906, by counties.

County.	Total tonnage 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.
	1906.	Increase (+) or decrease (−).	1905.	1906.	1905.	1906.	1905.	1906.	
	Short tons.	*Short tons.*							
Ada and Bannock	6,265	+ 6,055	2	2	$7.47	$4.08	$7.47	$4.08	$25,585
Bingham	30	+ 30	......	1	....	4.60	....	4.60	138
Blaine	17,844	− 1,001	14	15	25.45	13.14	12.10	7.56	134,824
Boise	16,406	+ 14,618	9	13	11.88	5.70	11.83	5.70	93,507
Canyon	....	....	......	......	....	....	....	....	....
Cassia	7	− 2	1	1	56.00	69.57	3.44	5.57	39
Custer	42,162	+ 27,658	6	7	10.39	16.63	2.48	3.65	154,039
Elmore	15,095	+ 3,869	10	6	10.07	7.37	10.07	7.37	111,212
Fremont	100	+ 97	1	1	123.66	66.96	1.33	1.34	134
Idaho	18,130	− 10,051	15	12	6.16	5.90	6.16	5.90	106,927
Kootenai	20	− 50	2	1	189.31	77.30	185.30	77.30	1,546
Latah	....	....	......	......	....	....	....	....	....
Lemhi	17,466	+ 195	9	11	10.21	10.04	5.32	5.86	102,425
Lincoln	....	....	......	......	....	....	....	....	....
Nez Perce	1,377	+ 1,177	2	4	26.77	7.85	26.77	7.85	10,809
Oneida	....	....	......	......	....	....	....	....	....
Owyhee	27,034	− 15,997	4	5	18.98	25.45	18.98	25.45	688,255
Shoshone	1,622,975	+ 96,048	27	28	11.24	13.01	2.89	3.33	5,397,381
Washington	2,762	− 4,011	3	4	41.89	23.66	9.57	3.60	9,948
Total	1,787,673	+118,635	105	111	11.62	13.05	3.58	3.82	6,836,769

The total tonnage of ore sold or treated in each county of Idaho during 1906, 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 of milling and smelting ore and concentrates, with gold value and quantity of silver contained in bullion, produced in Idaho in 1906, by counties.

County.	Ore to gold and silver mills.			Quantity of ore to concentrating mills.	Concentrates produced.		
	Quantity.	Gold in bullion.	Silver in bullion.		Quantity	Gold.	Silver.
	Short tons.		*Fine ounces.*	*Short tons.*	*Short tons.*		*Fine ounces.*
Ada and Bannock	20	$8,230	80	6,000	100	$5,002	154
Bingham	30	138	....	....	....	....	....
Blaine	....	2,336	86	1,780	3,311	4,824	113,682
Boise	3,613	47,320	1,063	12,617	1,165	38,068	2,000
Canyon	....	....	....	....	....	....	....
Cassia	....	....	....	....	....	....	....
Custer	1,241	60,073	2,953	....	....	....	....
Elmore	13,935	105,343	5,495	1,160	87	2,100	130
Fremont	....	....	....	....	....	....	....
Idaho	18,060	90,839	8,332	70	55	10,506	....
Kootenai	....	....	....	....	....	....	....
Latah	....	....	....	....	....	....	....
Lemhi	9,199	68,154	203	8,220	1,520	5,180	34,720
Lincoln	....	....	....	....	....	....	....
Nez Perce	1,377	10,622	279	....	....	....	....
Oneida	....	....	....	....	....	....	....
Owyhee	9,608	119,232	206,027	17,426	182	74,853	531,541
Shoshone	850	10,632	1,650	1,487,224	218,827	52,260	6,079,970
Washington	....	....	....	....	....	....	....
Total	57,933	522,919	226,168	1,534,497	225,247	192,793	6,762,197
Per ton	....	9.03	4.00	....	....	0.86	....

Tonnage of milling and smelting ore and concentrates, with gold value and quantity of silver contained in bullion, produced in Idaho in 1906, by counties—Continued.

County.	Crude ore to smelter.			Old tailings treated.			Total tons crude ore shipped or treated.
	Quantity.	Gold.	Silver.	Quantity.	Gold.	Silver.	
	Short tons.		*Fine ounces.*	*Short tons.*		*Fine ounces.*	*Short tons.*
Ada and Bannock	120	$11,990	308	125			6,265
Bingham							30
Blaine	1,156	4,158	70,569	14,908			17,844
Boise	176	5,944	183				16,406
Canyon							
Cassia	7	29	14				7
Custer	40,921	38,738	79,477				42,162
Elmore							15,095
Fremont	100		200				100
Idaho							18,130
Kootenai	20		2,308				20
Latah							
Lemhi	47	4,754	1,401				17,466
Lincoln							
Nez Perce							1,377
Oneida							
Owyhee							27,034
Shoshone	127,736	10,872	1,862,585	7,165			1,622,975
Washington	2,762	3,422	9,740				2,762
Total	173,045	79,907	2,026,785	[a] 22,198			1,787,673
Per ton		0.46	12.00				

[a] Gold and silver included under concentrates produced.

Subdivision of tonnage of ore sold or treated in Idaho in 1906, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Mixed ore.		
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.
Ada and Bannock	6,265						
Bingham	30						
Blaine			16,544				1,300
Boise	16,406						
Cassia						7	
Custer	1,247	40,859	14			42	
Elmore	15,095						
Fremont		100					
Idaho	18,130						
Kootenai	20						
Lemhi	11,046	420	6,000				
Nez Perce	1,377						
Owyhee	27,034						
Shoshone	965	84,416	1,520,052				17,542
Washington		2,722	40				
Total	97,615	128,517	1,542,650			49	18,842
Value per ton in gold and silver	$12.29	$3.34	$3.34			$52.20	$2.38

In 1905 the subdivision, in short tons, was as follows: Siliceous ore, 103,426; copper ore, 82,723; lead ore, 1,477,531; zinc ore, 1,682; copper-lead-zinc ore, 1,445; copper-lead ore, 38; lead-zinc ore, 2,193.

Production of placer gold in Idaho in 1906, by counties.

Ada	$1,243	Lincoln	$2,838
Bingham	5,271	Lemhi	27,844
Blaine	2,281	Nez Perce	38,461
Boise	137,692	Oneida	4,004
Cassia	3,331	Owyhee	2,149
Canyon	1,071	Shoshone	12,843
Custer	13,839	Washington	5,440
Elmore	24,731		
Idaho	69,685	Total	353,481
Latah	758		

The placer production of Idaho for 1905 and 1906 is given for the different methods of mining in the following table:

Gold production of Idaho placers by different methods, 1905 and 1906.

Year.		Hydraulic.[a]	Drift.	Dredge.	Total.
1905	Fine ounces..	14,346.00	463.00	1,661.00	16,470.00
1906	do....	15,054.30	190.59	1,854.73	17,099.62

[a] Includes sluicing.

The following table gives for 1906 the number of mines classified according to their chief products.

Number of producing mines classified by chief products in Idaho in 1906, by counties.

County.	Gold placer mines.				Deep mines.									Total mines producing.
	Hydraulic.	Dredge.	Drift.	Total.	Gold.	Silver.	Gold and silver.	Gold, silver, and copper.	Gold, silver, copper, and lead.	Gold, silver, and lead.	Silver and lead.	Gold, silver, lead, zinc	Total mines.	
Ada and Bannock	2			2			2						2	4
Bingham	5			5	1								1	6
Blaine	2			2						6	8	1	15	17
Boise	43	1		44	2		11						13	57
Canyon	2			2										2
Cassia	3			3					1				1	4
Custer	8	1		9	1		1	3	1		1		7	16
Elmore	7			7	3		3						6	13
Fremont								1					1	1
Idaho	30		5	35	8		4						12	47
Kootenai						1							1	1
Latah	4			4										4
Lemhi	9			9	6		3	1		1			11	20
Lincoln	4			4										4
Nez Perce	33	1		34	2		2						4	38
Oneida	3			3										3
Owyhee	4			4			5						5	9
Shoshone	7		1	8	1	1	[a] 4	2		13	5	2	28	36
Washington	1			1				3			1		4	5
Total	167	3	6	176	24	2	35	10	2	20	15	3	111	287

[a] One antimony.

REVIEW BY INDIVIDUAL COUNTIES.

ADA COUNTY.

Reports of production by 2 deep mines and from small placer operations along Boise River resulted in the output of $26,465 in gold and 565 ounces of silver. The largest part of the output came from deep mines.

Black Hornet district.—The Last Hope Mining Company shipped bullion from a test made with a 3-stamp prospecting mill. The company owns 6 claims which are being developed by 2 tunnels. The Twentieth Century Mining Company (Limited) developed during the year property consisting of 36 lode claims. The ore is low grade, averaging about $5 a ton, with values principally in gold. Development work consists of prospect tunnels and drifts aggregating 2,500 feet.

Shaw Mountain district.—The Big Giant Gold Mining Company owns a large group of claims, aggregating 240 acres, about 10 miles to the northeast of Boise City. The property is developed by tunnels, drifts, and raises aggregating a total of about 4,000 feet. The ore is white quartz associated with iron and having gold and silver values.

Neal district.—The Gold Eagle Mining and Milling Company, equipped with a 50-ton Monadnock amalgamation mill, produced concentrates and bullion. The development work is carried on by an incline shaft 275 feet deep, from which several levels have been driven. Other properties carrying on development work in the county are the Celtic Gold Mining Company and the Picket Pin Gold Mining Company.

BANNOCK COUNTY.

Fort Hall district.—The Fort Hall district extends east and south of Pocatello. No production is recorded for the district, but the Fort Hall Mining and Milling Company carried on development work on a copper deposit during 1906, and the tunnel is about 3,900 feet in length. The Moonlight claims 5 miles north of the Fort Hall claims have a crosscut tunnel driven for 700 feet, which is continued with the expectation of cutting a fissure at about 200 feet vertically below the point where several carloads of ore were taken out and shipped in 1904. The Great Western Mining Company continued developments of its property with a crew of 3 men. The underground development work consists of 975 feet of prospect tunnel.

BEAR LAKE COUNTY.

Bear Lake district.—Considerable development work has been carried on in the Bear Lake district for a number of years, but no important shipments have been made. As a rule, the ores are low grade, carrying values in gold, silver, and copper. The only mineral deposits attracting attention are the phosphate deposits[a] occurring in the Upper Carboniferous limestone about 4½ miles west of Montpelier, on the Oregon Short Line Railway.

BINGHAM COUNTY.

The reports of production were made by 1 deep mine and 5 placers on Snake River and in the Mount Pisgah district. The 2 dredges on Snake River were idle. In the Mount Pisgah district the American Hydraulic Placer Mining Company produced during three months of the year, and the Pittsburg Mining Company made a trial run of its mill, shipping a little bullion. Efforts are being made to continue operations again. The quantity of gold credited to the county amounted to 261.68 ounces, valued at $5,409.

BLAINE COUNTY.

Fifteen deep mines and 2 placers produced during the year. Six of the deep mines produced ore carrying gold, silver, and lead; 8, silver and lead ores; and 1, ores of gold, silver, lead, and zinc. The quantity and value of each metal produced from deep and placer

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[a] Weeks, F. B., and Ferrier, W. F. Phosphate deposits in western United States: Contributions to Economic Geology, Bull. U. S. Geol. Survey, No. 315, 1907, pp. 460-461.

mines in Blaine County during 1905 and 1906, with increase and decrease, are shown in the table which follows:

Production of gold, silver, and associated metals in Blaine County, Idaho, in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold....fine ounces..	88	$1,819	547.50	$11,318	+ 459.50	+ $9,499
Silver....do....	374,545	226,225	184,337	123,506	− 190,208	−102,719
Copper....pounds..	2,312	361	....	....	− 2,312	− 361
Lead....do....	3,983,833	187,240	1,737,605	99,043	−2,246,228	− 88,197
Zinc....do....	1,084,449	63,983	10,599	646	−1,073,850	− 63,337
PLACERS.						
Gold....fine ounces..	258	5,333	110.34	2,281	− 147.66	− 3,052
Silver....do....	9	5	....	....	− 9	− 5
Total....	....	484,966	....	236,794	....	−248,172

The production of metalliferous ore in Blaine County in 1905 was 18,846 short tons, valued at $25.45 per ton; in 1906 it was 17,844 short tons, valued at $13.14 per ton, a loss of 1,002 tons in quantity and of $12.31 in value per ton. The origin of the precious metals, by kinds of ore, is given in the following table:

Source of gold and silver in Blaine County, Idaho, in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Mixed ores.		Total.
					Copper-lead-zinc ore.	Lead-zinc ore.	
Gold....	1905	258.00	....	3.00	9.00	76.00	346.00
	1906	110.34	345.00	201.15	....	1.35	657.84
Silver....	1905	9.00	....	335,756.00	24,743.00	14,046.00	374,554.00
	1906	....	265.00	165,932.00	....	18,140.00	184,337.00

Dome district.—The Red Bird Group, developed by a vertical shaft 75 feet deep, made a small shipment of ore carrying values in gold, silver, and lead.

Lava Creek district.—The Idaho Silver and Zinc Company (Limited) carried on experimental work with a mill capable of crushing 50 tons of ore in ten hours.

Mineral Hill district.—The Oswego Mining Company, with properties located a short distance north of the Minnie Moore mine, developed its 2 lode claims, and shipped some lead-silver ore. The work is carried on by an incline shaft 200 feet deep, and the total underground work, including shafts, tunnels, crosscuts, and upraises, amounts to about 4,800 feet. The Eureka Development Company (Limited) reopened its property during the year and made several shipments of ore carrying silver and lead. The property is opened by an incline shaft 265 feet deep with 4 levels. There is also a long adit tunnel driven on the vein. The mine is equipped with a concentration mill of 60-ton daily capacity. The Croesus

Gold and Copper Mining Company's property is situated $3\frac{1}{2}$ miles west of Hailey and has recently been opened under a new management. Development work consists of a shaft 800 feet deep with levels at each hundred feet. A 10-stamp mill on the property was operating the last two months of the year and produced several thousand dollars in free gold. The Democrat mine, operated by the Della Mountain Mining Company, a short distance northwest of Hailey, is developed by 8 tunnels, the lower one, known as No. 10, being 3,600 feet long. The reduction plant is equipped with hand jigs and was operated successfully during the year. Silver-lead ore and concentrates were shipped to the smelter.

The Idaho Consolidated Mines Company has recently taken over the Minnie Moore mine, and has been completing a new shaft house preparatory to the sinking of a shaft to great depth, by which it is expected to develop the Minnie Moore vein in the Relief claim, and also to prospect further for the ore deposits in the Minnie Moore mine. During the year the surface workings of the Minnie Moore were exploited by lessees, who shipped a considerable quantity of high-grade ore, and at the concentration mill old tailings were re-treated. The ore tailing dump at the Red Cloud mine, which is a short distance west of the Nay Aug, was re-treated.

The Fourth of July Mining and Milling Company, as well as the Olive claim, made small shipments carrying values in silver and lead.

The Wood River Zinc Company operated the Nay Aug mine with a force of 20 men and shipped crude ore carrying values in gold, silver, and lead to the smelters. The property is developed by 3 tunnels, and a new one has been started that will be 2,600 feet in length. This will undercut 3 distinct ore shoots now known to exist at considerable depth, especially the one in the old works, which is to be drained fully 300 feet below the lowest level. No zinc ore was shipped from the Nay Aug during the year, but the company shipped one carload of zinc concentrates from a supply which was hauled to the mill last year from the War Dance claim. The latter property was not operated during 1906.

Development work on the Red Elephant mine of the Quincy Junior Mining Company has made the property productive, and several shipments of ore made during the year.

Rosetta district.—The Dollarhide Mining Company, owning property located at the head of Warm Springs Creek, 12 miles west of Ketchum, produced crude ore and concentrates with gold, silver, lead, and zinc values, which were shipped to smelters in Utah and Colorado. A concentration mill of 50 tons daily capacity was operated, but found inadequate, and was shut down during the latter part of the year for the installation of more improved machinery. The mine is developed by 4,000 feet of tunnels. This company also owns the Carrie Leonard property, formerly one of the large producers of the county, which has been idle for several years. The property has been put into shape for production and will likely enter the shipping list during 1907.

Placer production is recorded in this district from the Hollister placer, which has been under development for the past two years.

Snake River district.—A number of small operators produced along Snake River, the output being reported by storekeepers purchasing the gold.

Warm Springs district.—The Navy Group, operated by the Sampson Mining Company, has been steadily developing its property by various tunnels and crosscuts, and made a small shipment of ore.

BOISE COUNTY.

The production of Boise County in 1906 amounted to $229,024 in gold and 4,909 ounces of silver, valued at $3,289, a total of $232,313 of gold and silver. From 16,406 short tons of ore by 13 deep mines there were obtained $91,332 in gold and 3,246 ounces of silver, valued at $2,175, a total of $93,507 gold and silver, or an average of $5.70 per ton. From 44 placer properties there were obtained $137,692 in gold and 1,663 ounces of silver, valued at $1,114. Compared with 1905, the gold production showed an increase of 3,719.03 ounces and the tonnage an increase of 14,618 short tons. The average gold and silver content per ton decreased $6.18, a decrease from $11.88 in 1905 to $5.70 in 1906. The placer yield increased from 6,351 ounces, valued at $131,287, in 1905, to 6,660.83 ounces, valued at $137,692, in 1906.

The contents and commercial value of the output are as follows:

Production of gold, silver, and associated metals in Boise County, Idaho, in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold........fine ounces..	1,009	$20,858	4,418.20	$91,332	+3,409.20	+$70,474
Silver........do....	482	291	3,246	2,175	+ 2,764	+ 1,884
Lead........pounds..	2,064	97	....	....	− 2,064	− 97
PLACERS.						
Gold........fine ounces..	6,351	131,287	6,660.83	137,692	+ 309.83	+ 6,405
Silver........do....	1,478	893	1,663	1,114	+ 185	+ 221
Total........	....	153,426	....	232,313	....	+78,887

The ore production in Boise County, Idaho, in 1905 amounted to 1,788 short tons, valued at $11.88 per ton; the output in 1906 was 16,406 short tons, valued at $5.70 per ton, a gain of 14,618 tons and a loss of $6.18 in value per ton.

Source of gold and silver in Boise County, Idaho, in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Total.
Gold........	1905	6,351.00	721.00	288.00	7,360.00
	1906	6,660.83	4,418.20	....	11,079.03
Silver........	1905	1,478.00	182.00	300.00	1,960.00
	1906	1,663.00	3,246.00	....	4,909.00

The output of the county is derived from 13 deep mines, 2 of which carried the principal values in gold; and from 44 placers, 1 of which reported results from the operation of a dredge.

Boise Basin region.—The Belshazzar Gold Mining Company, owning property at Quartzburg, developed considerable ore during the year. Enough ore has been taken out for experimental work; it was treated in the 10-stamp mill recently moved from the Iowa mine. Forty per cent of the values are said to be free milling. A new mill of 100 tons capacity is planned, with a cyanide plant attached to treat the tailings.

The Cracker Jack claims were developed by several tunnels, the longest of which was 200 feet; they produced a small yield of gold bullion. The Golden Rod Mining Company is developing its property by a vertical shaft 260 feet deep. It is equipped with a mill of 80 tons daily capacity. Several hundred tons of ore were treated during the year.

The Amigo Mining Company, operating the Sunday mine, carried on development work by an incline shaft 125 feet deep and a tunnel 410 feet long. The property adjoins the Gold Hill. Further development will involve the draining of that property.

The Jupiter claim owned by the Great Divide Gold Mining Company is developed by a tunnel 700 feet long and is equipped with an experimental stamp mill.

The Merry Blue and Union claims were developed by a vertical shaft 150 feet deep and a tunnel 480 feet long. The gold ore is treated in an arrastra.

Near Pioneerville the Golden Age Mining Company (Limited) operated a 1-stamp experimental mill, and during the latter part of the year installed 5 more stamps to use water power.

The Golden Chariot and the Mammoth claims are developed by 2 shafts 400 feet and 160 feet respectively, with a total of 6,000 feet of drifting. A 5-stamp mill is located on the Mammoth property, and a 2-stamp mill on Rock Creek, 2 miles west of Summit Flat.

The Grimes Placer Mining Company owns 4 placer claims near Pioneerville; fully two-thirds of the acreage is stated to be virgin placer. During the season the property was tested and a successful run was made. The largest nugget found was valued at $72.70. A ditch 11 miles in length that will cost in the neighborhood of $25,000 is needed, but at present a ditch 3 miles long has been completed which furnished enough water to employ from 6 to 8 men. The Basin Branch placers operated by the Woodburn interests made the usual successful run on the property.

The Moline Mining Company operated its Risdon bucket elevator dredge almost the entire season with very good success.

The Boise Hydraulic Power Company has under operation the Reed placers near Placerville. The property embraces some of the richest old channel gravel in the Basin country, and also some recent stream gravel. The main bank on the Reed placer is from 50 to 100 feet deep. Development work on the property during the year consisted of digging 15 miles of new ditch and cleaning out as many miles more of old ditch for the purpose of diverting the water of Grimes Creek to the Placerville drainage.

Reporting to the Geological Survey were the following producing placers: Little Nuggett, Gold Hill Placer, Owry, Ashcroft, White Horse, Leary Diggings, Boyles Gulch, Steamboat, Cayotte, Oaks, Kentucky, Riley, Farren, Boston Girl, Headin, Ophir, Confederate, Gulch, Thorn Creek, Paymaster, and Nally. The total yield of gold from the operations of the Chinese miners is estimated to be 1,194.85 ounces.

West View district.—The Black Pearl Mining Company, operating the J. I. C. property, has its shaft 414 feet deep, with 2,500 feet of drifting. During the year 750 feet of development work was accomplished underground. On the 200-foot level a 6-foot vein was encountered, on which drifts were run for 800 feet. The ore is said to average about $15 per ton in gold and silver. The Elspass mill is of 50-ton capacity. The treatment employed has been concentration and cyanidation. It is decided to add stamps and tube mill with a Kelly filter press, which will be the first use of the tube mill and press in Idaho.

The Lincoln Mining Company (Limited) is developed to a depth of 300 feet, and at this point has a continuous ore shoot 1,000 feet long that is stated to average 4 to 5 feet in width and $11 per ton. The mill, which is of 100 tons daily capacity, is run by electrical power which is generated at Horseshoe Bend, 8 miles distant on the Payette River.

The Whitman Mining Company, operating the Leviathan mine, employed a force of 8 men on development work. Considerable low-grade ore has been blocked out and some ore of a shipping grade was sent to the smelters during the year. The total development work on the property will aggregate 2,500 feet. It is equipped with a 5-stamp mill, using amalgamation and concentration.

The Kentucky mine, operated by the United Mines Company (Limited), has about 3,000 feet of tunnel work. The vein has been opened to a depth of 900 feet below the surface. The property is equipped with a mill capable of treating 50 tons of ore per day, and made during the year an important shipment of concentrates. The ore is capable of being treated by cyanide, and several tests have been made with this method in view.

CANYON COUNTY.

It is estimated a total of 51.79 ounces of gold was produced by transitory placer operators on Snake River in this county.

CASSIA COUNTY.

The Cumora Mining and Milling Company sunk a winze from the level of its main tunnel to a depth of 100 feet, opening up the vein at the bottom 7 feet wide. Several tons of the best ore were shipped, yielding values in gold, silver, copper, and lead. It is reported that 20,000 tons of low-grade crude ore is available for milling.

Placer properties along Snake River, owned by the Fall Creek Sheep Company, were productive of some gold. The entire product from mining operations amounted to $3,819, showing a slight increase over that of 1905.

CUSTER COUNTY.

Alder Creek district.—The White Knob mine is operated by interests known as the Macbeth Lease. During the year these operators succeeded in developing some extensive bodies of good copper ore, and though a disastrous fire destroyed and delayed operations of its 400-ton smelter, a creditable output was made for the year. The mine is developed by a vertical shaft 700 feet deep, and a crosscut tunnel has been run for 5,000 feet, in which several bodies of ore were disclosed.

Bay Horse district.—The Salmon River Mining Company operated its Pacific property through lessees who took out a shipment of lead ore with values in copper, silver, and gold. The property is developed by several tunnels. The South Butte claim was operated and produced lead ore containing silver. The property has a tunnel 720 feet long.

Aetna Mining and Investment Company, operating the Guy C. Barton property, made a shipment of copper ore carrying silver with some gold.

Loon Creek district.—The Cash Box Company sent a trial shipment to the smelters from its surface workings. The owners continued development work during the entire season with a small force of men.

The placer properties owned by the Loon Creek Hydraulic Company were prospected during the year and a small amount of bullion was taken out. Equipment necessary for the proper working of the placers is being put in for the next season's work.

Yankee Fork district.—Holdings of the Golden Sunbeam Mines Company include the Custer, Lucky Boy, Badger, Charles Dickens, and Montana mines, which have a combined bullion record of several million dollars. During the year the company completed the installation of a roller mill of 40-ton daily capacity. Several thousand tons of gold-silver ore were taken out and milled.

Stanley Basin district.—The Challis and Sturkey placers reported a small production of gold bullion taken out during development work on stream and bench gravel deposits.

Joe's Gulch Placer mine continued production by sluicing operations. From Wormack's dredge, operating on the Stanley Creek placers, some bullion was also shipped.

ELMORE COUNTY.

The output of the county for 1906 was from 6 deep mines and from placers in 3 districts. The placer output is partly estimated, and came principally from small producers, among them a number of Chinese operating on Bear Creek and Middle Boise and Snake rivers. The deep mines produced 15,059 tons of gold and silver ore, valued at $111,212, an average of $7.37 per ton. The placer yield amounted to gold 1,196.38 ounces and silver 227 ounces, valued together at $24,883, and making the total value of the county production $136,095. These figures compared with those of 1905 show that the ore tonnage increased 3,869 short tons in quantity and decreased $1,861 in value. Gold decreased 121.05 ounces and $2,503 in value, and silver increased 2,897 fine ounces and $2,136 in value, a total decrease for the metal output of $367 in value.

Black Warrior district.—Much development work has been carried on in this district during the year. Among the properties developing are the Rico Mammoth mine, the Red Bird, the Imperial, and the Pathfinder groups of claims. Production was made by the Fourth of July claims and the Blue Cup Mining Company, operating the Red Bird group. The State wagon road, which has been in process of construction for two years, is expected to be completed during the summer of 1907.

Atlanta or Middle Boise district.—The Atlanta Mines Company, operating the Buffalo Monarch and the Last Chance claims, has developed them extensively during the last four years through a vertical shaft 600 feet deep and by a tunnel 1,000 feet long. The company has nearly completed the building of a mill which will have a capacity of 150 tons of ore a day and will be adapted to treating ore by amalgamation, concentration, and cyaniding. The plant is expected to be in operation during the fall months of 1907. An aerial tramway, $1\frac{3}{4}$ miles in length, was installed during the year, connecting the mine with the mill. Its carrying capacity is 21 tons of ore per hour.

The New Century Mines Company, operating the Rico Mammoth mine, employed 30 men in development work, besides making a small shipment of gold bullion. The property is opened by a tunnel 185 feet long and is equipped with an Elspass mill of 25 tons capacity per day.

The property of the Minerva Mining Company is developed by 2 tunnels, the longest of which is 850 feet, which, with drifts and upraises, carries a total of 2,600 feet of development work, of which 650 feet were driven during 1906. The mill, which is equipped with 10 stamps, Wilfley concentrators, and cyanide plant, was not operated to its full capacity, it being necessary to complete the construction of the cyanide plant, which is of the Garvin type and has a capacity of 40 tons of ore per day. It is possible to operate the entire plant by water power.

Pine Grove district.—The C. H. Gold Mines Company operated the Franklin mine, which is developed by tunnels run at 3 different levels. The 10-stamp mill on the property reduced the ore, which yielded mainly gold, with very little silver.

FREMONT COUNTY.

Skull Canyon district.—The Paymaster property of the Weimar Copper Company was operated during the year by open pits, and a number of carloads of copper ore was shipped to the Salt Lake smelters. This mineral deposit is located in the western part of the county and consists of narrow vertical fissures connecting with a flat-bedded deposit of high-grade carbonate and oxide ores and blue limestone near its contact with sandstone.

The coal deposit on Horseshoe Creek in the eastern part of the county is part of the Sublette field of Wyoming. The deposit continues to attract considerable attention, and it is reported that at least 10 workable seams of high-grade bituminous coal have been opened up. One of the coal claims operated at present furnishes about 20 tons of coal per day for the local trade.

IDAHO COUNTY.

The production of the county for 1906 came from 10 districts, in which 47 properties produced. Twelve of these were deep mines, located in 6 different districts, and 35 were placers in 14 different districts. The total tonnage of ore treated in the county amounted to 18,130 short tons of silver ore, valued at $106,927, or an average value per ton of \$5.90 gold and silver. The placer output was valued at \$70,085. The total output of the county, with increases and decreases, is given as follows:

Production of gold and silver in Idaho County, Idaho, in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold .... fine ounces..	8,254	\$170,625	4,902.54	\$101,344	−3,351.46	−\$69,280
Silver .... do....	4,905	2,963	8,332	5,582	+ 3,427	+ 2,619
PLACERS.						
Gold .... fine ounces..	2,289	47,318	3,371.01	69,685	+1,082.01	+ 22,367
Silver .... do....	254	153	597	400	+ 343	+ 247
Total	....	221,059	....	177,012	....	− 44,047

The production of ore in Idaho County, Idaho, in 1905, amounted to 28,181 short tons, valued at \$6.16 per ton; in 1906 it was 18,130 short tons, valued at \$5.90 per ton, a decrease of 10,051 tons in quantity and of 26 cents in value per ton.

Dixie district.—The Tiwaka claim produced ore yielding iron concentrates and some bullion.

Elk City district.—The Buffalo Hill placer mines have been developed for five years, and it is expected that with sufficient water for 1907 this property should become an important producer. In 1906 some gold was taken out during development work.

The Moose Creek Gold Mining Company, which at great expense put in extensive equipment during 1905, was expected to produce a large amount of gold during 1906, but on account of a shortage of water the production fell short of what was expected, and no final clean-up was made of the last month's run. Other properties in the district that produced are the Gold Hill, the Gefle, the Elk Trail Mining Company, and the Dead Rock placer.

Florence district.—The Bear Track claim, opened by various shafts and a short tunnel, is equipped with a 2-stamp triple discharge mill, which produced some gold bullion; concentrating machinery is now needed. The Skookum claim near the Bear Track and operated under the same management is equipped with a 5-stamp single discharge mill and has about 1,025 feet of development work. The production of the year was the result of experimental work. There was a small output from placer operation in the district.

Maggie Creek district.—The Maggie Creek placers and the Spider claims were producers of some placer gold.

Newsome district.—The Newsome and Leggett Creek placers operated by the Newsome and Leggett Creek Hydraulic Mining Company, also the Tippie and a number of other properties, produced placer gold.

Robbins (Buffalo Hump) district.—The property of the Cracker Jack Mining and Milling Company was operated to some extent during the year in experimental work and is equipped with a 10-stamp mill. The Jumbo Mining and Milling Company's property continues to be the principal producer of the district and, according to the published reports to stockholders, 2,973 tons of ore were treated, netting $3.23 per ton in free gold, by amalgamation, the concentrates being treated by chlorination. The tailings carried considerable values and are being cribbed for future treatment. The property is developed by 4 tunnels. The main working tunnel is 1,250 feet long, with an upraise connecting the 2 upper tunnels 210 feet in height. The mill is equipped with 24 stamps, 3 concentrating tables, and a chlorination plant of 1 ton capacity.

Simpson or Salmon River district.—The Horseshoe Bend Mining Company, operating the Robie and Smith placers, worked only until July, when high water damaged the ditch.

The placer properties operating and producing were as follows: Mountain Queen, Shorts Bar, Rattler, Spring Bar, Golden Rule, and Golden Rod. Drift mining is carried on in most of these properties.

Thunder Mountain district.—The Denway mine of the Thunder Mountain Mining and Milling Company is the principal producer in this district and county. It is developed by tunnel 1,700 feet long, through which were taken out 11,784 tons of ore, and it is equipped with a 10-stamp amalgamation mill. This ore contained an average of $5.25 per ton, and the net saving of gold was 85 per cent. The total cost of mining and milling was $3.51.

Warren district.—The Golden Rule Placer Mining Company, operating near Resort on bench-gravel deposits, had a very successful run. Other placer properties producing are Fish Creek placer, Shissler Creek placer, Gott placer, and considerable ground operated by lessees. The Silver King mine was operated during seven weeks and produced quite a large quantity of silver and gold bearing ore.

KOOTENAI COUNTY.

This county has a very small production of mineral to its credit for 1906, but the prospects for the future are good, and possibly the Pan Handle smelter will be put into operation during 1907. The Tyson Consolidated Mining and Milling Company owns a tract of placer ground on St. Marys River which has been developed for several years past and is expected to be ready for production at an early date.

Priest Lake district.—The Idaho Continental Mine, the Priest Lake Mining Company, the Mountain Chief Mine, the Gem Copper Mining Company, and the Pan Handle Copper Mining and Smelting Company continue development work on their properties.

LATAH COUNTY.

The output of this county consisted of 36.65 ounces of gold from placers, valued at $758, and 4 ounces of associated silver valued at $3, a total value of $761. Four placers contributed to the total, which was produced principally in the Moscow district. Gold Creek and Hoodoo districts also recorded production. The total value of the output was $3,903 less in 1906 than in 1905.

LEMHI COUNTY.

The production of Lemhi County shows little change in 1906. Among the important mines are the Kittie Burton, in the Indian

Creek district, and the Gilmore mines, in the Texas district. A survey for a railroad was made during the summer between the southern part of the county and the Oregon Short Line at Dubois. At the present time ore from the Texas district is being shipped by traction train 80 miles to Dubois at an expense of $10 per ton. Eleven mines reported an output of 17,466 short tons, against 9 mines and 17,271 short tons in 1905. Six of the companies reporting produced gold, 3 gold and silver; 1 copper, and 1 lead, in addition to the precious metals. Nine placers, against 10 in 1905, reported production. The placers and siliceous ore produced the greatest amount of gold, and lead ore the silver.

The output of the county for 1905 and 1906 is as follows:

Production of gold, silver, and associated metals in Lemhi County, Idaho, in 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.................fine ounces..	3,309	$68,403	3,777.52	$78,088	+ 468.52	+$9,685
Silver.........................do....	38,936	23,517	36,324	24,337	− 2,612	+ 820
Copper....................pounds..			40,000	7,720	+ 40,000	+ 7,720
Lead...........................do....	1,796,000	84,412	1,144,000	65,208	−652,000	−19,204
PLACERS.						
Gold.................fine ounces..	1,440	29,768	1,346.98	27,844	− 93.02	− 1,924
Silver.........................do....	421	255	129	87	− 292	− 168
Total............................		206,355		203,284		− 3,071

The production of ore in Lemhi County in 1905 was 17,271 short tons, valued at $10.21 per ton; in 1906 it was 17,466 short tons, valued at $10.04 per ton, an increase of 195 short tons and a decrease of 17 cents per ton.

Source of gold and silver in Lemhi County, Idaho, in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Lead ore.	Copper ore.	Total.
Gold..................................	1905	1,440.00	3,239.00	70.00		4,749.00
	1906	1,346.98	3,671.94	4.00	101.58	5,124.50
Silver..................................	1905	421.00	336.00	38,600.00		39,357.00
	1906	129.00	1,604.00	33,600.00	1,120.00	36,453.00

Gibbonsville district.—The North Fork Reduction Company has developed its Gibbonsville mine by a tunnel which is 3,000 feet long. It has a 20-stamp amalgamation and concentration mill on the property. These holdings were recently sold to the American Development, Mining and Reduction Company. The production for the year was gold bullion and concentrates, the latter being treated by cyanide. Several placer properties in this district have shown a production of placer gold during the last few years which continues to be important.

Indian Creek district.—The Kittie Burton Mining Company continues to be the principal producer of the district. This company treated a large tonnage of ore, containing principally gold, in a 15-stamp amalgamation mill equipped with concentrators. Production was also recorded from the Lee group of claims.

Mineral Hill district.—The Clipper Bullion mine, equipped with 5 stamps of 850 pounds each, has a capacity of 15 tons of ore per day, and treated several hundred tons of ore during 1906. The Big Lead Gold Mining and Milling Company recently purchased the Pine Creek group of claims, which have an aggregate of 1,500 feet of development work and are equipped with a 10-stamp mill, which was operated during the year. The Weimer mine, developed by 1,100 feet of tunnel work, made a small production of gold bullion. The Boulder Creek Hydraulic Mining Company (Limited) worked a short time during the year and produced some gold by hydraulic mining.

Parker Mountain district.—The Parker Mining Company shipped ore containing gold and silver to the smelters near Salt Lake City.

Texas district.—The Pittsburg-Idaho Mining Company, successors to the Gilmore Mining Company, is operating the Silver Dollar group, and has sunk a shaft 300 feet deep from tunnel level at a point 90 feet from the surface. Several drifts from the shaft increase the total development work to 3,000 feet. The ores produced and shipped direct to the smelters averaged in the neighborhood of 35 per cent of lead, 17 ounces of silver, and carried from 10 to 20 per cent of iron. A small jig plant capable of handling about 60 tons of ore per day is in constant operation bringing the grade of ore up to a higher percentage, which will permit its long wagon haul to the railroad, 80 miles distant.

Yellow Jacket district.—Some placer gold was produced from the Yellow Jacket claims. Development work is being continued on placers.

LINCOLN COUNTY.

This county produced 137.27 fine ounces of gold and 53 ounces of silver, having a total value of $2,874. The output came from placers located along Snake River. The total yield decreased in value $355 from the 1905 output.

NEZ PERCE COUNTY.

The county output of gold and silver for 1906 is valued at $49,569, which is an increase of $24,440 over that of 1905. The production was made by 34 placers and 4 deep mines. The total placer yield for 1906 is valued at $38,760, which was an increase of $18,985 over the yield of 1905.

Burnt Creek district.—The placers operated in the district were Cranberry Creek, Daylight, Venus, and others.

Pierce district.—At the Red Cloud mine of the Granite Mines Company litigation interfered with development work, and only a small production was obtained.

The Santiago mine was developed and made a small shipment of bullion, as did the Wild Rose and the Dewey claims, operated by the Gateway Mining and Milling Company. Among the placers operating was the Musselshell, doing chiefly development work. The most important work accomplished in the camp was by the Idaho Company (Limited) with a dredge on the Park City group of placers, consisting of 101 acres of ground at Pierce City. The dredge is of 1,000 yards daily capacity.

The American Placer Mining Company, on Orofino Creek, about 8 miles below Pierce, operated its ground at a profit during the season. On account of the flatness of the ground, the placers heretofore were not successfully operated until the introduction of the Ruble elevator. Other placers operating were as follows: Bummer Hill, Gold Branch Mining and Development Company, Last Chance, El Diablo, Rome, Rich Hill Water and Mining Company, Gray Mining Company (Limited), Orogrande, Missouri Rose, Hay Creek, and a number of others operated under the name of individuals.

ONEIDA COUNTY.

The total output of gold and silver, valued at $4,007, was produced entirely from placer operators along Snake River during 1906. The production decreased $4,126 from the figures for 1905.

OWYHEE COUNTY.

Five deep mines and 4 placers in 1906, against 4 deep mines and 3 placers in 1905, yielded an output valued at $690,411, of which the placer yield was $2,156. The deep mines produced 27,034 short tons of ore, valued at $688,255, an average value of $25.45 per ton, which is entirely for the gold and silver contents. The total quantity of gold produced by deep mines was 9,388.86 ounces, valued at $194,085, and of silver, 737,568 ounces, valued at $494,170. The comparison of these figures with those of 1905 shows that the ore decreased 15,997 short tons and its total value decreased $128,652. The principal cause of the decrease was the closing down of the De Lamar mill at De Lamar for the purpose of putting in new equipment.

Carson district.—The new mill put in by the De Lamar Company during 1906 for making a closer saving of the values was incomplete in a great many details and caused a great many aggravating delays. Many of the obstacles, however, have been overcome, and it is expected that the usual production from the property will be as good as, if not better than, in former years. The company has been a dividend payer for many years.

The Trade Dollar Consolidated Mining Company continued to yield and has the most extensively developed mines in the State. Its total development aggregates 80,000 feet, of which 5,585 feet were run during the year. The ore was treated in a 20-stamp wet crushing mill using direct concentration on Wilfley tables and Frue vanners, which recover about 75 per cent of its values. A total saving of 94 per cent of the gold and silver value of the ore is claimed. The concentrates, which are shipped to the smelters, run in the neighborhood of $2,000 per ton. According to the annual report to the directors of the company, the mining, milling, and general cost per ton of ore produced during 1906 was $20.93.

The Sunnyside mine is situated a few miles north of De Lamar. Most of the ore so far produced has been mined from open cuts and shallow shafts. A 5-stamp amalgamation mill has been erected on the property.

The Security Mining Company, owning the Commoner, the Southern, and the Nettie claims on War Eagle Mountain, produced one bar of bullion from ore taken out in prospecting the property.

The Pioneer Mines Company, operating the Cumberland Mine and a 10-stamp mill during the year, made a considerable production of gold. This property carries a small vein of good milling ore. The electric power for hoist and mill is supplied by the Trade Dollar Company from the Swan Falls plant.

A number of placer properties were worked in the French district and on Snake River.

SHOSHONE COUNTY.

This county embraces the Coeur d'Alene district, which is the largest lead producer in the United States. The output of copper and zinc in the county was increased. In addition, several carloads of rich antimony ore were shipped. Though the production of lead reported by producers is less for 1906 by 1,833,466 pounds than for 1905, the quantity of all other metals and the total values, including that for lead, increased very materially. The principal mines have large bodies of ore in sight, and new producers are being constantly added to the list. During 1906 the quantity of ore sold or treated was 1,622,975 short tons, an increase of 96,048 tons over 1905. Of the total tonnage, 850 tons treated at gold and silver mills yielded \$10,632 in gold and 1,650 ounces of silver; 1,487,224 tons treated at concentration mills producing 218,827 tons of concentrates, which yielded \$52,260 in gold and 6,079,970 ounces of silver; and from the shipment of 127,736 tons of crude ore direct to smelters \$10,872 in gold and 1,862,585 ounces of silver were realized. There were 7,165 tons of tailings taken from the creek beds and run through small concentration plants. The product obtained, which is included under concentrates, had a total value of \$29,745 for silver and lead.

The production of the county for 1905 and 1906 is given in the table following:

Production of gold, silver, and associated metals in Shoshone County, Idaho, in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
DEEP MINES.						
Gold.......fine ounces..	246	\$5,085	3,568.34	\$73,764	+ 3,322.34	+ \$68,679
Silver.............do....	7,292,655	4,404,763	7,944,205	5,322,617	+ 651,550	+ 917,854
Copper.........pounds..	5,225,606	815,194	6,393,940	1,234,030	+1,168,334	+ 418,836
Lead..............do....	253,855,662	11,931,216	252,022,196	14,365,265	−1,833,466	+2,434,049
Zinc...............do....	144,000	8,496	2,054,998	125,355	+1,910,998	+ 116,859
PLACERS.						
Gold.......fine ounces..	1,640	33,902	621.28	12,843	− 1,018.72	− 21,059
Silver.............do....	331	200	133	89	− 198	− 111
Total............	....	17,198,856	....	21,133,963	....	+3,935,107

The production of ore in Shoshone County in 1905 amounted to 1,526,927 short tons, valued at \$11.24 per ton; in 1906 it was 1,622,975 short tons, valued at \$13.01 per ton, an increase of 96,048 tons and of \$1.77 in value per ton.

Source of gold and silver in Shoshone County, Idaho, 1905 and 1906, by kinds of ore in fine ounces.

Metal.	Year.	Placers.	Siliceous ore.	Copper ore.	Lead ore	Copper-lead ore.	Lead-zinc ore.	Total.
Gold	1905	1,640.00	....	246.00	....	....	....	1,886.00
	1906	621.28	637.27	405.00	2,470.02	....	56.05	4,189.62
Silver	1905	331.00	....	390,000.00	6,891,344.00	5,894.00	5,417.00	7,292,986.00
	1906	133.00	2,827.00	478,349.00	7,415,995.00	....	47,034.00	7,944,338.00

Beaver district.—The Callahan group is a new producer situated about a mile and a half northwest of the Hercules mine. The ore shipped during the year assayed as high as 60 per cent of lead and 15 ounces of silver to the ton. The property is developed by 3 shafts, the deepest being 115 feet, and by a tunnel 800 feet long. Placer mining was carried on by the American Gulch, the Black Hill, the New Year, and several other properties with smaller operations.

Eagle district.—Placer operations were carried on to a large extent by several operators whose total product reached $7,766.87.

Evolution district.—The Big Creek Mining Company shipped a number of tons of silver ore from its property located on Big Creek, 8 miles below Wallace.

Hunter district.—The Snowstorm Mining Company has developed within the last few years a large body of low-grade copper ore, which at the surface was considerably oxidized and was treated at the company's mill by a leaching process. The smelting ore below water level is shipped to various copper smelters. The mill has been greatly improved by the addition of crushing machinery for finer grinding and of Callow traveling belt screens for hydraulic classification. The capacity is 200 tons of ore per day. The total development work of the year consisted of 700 feet of tunnel and 500 feet of raises, which resulted in the blocking out of several hundred thousand tons of ore. The mine is developed by a system of adits on 3 different levels.

The Federal Mining and Smelting Company, operating the Morning and You Like mines, is developed by tunnels and crosscuts aggregating 10,000 feet. The Morning vein was encountered at a depth of 2,000 feet, and connection was made by means of a winze between the tunnel and the No. 5 level, 900 feet vertically above. This property has a concentration mill of a capacity of 1,000 tons of ore per day. The ore is treated in 6-foot Huntington mills, with sizing and settling devices, embracing the Callow system of traveling screens and conical tanks, which size the ore to advantage. The material is then treated on Wilfley tables and vanners.

The Gold Hunter Mining and Smelting Company developed its property by a tunnel 3,000 feet long and a winze 200 feet deep. The ore occurs in a pronounced fissure vein several feet wide that is ore-bearing for several hundred feet. A tunnel, which is now being run from the mill level, is expected to intersect the ore at a depth of several hundred feet below the present workings. The company owns a concentration mill with a capacity of 250 tons of ore per day.

Leland district.—The Hercules Mining Company has developed its property to a depth of 1,300 feet by 3 crosscut tunnels; a fourth tunnel now being run will be a mile in length when completed, and will increase its depth to nearly 2,000 feet when it intersects the vein.

The new mill of this property, which has a capacity of 250 tons of ore per day, has recently been connected with an aerial tramway storage bin at Burke, from which ore can be conveyed and loaded on the cars.

The Stanley Consolidated Mining and Milling Company, operating a group of the same name situated in Gorge Gulch, a mile above Burke, made several shipments of stibnite averaging 55 per cent metallic antimony and $20 a ton in gold. The property is developed by 5 tunnels aggregating about 2,000 feet in all.

Tailings plants were operated below Gem on Canyon Creek and produced lead and silver valued at $20,848.

The Standard-Mammoth at Mace and the Tiger-Poorman at Burke, operated by the Federal Mining and Smelting Company, carried on active development work and the shipments were about the same as for 1905. In the Mace mine the great ore shoot has been opened in the lower levels for a length of 1,800 feet. The mine is developed by a shaft 1,200 feet deep with crosscuts aggregating 3,000 feet and connecting with the shaft. The mill on the property treats the ore by wet concentration and is of 1,000 tons daily capacity. The Burke or Tiger-Poorman property is developed by a shaft 2,000 feet deep sunk from the surface in the bottom of Canyon Creek. The concentration mill on the property treats 500 tons of ore per day.

The Tamarack and Chesapeake Mining Company, operating properties by the same name on Nine Mile Creek, became a producer during the year. A strong pay streak of ore is of shipping character and a large body is concentrating ore. The property is developed by tunnels 1,400 feet long.

The Frisco Mining Company made shipments of ore from old workings on its property in charge of lessees. The mine proper produced nothing during the year, as it was being unwatered and put in shape for future production. The development work consists of a 1,200-foot tunnel connected by a 1,400-foot vertical shaft. The shaft was sunk an additional 200 feet during the year and a new level is now being opened 1,600 feet below the main tunnel. The mine was shut down several years ago on account of the large amount of zinc in the ore. Since this product has been in demand, the 500-ton concentrator will probably be put in shape to treat this material.

The Hecla Mining Company developed its property on Canyon Creek from the creek level by a shaft 900 feet deep with drifts. The wet concentrator on the property is of 300 tons daily capacity. The new equipment includes a complete sorting and conveying belt for the ore at the mine and additional crushing machinery for finer grinding at the mill.

The Rex Mining Company, operating the "16 to 1" mine, treated a large tonnage of ore at the concentrating plant, which produced a high-grade concentrate.

Placer Center district.—The Success Mining Company, owning property on Nine Mile Creek, was equipped during the year with a new mining and milling plant. The bulk of the shipments from this mine carried a high percentage of zinc, which was shipped in the form of concentrates. The mill has a capacity of 150 tons of ore per day.

The Pittsburg-Lead Mining Company is operating the California mine, which is developed by a tunnel 3,800 feet long. The ores are concentrated in a mill with a capacity of 250 tons of ore per day.

St. Regis district.—The Monitor Consolidated Copper Mining Company worked a mine situated 3 miles east of Mullan, near the Idaho-Montana line. The development is by vertical shaft now 400 feet deep, which is being continued 100 feet deeper. The ore shipped contains mainly copper with gold and silver.

Summit district.—The Pilot mine, located at Murray, produced some of the richest ore ever seen in the district. The property is developed by tunnel, at the face of which an upraise was started to cut the rich shoot of ore outcropping near the surface.

The Bear Top Mining Company recently put in new concentrating machinery and a boiler plant. The capacity of the old mill has been increased and will forestall future shortage of water power during the dry season. The company is driving a long crosscut tunnel near the mill. The Daddy Gold Mining Company has developed its property by a tunnel 800 feet long and is provided with a 10-stamp mill. A test run was made on ore which carried principally gold. Placer operations were carried on by the Coeur d'Alene Mining Company and several smaller operations were recorded.

Yreka district.—The Stewart Mining Company is developing its property of 6 claims on Stewart Gulch, between Government and Deadwood Gulch, west of the Bunker Hill mine. The first discovery made was a narrow shoot of ore on the surface, from which the owners shipped 250 tons of lead ore in 1906 that averaged about $42 per ton. One tunnel on the property encountered at 900 feet several feet of very high-grade shipping ore. The property recently changed hands, and a report giving the later operations has not been received.

The Last Chance mine of the Federal Mining and Smelting Company was developed in the No. 3, No. 4, and No. 5 levels through a shaft in the Sweeney tunnel. Above this tunnel a large amount of low-grade ore has been developed, and new stopes have been opened in ground that had formerly been passed by. The total tunnel work will aggregate 1½ miles. The shaft is 800 feet deep, sunk at an angle of 45°.

The Bunker Hill and Sullivan Company operate contiguous properties, which are all exploited by the same openings. These are reached by the Kellogg tunnel from the concentrating plant 10,000 feet from the vein. At this point and at a depth of 400 feet below the tunnel very large bodies of good grade ore are reported to be found. The mill equipment has been supplemented by a large tailings plant, which will re-treat much of the product from the present mill, which has a capacity of 1,000 tons of ore daily. The new equipment will also treat the accumulated tailings as far as its capacity will permit. Serious underground mine fires during February, March, and April interfered with operations and reduced the output from what it would have been otherwise. The dividends disbursed for the fiscal year ending May 31, 1906, amounted to $2,340,000. Concentrates shipped from tailings plants in this district during the year aggregated in value the sum of $3,592.

WASHINGTON COUNTY.

Four deep mines and 1 placer yielded an output valued at $70,839. The deep mines produced 2,762 short tons of ore, valued at $65,355, at an average value of $23.66 per ton for the gold, silver, copper, and lead contents. The total quantity of gold produced by deep mines was 165.54 ounces, valued at $3,422; of silver, 9,740 ounces, valued at $6,526; of copper, 275,267 pounds, valued at $53,127, and of lead, 40,000 pounds, valued at $2,280. A comparison of these figures with those for 1905 shows that the tonnage decreased 4,011 tons and that the total value decreased $218,394. The quantity of gold produced in the county decreased 1,055.32 ounces and $21,815 in value; silver, 47,898 ounces and $28,283 in value, and copper, 1,128,226 pounds and $165,818 in value. No lead was recorded in 1905.

Black Lake district.—Development work was carried on by the Idaho Gold Coin Company, which drove a deep drain tunnel to tap its ore bodies at considerable depth. This tunnel has been driven 1,200 feet. The burning of the company's compressor plant seriously retarded work during the year. Four miles east of the Gold Coin Company is located the property of the Iron Springs Consolidated Company, which employed a force of 15 men during the year on development work.

Heath district.—The Idaho Metals Company made a small shipment of copper ore from its Railroad group during development work. The property is opened by a tunnel 211 feet long, which has gained a depth of 86 feet from the surface. At this point it is reported that a good body of copper ore with about 11 ounces of silver was encountered.

Meadows district.—The Rock Flat Mining and Milling Company worked their placer property on a small scale.

Seven Devils district.—The Ladd Metals Company made a number of shipments of copper ore to the smelter at Sumpter, Oreg. The American Mining Company (Limited) operated the Blue Jacket, the Queen, the Calumet, and the Alaska and Mountain Queen properties, and about 400 tons of copper ore carrying gold and silver were shipped.

MONTANA.

By Alexander N. Winchell.

PRODUCTION.

The total value of the metallic production of Montana during 1906, as reported by the producers, amounted to $69,257,083. On account of the high average price of the metals, especially copper, during the year, this is the largest total value in the history of mining in Montana. The value of the copper product constitutes more than four-fifths of this total, since the State produced 290,700,975 pounds of that metal, having a commercial value of $56,105,288. Silver is second in value, the product amounting to 11,980,705 fine ounces, valued at $8,027,072. The production of gold amounted to 216,188.56 fine ounces, having a value of $4,469,014. The amount of zinc won during the year was 6,579,000 pounds, valued at $401,319. Finally, the lead product amounted to 4,462,979 pounds, having a value of $254,390.

Comparison with the production of 1905 shows that gold decreased 15,725.19 fine ounces of a value of $325,069; this is a decrease of 7 per cent. Silver decreased 1,250,595 fine ounces, or 10 per cent, but the value of the product increased $35,367, or 0.5 per cent, on account of a higher average value of the metal during 1906 than during the preceding year. For the same reason, while the yield of copper decreased 14,022,551 pounds, or 4.6 per cent, the value increased $8,568,418, or about 23 per cent. But the decrease in lead, amounting to 1,802,019 pounds, or 28.7 per cent, entails a decrease in value of $40,065, or 13.6 per cent, in spite of an increase in the average value of the metal from 4.7 cents to 5.7 cents per pound. On the contrary, the zinc won increased 5,019,000 pounds, or 320 per cent, while the value increased $309,277, or 335 per cent. It is to be regretted that, owing to the destruction by fire of the plant of the Montana Zinc Company, there is no reason to expect that the State will equal this record in zinc in 1907, although an experimental plant for the recovery of zinc has been erected.

These variations in the metallic production of Montana during 1905 and 1906 may be shown in tabulated form, as follows:

Production of gold, silver, and associated metals, and their ores in Montana in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	231,913.75	$4,794,083	216,188.56	$4,469,014	− 15,725.19	− $325,069
Silver ....do....	13,231,300	7,991,705	11,980,705	8,027,072	− 1,250,595	+ 35,367
Copper ....pounds..	304,723,526	47,536,870	290,700,975	56,105,288	−14,022,551	+8,568,418
Lead ....do....	6,264,998	294,455	4,462,979	254,390	− 1,802,019	− 40,065
Zinc ....do....	1,560,000	92,042	6,579,000	401,319	+ 5,019,000	+ 309,277
Total value..........	....	60,709,155	....	69,257,083	....	+8,547,928
Ore output.....short tons..	5,020,137	a 12.01	5,497,971	a 12.60	+ 477,834	a+ 0.59

a Value per ton, placer product excluded.

Much of the activity in mining during 1905 consisted in exploration and development work, and its effects are not apparent in the statistics of production. About sixty mining companies were organized in Silverbow County alone, and many of these began actual development work during the year. It is to be expected that some results of this activity may be apparent in the record of production for 1907.

By a curious anomaly the high price of copper during the year is one of the important causes of the decrease in production of that metal. The large mining companies in Butte take advantage of the high price to mine ores carrying a lower percentage of copper, and thus keep their high-grade ores in reserve. And, since the smelters are operated nearly at their full capacity from one year to another, lower grade ores result in reducing the output. This results in no loss in profits, since the smaller amount of copper produced in 1906 was worth much more than the output of 1905.

The source of the production of metals in Montana in 1906, by counties, is shown in the table below. In this table, and others which follow, Chouteau and Flathead counties have been placed in one group, and Meagher, Ravalli, and Sanders counties in another group to avoid disclosing the production of individual mines.

Production of gold, silver, copper, lead, and zinc in Montana in 1906, by counties.

County.	Gold.				Silver.	
	Placer.		Deep mines.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ounces.*		*Fine ounces.*	
Beaverhead	7.84	$162	99.55	$2,058	58,561	$39,236
Broadwater	201.22	4,160	7,380.26	152,563	47,853	32,061
Cascade			324.46	6,707	294,556	197,352
Chouteau and Flathead	322.05	6,657	13,219.11	273,263	14,989	10,043
Deerlodge	152.63	3,155	3,934.77	81,339	4,270	2,861
Fergus			49,577.89	1,024,866	2,997	2,008
Granite	30.94	640	6,413.12	132,571	319,700	214,199
Jefferson	197.59	4,085	8,514.92	176,019	268,807	180,101
Lewis and Clark	529.92	10,954	25,327.03	523,556	102,689	68,802
Madison	18,916.74	391,044	13,142.24	271,674	117,476	78,708
Meagher, Ravalli, and Sanders	84.39	1,745	63.59	1,315	935	626
Missoula	2,256.23	46,640	80.16	1,657	2,595	1,739
Park	70.94	1,466	319.26	6,600	122	82
Powell	2,123.68	43,900	2,402.06	49,655	29,434	19,721
Silverbow	348.64	7,207	60,147.33	1,243,356	10,715,721	7,179,533
Total	25,242.81	521,815	190,945.75	3,947,199	11,980,705	8,027,072

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Beaverhead	246,841	$47,640	243,022	$13,852			$102,948
Broadwater	7,096	1,370	359,889	20,514			210,668
Cascade	360	70	569,046	32,436			236,565
Chouteau and Flathead	161	31					289,994
Deerlodge	142,140	27,433					114,788
Fergus	3,318	641	100,914	5,752			1,033,267
Granite	63,626	12,280	294,517	16,786			376,476
Jefferson	255,428	49,298	811,616	46,262			455,765
Lewis and Clark	47,537	9,173	522,248	29,768			642,253
Madison	80,633	15,562	461,986	26,333			783,321
Meagher, Ravalli, and Sanders	5,478	1,057	23,886	1,362			6,105
Missoula	57,436	11,085					61,121
Park	3,316	640					8,788
Powell	7,555	1,458	180,289	10,277			125,011
Silverbow	289,780,050	55,927,550	895,566	51,048	6,579,000	$401,319	64,810,013
Total	290,700,975	56,105,288	4,462,979	254,390	6,579,000	401,319	69,257,083

Silverbow County is the only producer of zinc ore in the State, although zinc ores are known to exist in several other counties. It is also the leading producer of gold, silver, copper, and lead. During 1906 the gold output of the county decreased slightly, but as the gold output in Fergus County shows a large decrease Silverbow retains its leading position in gold production. It produced during the year nearly 90 per cent of the State's silver output and over 99.5 per cent of the copper production. It leads in the production of lead this year, displacing Flathead County. Jefferson County is a close second in lead product, followed by Cascade and Lewis and Clark. Jefferson County also holds second rank in copper output, with Beaverhead next. Granite County still holds second place in silver in spite of a large decrease; Cascade and Jefferson follow in rank. Fergus County retains second place as a gold producer, followed by Madison and Lewis and Clark. Madison County is the leading producer of placer gold.

The following table shows the tonnage of ore sold or treated, the number of producing deep mines, and the tenor of ores in 1905 and 1906, by counties.

Tonnage of ore sold or treated, number of mines producing, and tenor of ores in Montana in 1905 and 1906, by counties.

County.	Short tons of ore sold or treated.		Mines producing (without placers).		Average value per ton.		Average value per ton in gold and silver.	
	1906.	Increase (+) or decrease (−).	1905.	1906.	1905.	1906.	1905.	1906.
Beaverhead	1,530	+ 230	5	11	$42.46	$67.18	$23.25	$26.99
Broadwater	15,119	+ 4,603	19	19	17.94	13.66	14.27	12.21
Cascade	8,393	− 3,558	6	14	24.27	28.19	21.33	24.31
Chouteau and Flathead	45,003	− 20,597	3	3	3.94	6.30	2.89	6.29
Deerlodge	17,266	+ 5,866	2	3	15.20	6.47	15.20	4.88
Fergus	228,434	+ 4,161	5	6	5.61	4.52	5.61	4.50
Granite	14,959	− 13,197	19	24	20.81	25.12	20.71	23.18
Jefferson	20,631	− 14,303	39	50	14.97	21.89	12.70	17.27
Lewis and Clark	96,437	− 55,218	24	43	4.35	6.55	4.28	6.14
Madison	20,497	− 28,707	55	60	11.46	19.04	10.94	17.00
Meagher, Ravalli, and Sanders	714	+ 714	....	2	....	6.09	....	2.71
Missoula	409	− 251	4	3	21.85	35.26	8.95	8.16
Park	218	− 3,803	3	2	11.28	33.56	11.28	30.62
Powell	9,127	+ 1,480	10	8	7.94	8.86	6.42	7.58
Silverbow	5,019,234	+499,934	60	60	12.59	12.91	1.82	1.68
Total	5,497,971	+477,834	254	308	12.01	12.60	2.47	2.18

It is to be noticed that the total number of deep mines producing shows a notable increase, and this increase is distributed quite generally throughout the State. On the contrary, the tonnage of ore shows a decrease in several counties, notably Lewis and Clark, Madison, Chouteau, and Flathead. The average value per ton usually increases as the tonnage decreases, and vice versa. Silverbow County is the source of nine-tenths of the ore treated.

The following table shows the number of mines classified as to their chief product. There are 141 mines which reported no production during 1906, and among the producing mines there are 62 placer mines, including 4 dredging placers and 6 drift placers. Of the total of 308 deep mines, 137 are classified as gold mines, of which Madison County has a large share, 78 as silver mines, many of them in Jefferson County, 68 as copper mines, chiefly located in Silverbow County, and 25 as lead mines, of which 10 are in Lewis and Clark County.

Number of mines classified by chief product in Montana in 1906, by counties.

County.	Gold placer mines.				Deep mines.					Mines reporting product.
	Hydraulic.	Drift.	Dredge.	Total.	Gold.	Silver.	Copper.	Lead.	Total.	
Beaverhead	1	....	....	1	1	4	5	1	11	12
Broadwater	4	1	....	5	17	1	....	1	19	24
Cascade	....	....	....	....	1	13	....	....	14	14
Chouteau and Flathead	2	....	....	2	2	....	1	....	3	5
Deerlodge	2	....	....	2	3	....	....	....	3	5
Fergus	....	....	....	....	5	....	....	1	6	6
Granite	2	....	....	2	8	14	1	1	24	26
Jefferson	1	1	1	3	17	26	3	4	50	53
Lewis and Clark	9	2	....	11	21	9	3	10	43	54
Madison	8	....	1	9	52	3	....	5	60	69
Meagher, Ravalli, and Sanders	1	....	....	1	1	....	....	1	2	3
Missoula	9	1	....	10	....	....	3	....	3	13
Park	2	1	1	4	1	....	1	....	2	6
Powell	9	....	1	10	5	....	2	1	8	18
Silverbow	2	....	....	2	3	8	49	....	60	62
Total	52	6	4	62	137	78	68	25	308	370

The tonnage produced by these deep mines may be classified as siliceous ores, copper ores, lead ores or mixed ores, including copper-lead and copper-lead-zinc ores. Such a classification by counties is given in the following table. It appears that Fergus County is the chief source of siliceous ores, Silverbow County of copper ores and mixed ores, and Cascade County of lead ores.

Subdivision of tonnage of ore sold or treated in Montana in 1906, by counties, in short tons.

County.	Siliceous ores.	Copper ores.	Lead ores.	Copper-lead-zinc ores.	Total.
Beaverhead	76	766	688		1,530
Broadwater	13,089		2,030		15,119
Cascade	2,641		5,752		8,393
Chouteau and Flathead	45,003				45,003
Deerlodge	17,238	28			17,266
Fergus	228,326		108		228,434
Granite	12,728	36	2,195		14,959
Jefferson	13,746	1,733	5,152		20,631
Lewis and Clark	93,981	87	2,330	39	96,437
Madison	18,455		1,375	667	20,497
Meagher, Ravalli, and Sanders	714				714
Missoula		409			409
Park	200	18			218
Powell	8,000	13	1,104	10	9,127
Silverbow	26,646	4,960,666		31,922	5,019,234
Total	480,843	4,963,756	20,734	32,638	5,497,971
Increase (+) or decrease (−)	−110,212	+582,517	−21,262	+26,791	+477,834
Average value per ton in gold and silver	$7.08	$1.58	$24.15	$8.43	$2.08

Silverbow County yields more than 90 per cent of the ore product of the State; Fergus County ranks second, and Lewis and Clark third. In total value of metals obtained from these ores the same statements hold true. Silverbow County is also the chief source of concentrates; but Lewis and Clark County is the chief source of old tailings, since the 38,750 tons credited to Silverbow County are actually smelter cleanings. It should be noted in this connection that the tonnage of smelter cleanings is an estimate based on the best information available; exact figures of tonnage could not be obtained. The following table shows the source of the tonnage of ore, concentrates, and old tailings in the State in 1906, by counties, as well as the value thereof.

Tonnage and value of ore, concentrates, and old tailings in Montana in 1906, by counties, in short tons.

County.	Total ore.		Concentrates produced.		Old tailings treated.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Beaverhead	1,530	$102,772				
Broadwater	15,119	206,487	1,514	$59,301	40	$707
Cascade	8,393	236,565			3,906	49,249
Chouteau and Flathead	45,003	283,321				
Deerlodge	17,266	111,620			3,233	10,067
Fergus	228,434	1,033,267				
Granite	14,959	375,834			1,091	6,740
Jefferson	20,631	451,676	66	22,523	395	12,362
Lewis and Clark	96,437	631,241	353	12,464	25,371	64,535
Madison	20,497	390,254	1,285	126,165	736	8,088
Meagher, Ravalli, and Sanders	714	4,353	69	3,770		
Missoula	409	14,424				
Park	218	7,316				
Powell	9,127	80,937	687	35,965		
Silverbow	5,019,234	64,802,763	1,613,469	44,873,676	38,750	1,784,916
Total	5,497,971	68,732,830	1,617,443	45,133,864	73,522	1,936,664

Madison County produced more than 75 per cent of the placer product of Montana; it was obtained by dredges on Alder gulch. Fergus County is the leading producer of gold from siliceous ores. Silverbow County, of course, leads in production of gold from copper ores. Jefferson County ranks first as to product of gold from lead ores. The detailed sources of gold in Montana, by kinds of ore, is shown in the following table:

Source of gold product in Montana, by kinds of ore, in 1906, by counties, in fine ounces.

County	Placers.	Deep mines.					Total.
		Siliceous ores.	Copper ores.	Lead ores.	Copper-lead-zinc ores.	Total.	
Beaverhead	7.84	29.52	21.72	48.31	....	99.55	107.39
Broadwater	201.22	6,529.25	....	851.01	....	7,380.26	7,581.48
Cascade	....	150.62	....	173.84	....	324.46	324.46
Chouteau and Flathead	322.05	13,219.11	....	....	....	13,219.11	13,541.16
Deerlodge	152.63	3,517.22	417.55	....	....	3,934.77	4,087.40
Fergus	....	49,564.76	....	13.13	....	49,577.89	49,577.89
Granite	30.94	6,106.91	12.04	294.17	....	6,413.12	6,444.06
Jefferson	197.59	5,601.92	47.55	2,865.45	....	8,514.92	8,712.51
Lewis and Clark	529.92	24,240.24	11.84	1,074.95	....	25,327.03	25,856.95
Madison	18,916.74	9,250.71	....	1,286.42	2,605.11	13,142.24	32,058.98
Meagher, Ravalli, and Sanders	84.39	63.59	....	....	....	63.59	147.98
Missoula	2,256.23	....	80.16	....	....	80.16	2,336.39
Park	70.94	308.42	10.84	....	....	319.26	390.20
Powell	2,123.68	737.90	....	1,662.29	1.87	2,402.06	4,525.74
Silverbow	348.64	4,405.45	54,452.20	....	1,289.68	60,147.33	60,495.97
Total	25,242.81	123,725.62	55,053.90	8,269.57	3,896.66	190,945.75	216,188.56

Very little silver is obtained through placer mining, but in this case Madison County ranks as the chief producer. Granite County leads in silver product from siliceous ores, with Silverbow first as to copper ores and Cascade as to lead ores. The source of the silver product of the State by kinds of ore by counties is shown in the following table:

Source of silver product in Montana, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placers.	Deep mines.					Total.
		Siliceous ores.	Copper ores.	Lead ores.	Copper-lead-zinc ores.	Total.	
Beaverhead	21	1,622	4,452	52,466	....	58,540	58,561
Broadwater	32	43,857	....	3,964	....	47,821	47,853
Cascade	....	83,363	....	211,193	....	294,556	294,556
Chouteau and Flathead	24	14,965	....	....	....	14,965	14,989
Deerlodge	19	4,251	....	....	....	4,251	4,270
Fergus	....	2,017	....	980	....	2,997	2,997
Granite	3	254,999	115	64,583	....	319,697	319,700
Jefferson	6	151,626	11,233	105,942	....	268,801	268,807
Lewis and Clark	86	61,541	496	38,490	2,076	102,603	102,689
Madison	3,020	102,934	....	5,546	5,976	114,456	117,476
Meagher, Ravalli, and Sanders	11	924	....	....	....	924	935
Missoula	85	....	2,510	....	....	2,510	2,595
Park	8	43	71	....	....	114	122
Powell	260	789	62	28,196	127	29,174	29,434
Silverbow	63	544,917	9,962,150	....	208,591	10,715,658	10,715,721
Total	3,638	1,267,848	9,981,089	511,360	216,770	11,977,067	11,980,705

REVIEW BY INDIVIDUAL COUNTIES.

BEAVERHEAD COUNTY.

Production of metals and their ores in Beaverhead County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	113.31	$2,342	107.39	$2,220	− 5.92	− $122
Silver.........do....	48,145	29,079	58,561	39,236	+ 10,416	+10,157
Copper.........pounds..	109,009	17,005	246,841	47,640	+137,832	+30,635
Lead.........do....	177,600	8,347	243,022	13,852	+ 65,422	+ 5,505
Total value.........		56,773		102,948		+46,175
Ore output.........short tons..	1,320	[a] 42.46	1,530	[a] 67.18	+ 230	[a] + 24.72

[a] Value per ton, placer product excluded.

Beaverhead County continues to be a small producer of metals, although the product for 1906 shows a large increase over the preceding year. Development work in the Argenta district was not entirely satisfactory. The mines of the Hecla Company were worked in a small way by lessees. After doing considerable development work and shipping some very high-grade copper ore the Washoe Copper Company allowed the Indian Queen mine to revert to its former owners. They have since made some shipments. The output of placer gold continues to decline. Other mines reporting a product include the New Departure and the Silver Belt.

BROADWATER COUNTY.

Production of metals and their ores in Broadwater County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	5,785.59	$119,599	7,581.48	$156,723	+1,795.89	+$37,124
Silver.........do....	58,627	35,411	47,853	32,061	− 10,774	− 3,350
Copper.........pounds..	49,647	7,745	7,096	1,370	− 42,551	− 6,375
Lead.........do....	656,606	30,861	359,889	20,514	− 296,717	− 10,347
Total value.........		193,616		210,668		+ 17,052
Ore output.........short tons..	10,516	[a] 17.94	15,119	[a] 13.66	+ 4,603	[a] − 4.28

[a] Value per ton, placer product excluded.

There were 24 producing mines in Broadwater County in 1906, against 23 in 1905, but the production decreased in all metals except gold. The total value shows an increase of $17,052. The tonnage of ore handled shows a considerable increase in 1906, but the value per ton decreased.

Backer district.—In the Backer district, near Diamond City, the Gold Bar Mining Company is treating gold-silver ore by the ordinary stamp-mill methods. Placer mines in this district are worked by sluicing.

Beaver Creek district.—In the Beaver Creek district, near Winston, the East Pacific Mining Company has a 75-ton concentrator. The mine is opened by means of a vertical shaft 1,000 feet deep, and four tunnels, the longest being 3,700 feet. The Custer mine in this district has a vertical shaft 600 feet deep and another 300 feet deep. The total length of its underground workings is nearly 4 miles.

Cedar Plains district.—The Barnato mine is located in the Cedar Plains district, near Radersburg. The mine has a 10-stamp concentrating mill. The Hidden Treasure mine was worked under lease, the gold-silver-lead ore being shipped to the smelter at East Helena.

Park district.—In the Park district, near Hassel, the Park-New Era group was operated by means of tunnels. The property is equipped with a 50-ton cyanide plant.

CASCADE COUNTY.

Production of metals and their ores in Cascade County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	183.18	$3,787	324.46	$6,707	+ 141.28	+$2,920
Silver....do....	415,708	251,088	294,556	197,352	−121,152	−53,736
Copper....pounds..	....	....	360	70	+ 360	+ 70
Lead....do....	747,686	35,141	569,046	32,436	−178,640	− 2,705
Total value....	....	290,016	....	236,565	....	−53,451
Ore output....short tons..	11,951	[a] 24.27	8,393	[a] 28.19	− 3,558	[a] + 3.92

[a] Value per ton.

Fourteen mines in Cascade County reported a production in 1906, but the total production shows a decrease, especially in silver.

Cascade County is in the central part of the State; metal mining is confined to the southeastern part of the county. In former years the district around Barker was an active mining region; at present mining is carried on only in the Montana district, near Neihart.

Montana district.—At Neihart the ores occur in gneiss, supposed to be of Archean age, which is penetrated by dikes and masses of rhyolite, porphyry, and diorite. In some cases the ore extends upward into the overlying Algonkian. The chief ore values are in silver and lead, but gold occurs in important amount in some mines, and other metals are present, including copper, iron, arsenic, antimony, etc. The veins belong to a single fissure system, which strikes approximately north 30° to 40° east and dips nearly vertically, as in the Galt and Queen mines, or steeply to the west. The veins are believed to be of post-Cretaceous age. Rhyolite porphyry is in many places closely associated with the veins.

The deepest shaft in the district attains 500 feet; it is on the Broadwater property, which also has a concentrating mill of 250 tons capacity, connected by tramway with the adit tunnel higher up on the mountain side. The Florence has a winze 400 feet deep, with four levels from the winze, and four tunnel levels above it.

The I X L and Eureka mines are located on Snow Creek northeast of Neihart; the Ripple and Big Seven are in the same direction, and all seem to be on a single lode, upon which the mines close to Neihart are also located.

CHOUTEAU COUNTY.

Little Rockies district.—In Chouteau County the Little Rockies district is proving very productive of gold. The Ruby Gulch Mining Company has opened its property by means of tunnels and raises, and is mining by the open-cut system. Active development work was in progress during the year, and the cyanide mill was enlarged from 100 tons to 300 tons daily capacity. Work on the property of the Alder Gulch Mining Company was suspended in the fall of the year.

DEERLODGE COUNTY.

Deerlodge County, which was at one time one of the large counties of the State, is now one of the smallest ones. Powell, Silverbow, and Granite counties have been created from parts of Deerlodge County. It now includes only the region of Anaconda and part of the Big Hole Valley to the southwest.

Georgetown district.—The Gold Coin, Southern Cross, and Cable mines, in the Georgetown district, were all active in 1906. At the Gold Coin extensive development work was in progress and will continue during 1907. The property now has a tunnel 1,100 feet long and a shaft 200 feet deep. The Southern Cross has an incline shaft 350 feet deep and a vertical shaft 240 feet deep. A 100-ton cyanide mill is in course of reconstruction. At the Cable mine the vertical shaft is 300 feet deep, and the aggregate length of underground tunnels exceeds 5,000 feet. The property is equipped with a 30-stamp mill.

Mr. W. H. Emmons has published a preliminary report on the general and economic geology of the Cable mine in Bulletin 315 of the U. S. Geological Survey.

Heber district.—The Allen Gold Mining Company is operating two placer mines in the Heber district. One property is operated by means of a steam derrick, with hydraulic mining and sluicing, and the other is worked by an Evans hydraulic elevator, using hydraulic pressure.

FERGUS COUNTY.

Production of metals and their ores in Fergus County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	60,719.80	$1,255,190	49,577.89	$1,024,866	−11,141.91	−$230,324
Silver..................do....	3,369	2,035	2,997	2,008	− 372	− 27
Copper............pounds..	....	....	3,318	641	+ 3,318	+ 641
Lead...................do....	10,000	470	100,914	5,752	+ 90,914	+ 5,282
Total value..................	....	1,257,695	....	1,033,267	....	− 224,428
Ore output.....short tons..	224,273	a 5.61	228,434	a 4.52	+ 4,161	a − 1.9

a Value per ton.

The value of the gold output of Fergus County in 1906 was $1,024,866, which is $230,324 less than in 1905. The lead product of the county shows a large increase, from 10,000 to 100,000 pounds. The total quantity of ore treated increased from 224,273 to 228,434, but the average value per ton decreased from $5.61 to $4.52.

North Moccasin district.—One of the leading mines in the North Moccasin district is the Kendall, operated by the Kendall Gold Mining Company. The mine is opened by means of a vertical shaft 700 feet deep, an incline shaft 400 feet deep measured on the incline, and a tunnel 700 feet long. It is equipped with a 500-ton cyanide mill. The ore occurs in limestone which has been penetrated by igneous intrusions. At the Barnes King mine the geologic conditions are nearly the same. This mine was sold late in the year to a new company. On this property the vertical shaft is now 400 feet deep, and the tunnel is 3,800 feet long. The ore is crushed to one-quarter inch in a roll mill, and then cyanided. New companies have recently been organized to develop property in this district.

Warm Spring district.—The Gold Reef Mining Company is operating successfully the Gold Reef mine, in the Warm Spring district, near Gilt Edge. It has a 370-ton cyanide plant. The Cumberland mine, near Maiden, is opened by a vertical shaft 220 feet deep. Some silver-lead ore high in gold values was sent to the East Helena smelter from the Maginnis mine.

FLATHEAD COUNTY.

Libby district.—The Rustler Mining and Milling Company was compelled to stop all work at the Snowshoe mine, in the Libby district, at the end of the year 1905 on account of lawsuits. Gold placer mining is in progress in this district, and in the Cabinet district, by the ordinary hydraulic methods.

GRANITE COUNTY.

Production of metals and their ores in Granite County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	7,353.35	$152,007	6,444.06	$133,211	− 909.29	−$18,796
Silver....do....	718,271	433,836	319,700	214,199	−398,571	−219,637
Copper....pounds..	6,144	959	63,626	12,280	+ 57,482	+ 11,321
Lead....do....	38,687	1,818	294,517	16,786	+255,830	+ 14,968
Total value....	....	588,620	....	376,476	....	−212,144
Ore output....short tons..	28,156	[a] 20.81	14,959	[a] 25.12	− 8,197	[a] + 4.31

[a] Value per ton, placer product excluded.

In Granite County the total tonnage of ore treated during 1906 amounted to 14,959 short tons, a decrease of 13,197 tons as compared with 1905. The silver recovered during the year amounted to less than half that obtained in 1905, a result which is due to decreased activity at Granite. The gold also decreased, but the copper and lead both increased by notable amounts. The value of all the metals won during 1906 was $376,476, against $558,620 in 1905.

First Chance district.—In the First Chance district, near Garnet, the First Chance Mining Company operated, chiefly through lessees, the Lead King, Red Cloud, Crescent, Robert Emmett, Fourth of July, and Fairview mines. These mines are opened by means of shafts and tunnels, the longest being 1,500 feet. The company has a 10-stamp amalgamation and concentration mill, but it was not used in 1906. Other mines operated include the Magone and Anderson, Nancy Hanks, Shamrock, and Lynx.

Production of metals and their ores in the First Chance district, Granite County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	6,133.95	$126,800	5,040.47	$104,196	−1,093.48	−$22,604
Silver.....do....	7,052	4,259	6,058	4,059	− 994	− 200
Total value.....	....	131,059	....	108,255	....	− 22,804
Ore output.....short tons..	2,709	a 48.38	3,250	a 33.31	+ 541	a− 15.07

a Value per ton.

Flint Creek district.—In the Flint Creek district at Philipsburg and Granite there were 13 mines reporting production during 1906. The output of silver in this district shows a large decrease, but the production of the other metals is increasing. The Good Hope Mining Company has a 10-stamp mill at Philipsburg, which is said to be the oldest mill in the State still in operation. The Hope mine has an adit tunnel 3,000 feet long. The Granite Bimetallic Consolidated Mining Company owns the Granite and Bimetallic mines at Granite. These are opened by means of vertical shafts 1,500 and 1,700 feet deep. The mines of the company are now operated by lessees. A preliminary report on the region by Mr. W. H. Emmons has appeared in Bulletin 315 of the United States Geological Survey. The tunnel on the Hobo mine was lengthened to 4,000 feet during 1906. The Trout mine has a vertical shaft 600 feet in depth. It is now operated by James Patten. The San Francisco mine has an incline shaft 550 feet deep. It produces silver-lead ore, which is smelted at East Helena.

Production of metals and their ores in the Flint Creek district, Granite County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	808.30	$16,709	1,011.54	$20,910	+ 203 24	+ $4,201
Silver.....do....	709,305	428,420	306,896	205,619	−402,409	−222,801
Copper.....pounds..	....	....	7,197	1,389	+ 7,197	+ 1,389
Lead.....do....	38,687	1,818	171,072	9,751	+132,385	+ 7,933
Total value.....	....	446,947	....	237,669	....	−209,278
Ore output.....short tons..	24,116	a 18.44	7,849	a 30.25	− 16,267	a+ 11.81

a Value per ton, placer product excluded.

Gold Creek district.—The Princeton Mining Company shipped some silver-lead ore from its mine near Princeton to East Helena. The mine is opened by a shaft 300 feet deep. Some placer mining is in progress in this district.

Red Lion district.—The Hannah mine, of the Milwaukee Gold Extraction Company, is located on a contact between granite and limestone. The company has a Chilian mill with amalgamation plates, and also a cyanide plant; these are connected with the mine by means of an aerial tramway.

South Boulder district.—The Gold Reef Mining Company has a shaft 325 feet deep and 2,600 feet of tunnels. The company has a 35-ton free-milling plant without concentration, and also a 10-ton cyanide mill.

JEFFERSON COUNTY.

Production of metals and their ores in Jefferson County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..................fine ounces..	8,765.45	$181,198	8,712.51	$180,104	− 52.94	−$1,094
Silver..........................do....	434,138	262,219	268,807	180,101	−165,331	−82,118
Copper.....................pounds..	174,073	27,155	255,428	49,298	+ 81,355	+22,143
Lead..........................do....	1,081,817	50,846	811,616	46,262	−270,201	− 4,584
Total value..................	....	521,418	....	455,765	....	−65,653
Ore output............short tons..	34,434	a 14.97	20,631	a 21.89	− 13,803	a + 6.92

a Value per ton, placer product excluded.

Forty-nine deep mines in Jefferson County report 20,631 tons of ore of an average value of $21.89 per ton sold or treated in 1906. This is a decrease of 13,803 tons, but an increase of $6.92 in the value per ton. The production of silver-lead ores decreased notably; gold shows very little change, while copper shows an increase. The total value of metals recovered during the year was $455,765, as against $521,418 in 1905.

Boulder district.—Moore and Gendle operated the Baltimore mine in the Boulder district, shipping the ore, which carries gold, silver, and lead, to the East Helena smelter.

Cataract district.—Mr. P. F. Dowling shipped old tailings from the mill on the Ruby mine to smelters at Butte. He also operated the Hiawatha mine, shipping gold-silver ore to Butte. This mine is opened by a vertical shaft 400 feet deep and a tunnel 600 feet long. The Gray Eagle mine, in the Cataract district, is now controlled by the Montana Consolidated Copper Company, which operated it during part of 1906. The mine has one tunnel 1,400 feet long. The same company shipped gold-silver-lead ore from the Comet mine to East Helena. The Pittsburg and Montana Development Company is shipping similar ore from the Sirius mine.

Production of metals and their ores in the Cataract district, Jefferson County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..................fine ounces..	1,408.47	$29,116	2,152.13	$44,489	+ 743.66	+$15,373
Silver..........................do....	131,965	79,707	107,697	72,157	− 24,268	− 7,550
Copper.....................pounds..	132,073	20,603	35,721	6,893	− 96,352	− 13,710
Lead..........................do....	173,529	8,156	331,497	18,895	+157,968	+ 10,739
Total value..................	....	137,582	....	142,434	....	+ 4,852
Ore output............short tons..	4,443	a 30.97	5,502	a 25.89	+ 1,059	a− 5.08

a Value per ton.

Colorado district.—From the Alta mine in the Colorado district near Wickes ore was shipped to the East Helena smelter. The Helena and Livingston Smelting and Reduction Company worked the Gregory, Banner, and West Rumley mines. The Bertha mine was worked in 1906 by Chapin and Bartlett; it is now controlled by the Boston and Corbin Copper and Silver Mining Company. The mine produces values in gold, silver, and copper. Other mines reporting production in this district include the Mount Washington, East Rumley, Minah, State, and Minnesota.

Production of metals and their ores in the Colorado district, Jefferson County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	777.11	$16,064	303.86	$6,281	− 473.25	−$9,783
Silver.....do....	66,368	40,086	23,066	15,453	− 43,302	−24,633
Copper.....pounds..	23,380	3,647	168,374	32,496	+144,994	+28,849
Lead.....do....	409,672	19,255	104,572	5,962	−305,100	−13,293
Total value.....	.....	79,052	.....	60,192	.....	−18,860
Ore output.....short tons..	3,194	[a]24.75	2,393	[a]25.15	− 801	[a]+ 0.40

[a] Value per ton.

Elkhorn district.—From the Elkhorn district ten mines report production in 1906, as compared with six in 1905. The total value of metals recovered in 1906 was $117,453, against $90,743 in 1905. Mr. J. H. Longmaid has reopened the famous Elkhorn mine, which has an incline shaft 2,300 feet deep, and is pumping out the water. The mill on the property is equipped with Frue vanners. Much gold ore was shipped to East Helena from the Gould and Curry mine. This ore carries a large amount of iron, making it valuable for fluxing purposes. A 100-ton cyanide plant is under construction at the mine. The Heagen mine is probably on the same vein system as the Gould and Curry. Other producing mines include the Rose Gold, Little Hope, Scioto, Golden Moss, and Peacock. Mr. W. H. Weed has described the geology and ore deposits of the Elkhorn district in the Twenty-second Annual Report of the Geological Survey.

The production of metals in 1906 is given in the following table:

Metallic production in the Elkhorn district, Jefferson County, Mont., in 1906.

Gold.....fine ounces..	3,950.22	$81,657
Silver.....do....	39,788	26,659
Copper.....pounds..	27,158	5,242
Lead.....do....	68,313	3,895
Total value.....		117,453

Lump Gulch district.—The Liverpool Mining Company operated the Liverpool and Washington mines until about the middle of the year when a strike of the miners resulted in closing the mine. The mine has a well-timbered two-compartment shaft 750 feet deep.

Warm Spring district.—The Carbonate Chief mine in the Warm Spring district near Clancy is opend by three tunnels, the longest being 1,500 feet. Gold-silver-lead ore was shipped from the Bell mine, which is opened by three adit tunnels 500, 1,000, and 1,200 feet long, respectively.

LEWIS AND CLARK COUNTY.

Production of metals and their ores in Lewis and Clark County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold.................fine ounces..	574.39	$11,874	529.92	$10,954	− 44.47	− $920
Silver.........................do....	85	51	86	58	+ 1	+ 7
DEEP MINES.						
Gold.................fine ounces..	26,929.75	556,687	25,327.03	523,556	−1,602.72	−33,131
Silver.........................do....	153,505	92,717	102,603	68,744	− 50,902	−23,973
Copper.....................pounds..	5,705	890	47,537	9,173	+ 41,832	+ 8,283
Lead...........................do....	205,283	9,648	522,248	29,768	+ 316,965	+20,120
Total value..........................	....	671,867	....	642,253	....	−29,614
Ore output............short tons..	151,655	*a* 4.35	96,437	*a* 6.55	− 55,218	*a* + 2.20

a Value per ton, placer product excluded.

Forty-three deep mines in Lewis and Clark County report a total ore tonnage of 96,437 tons, which is a decrease of 55,218 tons as compared with the figures for 1905. But the total value of metals recovered decreased only $29,614, on account of a notable increase in the average value per ton of the ore treated. Gold is the chief product of the mines of the county, the yield being more than half a million dollars during the year.

Bald Butte district.—Operations at the Bald Butte mine took on new life on account of the discovery of additional ore bodies. The mine is equipped with a 40-stamp plate amalgamation mill provided with Frue vanners for concentration. Hendricks Bros. have a 2-stamp mill at the Mammoth and Strawberry mines.

Dry Gulch district.—In the Dry Gulch district near York some gold ore was shipped from the Golden Cloud mine. Other producing mines include the Edith, Last Rose of Summer, and Mike Horse.

Helena district.—A considerable quantity of gold-silver-lead ore was shipped from the Howard mine. The Pittsburg and Montana Copper Company sent the fluxing ore from the Spring Hill mine to the Pittsmont and Washoe smelters. Other mines operated include the Jumbo, Helena, Jaspar, and West Virginia.

Ottawa district.—The Montana Mining Company (Limited) is working the Drum Lummon mine, and treating old tailings in a 400-ton cyanide plant. It also has a 40-stamp mill with concentrating equipment. Other mines producing during the year include the Jerusha and Penobscot.

Stemple district.—The Gold Cord Mining and Milling Company controls the Empire mine. The company has a 60-stamp mill and a 500-ton cyanide plant. The Gould Mines Company worked the Jay Gould mine in the Stemple district. The company has a 30-stamp mill without concentration, and also a 100-ton cyanide plant.

Unionville district.—The Whitlatch Mining Company is operating the Whitlatch mine. The ore, which carries values in gold and silver, is run through a 20-stamp plate-amalgamation mill equipped with concentrating machinery, and the concentrates are sent to the East Helena smelter.

Vaughn district.—The Valley Forge mine in the Vaughn district at Rimini was operated. Gold-sliver-lead ore was shipped from the Caplice Extension mine to the East Helena smelter. Other mines in the district productive in 1906 include the Lady Washington, Mary Aloys, R. E. Lee, South Bend, Bassett, Transit, Hennessy, and Castle Rock.

MADISON COUNTY.

Production of metals and their ores in Madison County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold............fine ounces..	13,122.13	$271,258	18,916.74	$391,044	+5,794.61	+119,786
Silver............do....	1,985	1,199	3,020	2,023	+ 1,035	+ 824
DEEP MINES.						
Gold............fine ounces..	22,065.62	456,137	13,142.24	271,674	−8,923.38	−184,463
Silver............do....	135,855	82,056	114,456	76,685	− 21,399	− 5,371
Copper............pounds..	25,437	3,968	80,633	15,562	+ 55,196	+ 11,594
Lead............do....	466,828	21,941	461,986	26,333	− 4,842	+ 4,392
Total value............	....	836,559	....	783,321	....	− 53,238
Ore output............short tons....	49,204	[a] 11.46	20,497	[a] 19.04	− 28,707	+ [a] 7.58

[a] Value per ton, placer product excluded.

Sixty deep mines in Madison County reported a total tonnage of 20,497, against fifty-nine mines with an output of 49,204 tons in 1905; but this decrease in tonnage is largely offset by a large increase in the average value per ton, and the net result is a loss of $173,848 in total value of the output of deep mines. Gold is the chief product of the mines of Madison County, but silver and lead ores are produced in considerable amounts.

The output of the placer mines of the county registers a large increase, and this is due to the success of dredging operations on Alder Gulch, where the Conrey Placer Mining Company has several dredges at work. One of the novel features of the work is the use of electric power to operate the dredges. Another is the success achieved in handling the gravel even where it contains large bowlders. Bed rock is found to be generally a tenacious clayey material, which may be volcanic ash. There is no increase in gold values just above this bed rock; therefore the operators aim to excavate to bed rock without penetrating it. This is desirable for the further reason that the clay bed rock will not fall from the buckets, but must be scraped out.

Browns Gulch district.—The Easton and Pacific mines, in the Browns Gulch district, near Virginia City, were operated by the Elling estate. The mines are opened by a vertical shaft 300 feet deep and by four tunnels. The equipment includes a 10-stamp mill with concentrating tables and a 25-ton cyanide plant used on the tailings.

Lower Hot Spring district.—Charles Carlson and Albert Barter shipped gold-silver ore from the Red Bluff mine to East Helena. Mining in this district is at present on a small scale from several properties, including the Birdie, Pony, Mascot, and Borosco.

Mineral Hill district.—The Garnet Gold Mining Company is operating the Galena group of mines, in the Mineral Hill district, near Pony. The ore is reduced in a 20-stamp mill, with copper plates and vanners, and carries values in gold, silver, copper, and lead. Elling and Morris are working the Boss Tweed group. They have a 10-stamp mill 2 miles below the mine. Other mines in this district productive in 1906 include the White Pine, Ned, Pony, and Union.

Production of metals and their ores in the Mineral Hill district, Madison County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	4,321.78	$89,339	4,008.37	$82,859	−313.41	−$6,480
Silver....do....	4,356	2,631	8,893	5,959	+ 4,537	+ 3,328
Copper....pounds..	3,205	500	50,383	9,724	+47,178	+ 9,224
Lead....do....	85,326	4,010	112,007	6,385	+26,681	+ 2,375
Total value....	....	96,480	....	104,927	....	+ 8,447
Ore output....short tons..	16,932	[a] 5.70	11,132	[a] 9.42	− 5,800	[a] + 3.72

[a] Value per ton.

Rabbit district.—The total value of the metal product of the Rabbit district increased from $14,597 in 1905 to $26,612 in 1906. Mines producing during the year include the Anything, Watseca, Legal Tender, Cooper, New Clifton, Eureka, Elfeida, Golden Pacific, and Carolina.

Silver Star district.—The Iron Rod Mining Company operated the Hudson and Iron Rod mines, in the Silver Star district. The Hudson mine has an incline shaft 350 feet deep, while the Iron Rod mine is opened by a tunnel 1,100 feet long. The company has a 15-stamp amalgamation mill, with concentrating tables, and a 20-ton cyanide plant, used in cyaniding old tailings. The Broadway Mining and Milling Company worked the Bowery mine through an incline shaft 550 feet deep and a tunnel 1,100 feet long. Other productive mines include the Stella, Green Campbell, Moonlight, Crickett, and Lester.

Production of metals and their ores in the Silver Star district, Madison County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold....fine ounces..	3,189.58	$65,934	1,668.11	$34,482	−1,521.47	−$31,452
Silver....do....	4,435	2,679	2,847	1,909	− 1,588	− 770
Copper....pounds..	6,000	936	22,733	4,387	+ 16,733	+ 3,451
Lead....do....	83,330	3,917	123,925	7,063	+ 40,595	+ 3,146
Total value....	....	73,466	....	47,841	....	− 25,625
Ore output....short tons..	1,918	[a] 38.30	1,919	[a] 24.93	+ 1	[a] − 13.37

[a] Value per ton.

Summit district.—The Kearsarge was bonded to parties who carried on development work during the latter part of the year. Gold-silver-lead ore was shipped from the St. John mine to East Helena.

Tidal Wave district.—Shipments from this district were all small. They came from the Little Goldie, Miner's Union, Keynote, Rollette, and Johnson mines.

Upper Hot Springs district.—The Columbus mine, in the Upper Hot Springs district, near Norris, was operated. The mine workings reach a depth of 350 feet. Other producing mines include the Revenue and the Boaz.

Washington district.—The George McKee mine, in the Washington district, is being worked. It is located on a contact between rhyolite porphyry and Archean gneiss. Other properties include the High Bluff and Lehigh mines.

MEAGHER COUNTY.

The Castle Mountain Mining district, in Meagher County, is inactive at present. The same is true of the Mussel Shell district, near Copperopolis. The California Mining Company is operating a placer mine in Thompson Gulch near White Sulphur Springs.

MISSOULA COUNTY.

Production of metals and their ores in Missoula County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold .... fine ounces..	2,067.26	$42,734	2,256.23	$46,640	+188.97	+$3,906
Silver .... do....	90	55	85	57	− 5	+ 2
DEEP MINES.						
Gold .... fine ounces..	141.50	2,925	80.16	1,657	− 61.34	− 1,268
Silver .... do....	4,933	2,980	2,510	1,682	− 2,423	− 1,298
Copper .... pounds..	45,086	7,034	57,436	11,085	+12,350	+ 4,051
Lead .... do....	31,516	1,481	....	....	−31,516	− 1,481
Total value	....	57,269	....	61,121	....	+ 3,912
Ore output .... short tons..	660	[a] 21.85	409	[a] 35.26	− 251	[a] + 13.41

[a] Value per ton, placer product excluded.

Missoula County registered a decrease in the metallic output of deep mines except in copper, but the total value of the product of the deep mines shows practically no change. On the other hand, the average value per ton shows a notable increase. The placer product also shows an increase.

Wallace district.—The Cape Nome Mining Company has a double-compartment vertical shaft 300 feet deep on the Cape Nome mine, in the Wallace district, near Clinton. The Hidden Treasure mine, in the same district, is operated by the owner and also by lessees.

PARK COUNTY.

The value of the metal output of Park County in 1906 was quite small, but developments are in progress in the county which may restore it to its place as an important producer. In the New World district at Cooke City two smelters have been erected, and thus the handicap of lack of transportation facilities is in a measure removed.

Several companies are now engaged in mine-development work in the district.

In the Crevasse district near Jardine the Conrad Stanford Company has prosecuted active development work on the Crevasse Mountain mine. In the Sheepeater district, also near Jardine, the Kimberley Montana Gold Mining Company has found a valuable deposit of tungsten ore (scheelite) in the Kimberly mine.

POWELL COUNTY.

Production of metals and their ores in Powell County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
PLACERS.						
Gold....fine ounces..	1,471.97	$30,429	2,123.68	$43,900	+651.71	+$13,471
Silver....do....	157	95	260	174	+ 103	+ 79
DEEP MINES.						
Gold....fine ounces..	1,764.62	36,478	2,402.06	49,655	+637.44	+ 13,176
Silver....do....	20,855	12,597	29,174	19,547	+ 8,319	+ 6,950
Copper....pounds..	532	83	7,555	1,458	+ 7,023	+ 1,375
Lead....do....	245,428	11,535	180,289	10,277	−65,139	− 1,258
Total value....	....	91,217	....	125,011	....	+ 33,794
Ore output....short tons..	7,647	[a] 7.94	9,127	[a] 8.86	+ 1,480	[a] + 0.92

[a] Value per ton, placer product excluded.

Nine deep mines in Powell County reported a total output of 9,127 tons in 1906 against six mines with a total output of 7,647 tons in 1905. The production of all metals increased except in the case of lead. Gold is the most important product of the Powell County mines.

Placer mining is making good progress in the county; one company has a dredge in operation on Gold Creek; another company is doing extensive hydraulic mining in the Pioneer district.

Ontario district.—The Twin City Mining and Milling Company is developing the Blow mine in the Ontario district near Elliston. Gold-silver-lead ore was shipped to the East Helena smelter from the Big Dick mine.

Zozell district.—The Emery Mining Company operated its concentrator at the Carbonate mine in the Zozell district near Deer Lodge, sending the concentrates to the East Helena smelter.

RAVALLI COUNTY.

The Curlew mine near Victor was reopened during 1906, and shipments of silver-lead ore were sent to the East Helena smelter. The mine has a vertical shaft 300 feet deep; it is equipped with a 120-ton concentrator. Some of the interesting geologic features of this mine were mentioned in a survey report on the Bitter Root Mountains by W. Lindgren (Professional Paper 27, U. S. Geol. Survey, 1904).

SANDERS COUNTY.

The new county of Sanders came into existence by legislative enactment on March 1, 1906, being created out of the northwestern portion of Missoula County. Very little mining is in progress. The Poorman Mining Company shipped some gold ore from Plains to the smelter at East Helena.

SILVERBOW COUNTY.

Production of metals and their ores in Silverbow County, Mont., in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	61,251.20	$1,266,175	60,495.97	$1,250,563	− 755.23	− $15,612
Silver..............do....	11,191,016	6,759,373	10,715,721	7,179,533	− 475,295	+ 420,160
Copper...........pounds..	304,307,893	47,472,031	289,780,050	55,927,550	−14,527,843	+8,455,519
Lead................do....	1,140,666	53,611	895,566	51,048	− 245,100	− 2,563
Zinc..................do....	1,560,000	92,040	6,579,000	401,319	+ 5,019,000	+ 309,279
Total value.........	....	55,643,230	....	64,810,013	....	+9,166,784
Ore output...short tons..	4,419,300	*a* 12.59	5,019,234	*a* 12.91	+ 599,934	*a*+ 0.32

a Value per ton, placer product excluded.

Sixty deep mines in Silverbow County report a total output of ore of 5,019,234 tons in 1906 against 60 mines with an output of 4,419,300 tons in 1905. The average value per ton increased from $12.59 in 1905 to $12.91 in 1906. The total value reached $64,810,013 in 1906, which is an increase of $9,166,784 over the preceding year. These large figures of increased value are not due to increased output of metals, as the county shows a decrease in the production of all the metals except zinc, but are due to the high ruling price of copper and, to a less extent, of silver, lead, and zinc during 1906.

In value of copper produced and in total value of metallic output Silverbow County established a new record in 1906, and this resulted in larger totals in the same items for the whole State than ever before. This resulted in spite of a decreased production of copper, silver, gold, and lead.

The high price of copper has resulted in still further increasing the available ore reserves in the mines of Butte, and much of the ore mined in 1906 could not have been treated at a profit when copper was worth only 12 cents.

Summit Valley district.—The production of the Summit Valley district in 1906 was the total production of Silverbow County, except for the placer gold obtained in German gulch and elsewhere. This condition may soon cease, however, since exploratory work has gradually spread from the central portion of Butte until it has gone beyond the limits of the district in all directions.

On account of the prominence of the city whose growth has been due to the mines of the camp the Summit Valley district is commonly known as the Butte district.

Probably the most important occurrence of the year in mining circles in Butte was the settlement of the long continued struggle between the United Copper Company and the Amalgamated Copper Company. By the terms of the settlement all the large properties of the United Copper Company in Butte except the Lexington mine were taken over by the Butte Coalition Copper Company on February 14. This latter company is a new corporation friendly to the Amalgamated Company, and organized by Thomas F. Cole, John D.

Ryan, and others allied with the last-named company. As a result of this settlement, all of the numerous lawsuits between the warring companies have been dismissed, rich ore bodies which were under injunction have been released for active mining, and capital both in Butte and elsewhere has been found abundantly for elaborate and expensive exploratory work on all sides of Butte. Much more work of this character is now in progress than ever before in the history of the district. Actual results in the way of ore shipments were obtained by only a few of the new companies during 1906. Such results came especially from the region near Columbia Gardens, east of Butte, perhaps chiefly because the ore there is found at shallow depth in the form of chrysocolla, cuprite, etc.

The Anaconda Copper Mining Company deepened the shaft on the High Ore mine 400 feet to the 2,600-foot level. This mine is equipped with large pumping engines, and several mines in the vicinity are allowed to drain into it. Therefore there is need that its workings be kept lower than those of the others. The shaft during the first half of 1907 was deepened further to 2,875 feet. The Boston and Montana Company completed the new 4-compartment shaft on the Leonard by raising from several different levels, and its depth is now 1,200 feet. The company also deepened the shaft on the Mountain View 200 feet to the 1,600-foot level, and that on the East Colusa 100 feet to the 900-foot level. The Trenton Company sank the shaft on the Gagnon 200 feet to the 2,100-foot level. The shaft on the Moonlight mine of the Washoe Company is now 1,800 feet deep.

The Original Company deepened the shaft on the Original to the 2,000-foot level. The same company entered into a contract with the new Davis Daly Estates Company to run a crosscut, starting on the 1,800-foot level of the Original mine, some 2,000 feet south, in order to explore ground owned by the latter company.

The Red Metal Company, which is the operating company for the Butte coalition, deepened the shaft on the Rarus 100 feet to the 1,600-foot level, that on the Cora 200 feet to the 2,300-foot level, and that on the Minnie Healey 200 feet to the 1,300-foot level.

The North Butte Company continued its crosscutting to the north after buying the Berlin group, but has not yet reached the vein on the Berlin.

The Montana Zinc Company lost the mill which it was operating, and its equipment, by fire in July and has not resumed operations.

Development work on a large scale was carried forward in the region east and northeast of Butte. The Boston and Montana Company reached the 600-foot level in the new shaft on the Greenleaf, and will go to the 1,000-foot level. The Butte Copper Exploration Company, which is a new corporation, sank the Six O'clock shaft to the 1,000-foot level and began crosscutting. The Butte and London Company is sinking a shaft some distance eastward from the North Butte, and the Butte and Bacorn Company is sinking three shafts in the district farther north. Several other companies are actively engaged in important development work.

Former Senator W. A. Clark has begun work on a shaft on the Elm Orlu to develop that claim and the Poser.

Several changes occurred during the year which affected the treatment of ores by the various smelters. The M. O. P. smelter was owned and operated by the Montana Ore Purchasing Company until February 14, when it passed into the hands of the Red Metal Company, which operated it for five months and then closed it down and dismantled it. The ores of the Red Metal Company now go to the Washoe smelter. The Pittsmont smelter was closed on April 15, and the ores of the Pittsburg and Montana Company have since gone to the Washoe smelter. Near the end of the year orders were given for extensive improvements at the Boston and Montana smelter at Great Falls, which will largely increase its capacity. At the Butte Reduction Works the entire crushing mill was destroyed by fire early in January. Arrangements were immediately made to concentrate the ores of the Original Company at Anaconda and the Butte smelter was thus kept in continuous operation. The whole concentrator was rebuilt with improvements, and was in operation in about sixty days after the fire.

At the Washoe smelter of the Amalgamated Company improvements and enlargements continue. The capacity of the concentrator has been increased to 9,000 tons daily without enlarging the building. The concentrator is now operated by electric power instead of steam, and the use of electric power is to be extended to all parts of the smelter. Electric power is now obtained to the amount of 4,400 horsepower from the Missouri River near Canyon Ferry, and to the amount of 1,200 horsepower from Flint Creek near Philipsburg. The roasting plant now consists of 64 of the Evans Klepetko McDougal furnaces. The reverberatory plant consists of eight furnaces, one 102 feet in length, six 112 feet long, and one 116 feet in length in the hearth. The converter plant consists of eleven stands, and one more is to be added, and the building enlarged. In the blast-furnace section there are two furnaces 51 feet long and 56 inches wide at the tuyeres, and one furnace 87 feet long by 56 inches wide. This last furnace will soon be lengthened to 144 feet. The average daily capacity of the smelter is now 10,200 tons.

NEVADA.

By Charles G. Yale.

PRODUCTION.

As the total value of the gold, silver, and associated metals produced in Nevada in the calendar year 1905 amounted to $9,453,114 and in 1906 to $15,714,841 it will be seen that the State shows the very marked increase for the year of $6,261,727. Moreover, there was a decided gain in every one of the metallic values, the most notable, as was to have been expected, being in the gold—$5,200,885. The silver increase was considerably over half a million dollars and the copper about a quarter of a million, and both lead and zinc show satisfactory advances, as subsequent tables in this chapter show in detail.

Although Nye County was much the largest producer in the State in 1905 and increased its output in the year under review by $685,620, yet it now takes second rank, giving the first place to Esmeralda County, which has a total output for the year of $7,293,543. Of this

$7,125,119 is gold, $7,026,154 of which came from the famous Goldfield camp, which also yielded $10,484 in silver. The increase in production of this camp over the previous year was $5,148,499. The increase at Tonopah, Nye County, was $672,803. The only other county of the State with a record for the year of over a million dollars is Lincoln, the total production of which was $1,506,341.

The figures quoted show a marked increase in bullion product and indicate material progress in the condition of the mineral industry of the State. They may, however, be questioned by many persons engaged in mining stock transactions who have led the public to believe that millions of dollars are coming monthly from the mines in the newer camps. To those engaged in legitimate mining enterprises, however, who know the time required to bring even the best of mines to a stage of development where steady and regular production may be expected the showing is most satisfactory. The grade of ore in certain of the mines has been remarkably high considering the quantities shipped, and as these shipments have been published when the ore was hoisted and sacked, again when actually shipped, and still again when returns were received exaggerated ideas as to the weekly and total output of certain prominent mines prevail. Nevada has doubtless attracted more attention from miners, prospectors, and investors during the past few years than any of the other mineral-producing States of the Union. Everything indicates a still more marked increase in output for 1907.

The State has two very decided advantages from a mining point of view. It really has numerous mines of merit, and what is about of equal importance has plenty of capital ready to develop them. After a long period of depression in mining affairs and a gradually decreasing yield the discoveries in the southern portion of the State a few years ago once more attracted general attention to the possibilities of the mineral regions. These camps were very rapidly developed and a very natural result of these changed conditions was the revival of old camps which were prosperous a quarter of a century ago, but which since then had been virtually abandoned. Nearly all of these older localities are now being exploited to a greater or less degree. Moreover, not only silver and gold are now being sought, but also copper, zinc, and other metals.

The newer and most successful districts naturally attracted the larger population and the most attention, and it is these new camps from which the bulk of the bullion production of the State is now being derived and from which the most material increase of the future is to be expected.

Over 77 per cent of the entire bullion output of the State in 1906 came from the two camps of Goldfield and Tonopah, Goldfield alone producing nearly 45 per cent of the total yield. This statement shows clearly the importance of the new camps, and also why these two camps have had such an influence in bringing population and capital to the State. Much of the money derived from these new mines is being invested in developing properties at other points in Nevada, and outside capital is doing its share also.

While more or less leasing is still going on, the larger productive mines are now worked solely on owners' account, the leases having expired, and not having been renewed. In this connection it is proper to make some mention of the so-called "high grading," or ore stealing, in the mines which carry the richest ore at Goldfield. In the opinion of the officials of the most prominent mines the ore stolen by the "high graders" amounted in 1906 to $1,250,000, of which about $250,000 was ultimately recovered. This leaves a million dollars worth of ore presumably still secreted and as yet unmarketed. Of course this amount is not included in the statistical tables given in this chapter.

Aside from Goldfield and Tonopah most of the newer camps of the State were only small shippers in 1906, although much development was accomplished. Some mines, which were in a position to ship ore, were awaiting the completion of railway lines, while others were holding their ore until prepared to mill it themselves. Some of the companies have now installed electric power and several have built large mills at Tonopah or near by.

The San Pedro, Los Angeles and Salt Lake Railway Company is now completed from Las Vegas, Lincoln County, to Bullfrog, Nye County, and will open up a large mineral-bearing section. The New Western Pacific line will also soon be completed in the eastern part of Nevada, and will put many properties in White Pine County on a shipping basis. The completion of the Nevada Northern Railroad line from the main line of the Southern Pacific to Ely will be of the greatest advantage to the many low-grade copper properties being developed at that camp.

There is also some indication of the Nevada Central Railroad, which runs from Battle Mountain to the old camp at Austin, being extended south through Reese River district to the Round Mountain and Manhattan districts, in the northern portion of Nye County. Lack of transportation has prevented anything but the richer ores being shipped out of all this region.

The developments at the Fairview and Wonder camps would also seem to warrant the construction to them of a branch railroad line from Hazen, on the Southern Pacific line. The completion of the Tonopah and Tidewater Railroad line will give a second outlet to the camps in southwestern Nye and Esmeralda counties.

Although there were only 143 deep mines reporting product in the State in 1906, they yielded 496,307 tons of ore. The dry or siliceous ores amounted to 463,672 tons, an increase of 42,268 tons, and of an average value of $32.37 per ton. The 5,184 tons of copper ore averaged $5.84 per ton in gold and silver, and the 18,940 tons of lead ore averaged $13.51 per ton in gold and silver. There were also 8,511 tons of zinc-lead ore worked. Altogether the increase in tonnage for the year is 64,105. The amount of concentrates produced was 1,395 tons, worth $440,375. In addition there were 67,387 tons of old tailings worked, which yielded $170,995. These were nearly all from the Comstock.

Altogether there are 154 producing mines in Nevada, 142 deep and 12 placers. Two of these latter are hydraulic and the others surface placers. Of the deep mines 75 have gold as the predominating metal, 34 silver, 6 copper, 26 lead, and 2 zinc-lead. There have also been received reports from 1,070 nonproducing mines. Of these latter Nye County has the most, 271, followed by Esmeralda with 193, Lincoln with 171, and the other counties with smaller numbers. All of these properties are in process of development, or held by annual assessment.

The following table shows the total production of gold, silver, and associated metals in Nevada for the calendar years 1905 and 1906, with the increase for 1906:

Production of gold, silver, and associated metals in Nevada in 1905 and 1906.

	1905.		1906.		Increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.........fine ounces..	254,927.51	$5,269,819	506,520.32	$10,470,704	251,592.81	$5,200,885
Silver................do....	6,482,081	3,915,177	6,770,611	4,536,310	288,530	621,133
Copper............pounds..	413,235	64,465	1,625,985	313,816	1,212,750	249,351
Lead..................do....	3,457,124	162,485	3,823,617	217,945	366,493	55,460
Zinc...................do....	697,757	41,168	2,886,328	176,066	2,188,571	134,898
Total................	....	9,453,114	....	15,714,841	....	6,261,727

The output of metals in quantity and value in each of the different counties is given in the following table, which is so plain as to require no analysis. It will be seen that Esmeralda County leads in gold output, Nye in silver, Lyon in copper, Eureka in lead, and Lincoln in zinc:

Production of gold, silver, copper, lead, and zinc in Nevada in 1906, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
Churchill and Douglas......	1,749.77	$36,171	192,138	$128,733	....	....
Elko.........................	8,497.22	175,653	43,854	29,382	....	....
Esmeralda..................	344,677.61	7,125,119	141,975	95,123	180,000	$34,740
Eureka......................	2,462.82	50,911	77,552	51,960	6,653	1,283
Humboldt...................	774.49	16,010	9,030	6,050	518	100
Lander......................	538.27	11,127	86,564	57,998	3,404	657
Lincoln......................	54,561.97	1,127,896	73,899	49,512	521,043	100,560
Lyon.........................	2,375.79	49,112	68,027	45,578	868,993	167,718
Nye..........................	71,824.75	1,484,749	5,739,852	3,845,701	....	....
Storey.......................	15,855.68	327,766	277,258	185,763	....	....
Washoe.....................	1,453.09	30,038	8,958	6,002	....	....
Whitepine..................	1,748.85	36,152	51,504	34,508	45,374	8,757
Total................	506,520.31	10,470,704	6,770,611	4,536,310	1,625,985	313,816

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Churchill and Douglas..............	....	....	....	....	$164,904
Elko..................................	61,719	$3,518	....	....	208,553
Esmeralda...........................	676,510	38,561	....	....	7,293,543
Eureka...............................	1,014,244	57,812	492	$30	161,996
Humboldt............................	16,250	926	....	....	23,086
Lander...............................	90,506	5,158	590	36	74,976
Lincoln...............................	918,830	52,373	2,885,246	176,000	1,506,342
Lyon..................................	14,000	798	....	....	263,206
Nye...................................	16,508	941	....	....	5,331,391
Storey................................	....	....	....	....	513,529
Washoe..............................	600,000	34,200	....	....	70,240
Whitepine...........................	415,050	23,658	....	....	103,075
Total.........................	3,823,617	217,945	2,886,328	176,066	15,714,841

The next two tables show the tonnage and value of ore concentrates and old tailings, by counties, and the subdivision of tonnage of ore treated or sold, in suitable classification:

Tonnage and value of ore, concentrates, and old tailings in Nevada in 1906, by counties, in short tons.

County.	Total tons of ore sold or treated.	Increase (+) or decrease (−) compared with 1905.	Concentrates produced.		Old tailings treated.	
			Quantity.	Value.	Quantity.	Value.
			Tons.		*Tons.*	
Churchill and Douglas	485	− 215				
Elko	28,504	+12,398	200	$59,082	5,100	$10,000
Esmeralda	71,883	+47,680	473	140,187	7,000	36,780
Eureka	12,040	+ 8,400				
Humboldt	1,883	− 4,902	10	1,362		
Lander	703	+ 278				
Lincoln	207,981	+32,295	1	190	35,495	58,930
Lyon	14,703	− 2,689			6,692	21,000
Nye	109,574	+17,923	38	3,661		
Storey	39,407	−50,077	372	168,443	13,100	44,285
Washoe	7,904	+ 4,262	200	42,200		
Whitepine	1,240	− 1,248	101	25,250		
Total	496,307	+64,105	1,395	440,375	67,387	170,995

Subdivision of tonnage of ore sold or treated in Nevada in 1906, by counties, in short tons.

County.	Dry or siliceous ores.	Copper ores.	Lead ores.	Zinc ores.	Zinc-lead ores.	Total.
Churchill and Douglas	485					485
Elko	28,350		154			28,504
Esmeralda	70,545	450	888			71,883
Eureka			12,029		11	12,040
Humboldt	1,811		72			1,883
Lander	186		517			703
Lincoln	197,198	2,233	50		8,500	207,981
Lyon	12,192	2,501	10			14,703
Nye	109,424		150			109,574
Storey	39,407					39,407
Washoe	3,404		4,500			7,904
Whitepine	670		570			1,240
Total	463,672	5,184	18,940		8,511	496,307
Increase	42,268	3,916	11,186		6,745	64,105
Average value per ton in gold and silver	$31.64	$5.84	$13.19		$0.03	

The number of producing mines, both deep and placer, classified by chief product, and the number of nonproducing mines, by counties, are given in the following table:

Number of mines, classified by chief product, in Nevada in 1906.

County.	Nonproducing mines.	Gold placer mines.			Deep mines.							Grand total.
		Hydraulic.	Dry wash sluice.	Total.	Gold.	Silver.	Copper.	Lead.	Zinc.	Zinc-lead ores.	Total.	
Churchill	59					2					2	2
Douglas	21	1		1								1
Elko	23		1	1	2	3		2			7	8
Esmeralda	193		1	1	20	2	1	2			25	26
Eureka	18							7		1	8	8
Humboldt	77		1	1	2	5		2			9	10
Lander	44				1	3		4			8	8
Lincoln	171				11		3	1		1	16	16
Lyon	34		1	1	5		2	1			8	9
Nye	271		4	4	16	13		1			30	34
Ormsby	9											
Storey	23				10	5					15	15
Washoe	52				6			1			7	7
Whitepine	75	1	2	3	2			5			7	10
Total	1,070	2	10	12	75	33	6	26		2	142	154

As to the source of gold product, with the exception of 2,556 ounces from placers, 128 ounces from copper ores, and 3,160 ounces from lead ores, it all came from siliceous ores. By far the largest proportion was derived from the mines at Goldfield, Esmeralda County. The following table shows these sources by counties:

Source of gold product in Nevada in 1906 by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.					Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc-lead ores.	Total.	
Churchill and Douglas	197.42	1,552.35				1,552.35	1,749.77
Elko	24.19	8,472.06		0.97		8,473.03	8,497.22
Esmeralda	87.09	344,277.24	48.38	264.90		344,590.52	344,677.61
Eureka				2,462.63	0.19	2,462.82	2,462.82
Humboldt	241.88	532.61				532.61	774.49
Lander		382.36		155.91		538.27	538.27
Lincoln		54,482.63	79.34			54,561.97	54,561.97
Lyon	60.47	2,314.98		.34		2,315.32	2,375.79
Nye	1,855.52	69,843.94		125.29		69,969.23	71,824.75
Storey		15,855.68				15,855.68	15,855.68
Washoe		1,307.96		145.13		1,453.09	1,453.09
Whitepine	89.49	1,654.52		4.84		1,659.36	1,748.85
Total	2,556.06	500,676.33	127.72	3,160.01	.19	503,964.25	506,520.31
Increase	2,155.80	247,660.78	76.40	2,699.62	.19	249,437.00	251,592.80

In the matter of silver product and its source by class of ore, the placers yielded 1,296 fine ounces, copper ores 41,273 ounces, lead ores 275,469 ounces, and zinc-lead ores 391 ounces. This leaves 6,452,182 ounces as having been derived from siliceous ores. Of the total amount of silver, 5,739,852 ounces came from Nye County, mainly from the mines at Tonopah. The details, by counties, are given in the following table:

Source of silver product in Nevada in 1906 by kinds of ore, by counties, in fine ounces.

County.	Placers.	Deep mines.						Grand total.
		Siliceous ores.	Copper ores.	Lead ores.	Zinc-lead ores.	Zinc.	Total.	
Churchill and Douglas	28	192,110					192,110	192,138
Elko	8	39,775		4,071			43,846	43,854
Esmeralda	15	34,222	2,200	105,538			141,960	141,975
Eureka				77,161	391		77,552	77,552
Humboldt	52	7,311		1,667			8,978	9,030
Lander		34,522		52,042			86,564	86,564
Lincoln		34,826	39,073				73,899	73,899
Lyon	27	67,976		24			68,000	68,027
Nye	1,151	5,728,247		10,454			5,738,701	5,739,852
Storey		277,258					277,258	277,258
Washoe		1,495		7,463			8,958	8,958
Whitepine	15	34,440		17,049			51,489	51,504
Total	1,296	6,452,182	41,273	275,469	391		6,769,315	6,770,611
Increase (+) or decrease (—)	+1,198	+268,594	+39,584	—16,484	+391	—4,753	+287,332	+288,530

REVIEW BY COUNTIES.

CHURCHILL AND DOUGLAS COUNTIES.

These two counties produced altogether $164,904, of which $128,733 was silver. In Churchill County the principal producing mine was the Nevada Hills Mining Company at Fairview, the only 1906 producer at this new camp. Only a small tonnage was shipped, but the ore was of high grade. Other properties at this camp will be shippers in 1907. There were many active properties at Wonder, Hercules, and Eastgate, some of which will be shippers in 1907. The Silver Queen Mining Company in the I-X-L district was a small producer. In Douglas County the output was small, most of the placers having been inactive. In the two counties 80 mines reported no output, though many were in the development stage.

ELKO COUNTY.

The output of this county for the year was $208,553, of which $175,653 was gold, $29,382 silver, and $3,518 lead, the increase for the year being $46,797. In this county are the districts of Maggie, Centennial, Vandusen, Spruce Mountain, Tuscarora, Bullion, and Aura. The largest producer in the county was the Montana Mining Company, owner of the Lucky Girl mine in the Centennial district. Other producers are the Nevada-Star Mining Company in the Maggie district and the Nelson Mining Company and Protection Mining Company in the Vandusen district. The Black Forest Mining and Smelting Company, which has a small smelter in the Spruce Mountain district, did not operate extensively on account of scarcity of labor. The old Dexter mine in the Tuscarora district was operated in a small way by leasers. Development was active in the Bullion and Aura districts, and some of the mines will be producers in 1907. In this county nearly all the ore is milled at the mines.

ESMERALDA COUNTY.

Esmeralda is by far the most productive county in Nevada, and the increase in output for the year is the most marked. The total yield of the county in 1906 was $7,293,543, of which $7,125,119 was gold, $95,123 silver, $34,740 copper, and $38,561 lead. This is an increase for the year of $5,235,102, mainly in gold. The mines outside of Goldfield are all small producers. There were 71,883 tons of ore worked in the county, an increase of 47,680 tons over the previous year. Of concentrates 473 tons were saved, and there were also 7,000 tons of old tailings worked. Except for 450 tons of copper ore and 888 tons of lead ore, the returns came from dry or siliceous ores. The yield from placers was nominal, only one being worked. Of the 25 deep producing mines, 20 have gold as the principal metal in their ore, 2 silver, 1 copper, and 2 lead. Reports were received from 193 nonproducing mines in process of development or held by assessment work.

The most active district in the county and in the State is that of Goldfield, which at present is the largest producer of any camp in Nevada.

The following table will show the yield of the district in the past three years with the increase in 1906 over 1905:

Production of Goldfield district, Esmeralda County, Nev., 1904-1906, in 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
1906	339,890.20	7,026,154	15,648	10,484	7,036,638
Increase	248,802.43	5,143,203	7,059	5,296	5,148,499

The producers at Goldfield in 1906 were the Combination Fraction Mining Company, Florence Gold Mining Company, Gold Bar Mining Company, Goldfield C. O. D. Mining Company, Goldfield Daisy Mining Syndicate, Goldfield Consolidated Mines Company (Mohawk, Jumbo, Combination), Goldfield Great Bend Mining Company, Jumbo Extension Mining Company, and Diamondfield Black Butte Consolidated Mining Company. By far the largest proportion of the output was from the various mines of the Goldfield Consolidated Mines Company. During the year 59,628 tons of ore were treated, yielding $7,036,638, of which $10,484 was silver and the rest gold; 19,461 tons of ore were worked at gold and silver mills, and 40,167 tons were shipped to smelters. Much very high-grade ore was shipped, but the average value of the total amount treated was $118 per ton, of which $117.83 was gold and 17 cents silver. The local milling capacity of the camp will be much larger in 1907 than it was in the year under review. The prescribed limits of this chapter prevent any extended review of conditions other than those made apparent by the statistics collected and the facts herewith presented. It may be said generally, however, that it is apparent that the camp is in a position largely to increase its output and will do so for some time to come.

There was a revival in the old Aurora district, where the Cain Consolidated Gold Mining Company is quite a large producer. The Summit group in the same district is also making some output. In the Columbus district the Humboldt and Georgina mines shipped a small quantity of ore, in which silver predominated. A small product was made by the Lida Golden Chariot Mining Company in the Lida district. The Douglas Mining Company in the Gold Range district made a good output, as did the Nevada Rockland Mining Company in the Wilson district.

The production of the Silver Peak district was not large, for many mines were inactive and the mill of the largest operator, the Mohawk Alpine Mining Company, was destroyed by fire early in the year. In the Silver Star district near Mina the Blue Light and Moho mines were both shippers. The ore of the Blue Light is copper, while the chief values of the Moho are in lead. The only other prominent producers in 1906 were the Nevada-Alpine Mining Company in the Lone Mountain district, the largest producer of both silver and lead in the county; and the Southern Klondike mine in the district of the same name—a silver mine. No reports of producing properties were received from the Gold Mountain, Palmetto, Buena Vista, or Montezuma districts in 1906, but the new mill of the Bonnie Claire Mining Company near Thorp has been completed since and is now in operation.

EUREKA COUNTY.

This county yielded in the period under review $50,911 in gold, $51,960 in silver, $1,283 in copper, $57,812 in lead, and $30 in zinc, a total of $161,996, which is an increase of $73,603 over the previous year. There are only eight mines producing in the county, all but one having lead as the principal metal in their ore. Six of these mines are in the Eureka district, viz, the Bullwhacker Mining Company, Cyanide, Diamond Mining Company, U. S. Mining and Smelting Company (Eureka Consolidated), Jackson Mining Company, and Laurel mine.

The following table shows the output of Eureka district for the past two years:

Production of Eureka district, Eureka County, Nev., in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	651.85	$13,457	36,341	$21,950		
1906	2,396.01	49,530	68,760	46,069	6,653	$1,283
Increase (+) or decrease (−)	+1,744.16	+36,073	+32,419	+24,119	+6,653	+1,283

Year.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	416,308	$19,566	9,120	$538	$55,511
1906	992,929	56,597			153,479
Increase (+) or decrease (−)	+576,621	+37,031	−9,120	−538	+97,968

Outside the Eureka district the only producing mines in Eureka County are the Tenabo Mining Company and the Flagstaff in the Cortez district.

HUMBOLDT COUNTY.

While prospecting and development work were active in this county, the production was comparatively small, amounting altogether to $23,028 as compared with $42,758 in the previous year. There were only 10 productive mines in 1906, while 77 were reported as nonproductive. The producing mines in 1906 all showed a small output and were confined to the following districts: Vicksburg, Pueblo, Humboldt, Kennedy, Star, and Buena Vista. The decline in output was caused mainly by the fact that the mill owned by the Pine Forest Gold Mining Company at Ashdown, Vicksburg district, was operated for a brief period only. Many mines are being worked in the new Rosebud district, 30 miles north of Mill City, but there were no shippers in 1906. The Seven Troughs district was also active, but operations were confined to development work.

LANDER COUNTY.

There were but 8 producing mines in this county in 1906, 4 of which were in the Reese River district, 3 in the Bullion, and 1 in the Campbell. The total output was $74,976, of which $57,998 was silver, and the total increase over the previous year was $53,463. Dozens of new properties were located in Reese River district, and, while the amount of ore shipped in 1906 was not large, prospects are good for an increased output. The values in the ore are mainly silver. Some of the producers in this district are the Austin Goldfield Mining Company, Austin Hannapah Mining Company, Klondike, and Double H mines; the Bullion district had three shippers, the Gold Quartz Mining Company, Little Giant, and Gray Eagle. The Lander Mill and Mining Company was the only shipper in the Campbell district. The Beowawe mines were active and will be among other shippers in 1907.

LINCOLN COUNTY.

Lincoln County produced in 1906 $1,056,056, being the third in rank of production in the State. The comparative output for two years is as follows: 1905: Gold, $1,061,215; silver, $38,228; lead, $14,200; copper, $3,558; zinc, $40,454; total, $1,157,655. 1906: Gold, $1,127,896; silver, $49,512; lead, $52,373; copper, $100,560; zinc, $176,000; total, $1,506,341.

The increase for the year is $348,786, and there has been an increase in every one of the metals, and notably in lead, copper, and zinc. In zinc the increase amounts to $135,546; in copper to $97,002; and in lead to $38,173. The gold and silver also increased, but not in so large a proportion as the other metals. The tonnage of ore treated was by far the largest of any county in the State, amounting to 207,981 tons, an increase of 32,295 tons over the previous year. Of copper ore there were 2,233 tons worked; of lead ore, 50 tons; and of zinc-lead, 8,500 tons, leaving 197,198 tons as dry or siliceous ores. Of old tailings, 35,495 tons were treated, yielding $58,930. There are 16 deep mine producers in the county, but no placers, and 171 mines reported as nonproductive.

Product is reported from the districts of Crescent, Ferguson, Eagle Valley, Pioche, Yellow Pine, and Searchlight. The largest and most important producers in the county, and one of the largest producers of gold in the State, is the Bamberger Delamar Mining Company, in the Ferguson district. In output of gold two properties exceed it, those of the Goldfield Consolidated Mines Company and the Tonopah Mining Company. It handles, however, very much the largest tonnage of any property in the State, and the ore is crushed and cyanided at its own plant. Aside from this mine in the Ferguson district, the largest producing district in the county is the Searchlight. The following table shows the output of this district for the past two years:

Production of Searchlight district, Lincoln County, Nev., 1905 and 1906.

Year.	Gold.		Silver.		Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ozs.		*Fine ozs.*		*Pounds.*		*Pounds.*		
1905	19,329.43	$399,575	28,528	$17,231	22,808	$3,558	12,064	$567	$420,931
1906	25,144.60	519,785	11,543	7,734	11,182	2,158	9,655	550	530,227
Increase (+) or decrease (−)	+5,815.17	+120,210	−16,985	−9,497	−11,626	−1,400	−2,409	−17	+109,296

The companies making this production were the Cyrus Noble Mining Company, Brockman Mines Company (Duplex mine), Quartette Mining Company, Southern Nevada Mining and Milling Company, and Searchlight Mining and Milling Company. Of the 45,668 tons of ore worked in 1906, the Quartette company produced 23,346, and is therefore the largest producer. Four of these companies have 10-stamp mills, while the Quartette has a 20-stamp mill and added 20 stamps in 1907. The shaft on this latter mine is 850 feet deep, while the shafts of the others run from 250 to 500 feet in depth.

The Crescent district was very active in 1906, although there were only two producers, the Ajax Bullfrog Mining Company and the Big Four Mining Company. In the Eagle Valley district the Irus mine and the Newport Nevada Mining Company were producers. The new railway (the "Clark" road) has given new life to the old districts of Pioche and Yellow Pine. The only prominent producer in Pioche was the Bristol Consolidated Copper Company, which shipped a large tonnage of ore carrying silver, copper, and lead. The principal producer in the Yellow Pine district was the Potosi Zinc-Lead Company, which is the largest producer of zinc in the State. Others which made an output were the Columbia Mining Company, Nevada Keystone Mining Company, Ninety-nine, and Hoosier mines. At Gold Butte, El Dorado Canyon, and Fay only development work was done on the mines.

LYON COUNTY.

The producing districts in Lyon County are Palmyra, Devils Gate and Chinatown, Silver City, Pine Nut, and Mason. Nine mines reported product, one of them a placer. Production of gold, silver, lead, and copper for the past two years was as follows: 1905: Gold $39,837; silver, $22,933; copper, $45,914; total, $108,684. 1906: Gold, $49,112; silver, $45,578; copper, $167,716; lead, $798; total, $263,204.

This shows an increase of $154,520 for the year, mainly in copper, though all the metals increased somewhat. The principal feature of the 1906 production was the copper ore shipped from Mason district. Many properties are under development, but the only prominent 1906 shipper was the Ludwig Copper Mining Company, from which ores were shipped to the smelters of the Mountain Copper Company, in California. The production in the Pine Nut, Palmyra, and Silver City districts was small. In the Devils Gate and Chinatown district the principal producers were the Nevada Reduction Works, Comstock Mining and Milling Company, and the Oest Gold and Silver Mining Company.

NYE COUNTY.

Nye ranks second in output among the bullion-producing counties of the State. The production of gold, silver, and lead for the past two years is as follows: 1905: Gold, $1,342,547; silver, $3,292,727; lead, $10,497; total, $4,645,771. 1906: Gold, $1,484,749; silver, $3,845,701; lead, $941; total, $5,331,391.

This shows the total gain for the year for the county to have been $685,020, drawn from 30 deep mines and 4 placers. There were 109,574 tons of ore sold or treated, or 17,923 tons more than in the previous year. With the exception of small amounts of gold and silver from lead ores and placer mines the entire values were derived from dry or siliceous ores.

The producing mining districts in the county are Bellehelen, Bullfrog, Fairplay, Union, Round Mountain, Manhattan, Lodi Valley, Milletts, Reveille, Silver Bow, and Tonopah.

The principal district is Tonopah, which comes next in value of output to Goldfield, Esmeralda County. The producers at Tonopah in 1906 were as follows: Jim Butler Tonopah Mining Company, MacNamara Mining Company, Montana Tonopah Mining Company, Tonopah North Star Tunnel and Development Company, Tonopah Belmont Development Company, Tonopah Extension Mining Company, Tonopah Midway Mining Company, Tonopah Mining Company, and West End Consolidated Mining Company. The following table shows the output for the camp for 1904–1906, with the increase in each metal in 1906 over 1905.

Production of Tonopah district, Nye County, Nev., 1904–1906, in 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
1906	63,113.75	1,304,677	5,697,928	3,817,612	5,122,289
Increase	4,756.81	98,332	328,489	574,471	672,803

The amount of ore treated from this camp in 1906 was 106,491 tons, yielding $1,304,677 in gold and $3,817,612 in silver, or an average value per ton of $48.10, of which $35.85 was silver and $12.25 gold. All the ore from the camp in 1906 was shipped to smelters except that sent by the Tonopah Mining Company to Charles Butters & Co. for cyanide treatment. Over two-thirds of the silver output of the State came from Tonopah, the main values in the ores being in that metal as shown above. The tonnage of the camp would have been greater had the companies been able to get sufficient cars for all the shipments they desired, but the railroad was crowded beyond its car capacity.

The districts or camps tributary to Tonopah were only small producers in 1906, although some of them were quite active. Among these were the Bellehelen, which had one shipper, the Cornforth; the Millett one shipper, the Manuel Mining Company; the Reveille one, the Highland Boy Mining Company, and the Silver Bow two, the Silver Bow and Lucky Boy.

The shipments of ore from the Bullfrog district were comparatively small in 1906, but increased railroad facilities will soon stimulate the production. The mines reporting production were the Montgomery Shoshone Consolidated Mining Company, Skookum Bullfrog Mining Company, Gibralter Consolidated Mines Syndicate, and Tramp Consolidated Mining Company. The Berlin mine, in the Union district, had a smaller output than usual. The new district at Fairplay had many active mines, but the only 1906 shippers were the Griggs Attwood Mining Company, Attwood Mining Company, and Pactolus Mines Company.

The placer production in Round Mountain district was large for a new camp. Dry washers were operated and gave good results. Water was piped in 1907 to some of these placer properties, so that it is reasonable to expect a large increase in the placer output for the next year. While the gold and silver placer output of the State was $53,706, of which $4,703 came from hydraulicking and $9,875 from sluicing, the larger sum of $39,128 came from dry-washing operations in Round Mountain district—an exceptional amount to be derived from such a source. Two quartz mines, the Round Mountain Antelope Company and the Round Mountain Daisy Mining Company, are working in the district; both have small mills.

The producing mines in Manhattan district were the April Fool of the Seyler Humphrey Mining Company, Jumping Jack Manhattan Mining Company, Manhattan Dexter Mining Company, Stray Dog Manhattan Mining Company, and Wolf Tone Mining Company. Reduction plants will probably be installed by some of these companies, and many properties now idle will be encouraged to production when milling facilities are at hand. The metallic output of the camp amounted to 677 tons of ore, which yielded 3,873.58 fine ounces of gold, valued at $80,074, and 5,697 fine ounces of silver, valued at $3,817; a total value of $83,891.

The only other prominent producer in the county was the Lodi Mines Company, in Lodi Valley district.

STOREY COUNTY.

The production of gold, silver, and copper in this county for the past two years is as follows: 1905: Gold, $613,424; silver, $348,959; copper, $3,795; total, $966,178. 1906: Gold, $327,766; silver, $185,763; total, $513,529.

This shows a decrease in output for the year of about 50 per cent, or $452,649. There are only 15 producing properties in the county; all are deep mines, 10 of them having gold as predominating metal and 5 silver. The amount of ore sold or treated in the year was 39,407 tons, and there were 13,100 tons of old tailings treated, most of them by cyanide process. The returns are all from the famous old Comstock mines, the unwatering of which has progressed steadily with the exception of a temporary suspension due to lack of fuel and power. Those companies reporting product for the year were the Comstock Mining and Milling Company (Morgan and California plants), Alpha Mining Company, Overland Mining Company, Silver Hill Mining Company, Sierra Nevada Mining Company, Andes Mining Company, Chollar Mining Company, Hale & Norcross Mining Company, Kinkead Mining and Milling Company, Lady Bryan mine, Ophir Mining Company, Potosi Mining Company, Sutro Tunnel Company, and Cosmopolitan mine.

WASHOE COUNTY.

This county yielded $22,811 in 1905 and $70,240 in 1906, an increase for the year of $47,429. The principal feature of 1906 was the operation of the Nevada Commonwealth Mining and Milling Company in Washoe district. This company has a new 150-ton concentrator and was much the largest producer in the county in 1906. The ore carries gold, silver, and lead, the principal value being in lead. The only producer in Peavine Mountain district was the Reno Mizpah Company. Development was active in the White Horse district, although the output is comparatively small. The

Nevada Consolidated Mining and Milling Company has erected a new 50-stamp mill, with electric power, and is expected to become a large producer. The producing mines in this district in 1906 were the Emma L. Mining and Milling Company, Olinghouse Nevada Mining Company, Nevada Consolidated Mining and Milling Company, and Texas Nevada Gold Mining Company.

WHITE PINE COUNTY.

White Pine County shows a falling off of $69,508 from the total output of the preceding year. The largest gold producer was the Black Horse Mines Development Company, in the Black Horse district. The ore in this district is free milling and the values are nearly all gold. Development work is being actively carried on. The Hartford Nevada Gold Mining Company, in the Gold Canyon district, had a small output. The Vulcan Mining and Smelting Company, in the Hunter district, shipped a quantity of ore rich in silver, copper, and lead. The principal producing mines in the White Pine district, where the ores are mainly silver-lead, were the Julia No. 2, Rocco Homestake Nevada Mining Company, Ne Plus Ultra mine of the White Pine Lead Company, and the Young Treasure mine. The only other producer in the county is the Bay State mine, in the Newark district—a silver-lead ore carrying a small percentage of copper.

In the Ely district very extensive development work is being carried on by several copper companies, among which are the Nevada Consolidated Copper Company, which is erecting a concentrator; the Giroux Consolidated Mining Company, the McDonald Ely Copper Company, Butte and Ely Copper Company, Ely Consolidated Copper Company, Cumberland-Ely Mining Company, and others. There were no shippers in 1906.

NEW MEXICO.

By Chester Naramore.

PRODUCTION.

The producing mines of New Mexico reported to the United States Geological Survey a total gold output during 1906 of 14,174.80 fine ounces, worth $293,019, and a total silver output of 491,127 fine ounces, valued at $329,055. Compared with 1905, gold shows a decrease of $24,491 and silver an increase in quantity of 121,935 fine ounces and in value of $106,063. The difference in the price of silver augmented the total silver value in 1906. The total value of the precious metals increased $81,572.

Of the 71 properties reporting production in 1906, 52 were deep mines and 19 were placers, as against 52 deep mines and 21 placers in 1905. The tonnage from the lode mines (207,691 short tons) is an increase of 62,062 tons, or nearly 43 per cent over that of 1905 and almost double that of 1904.

The average total value per ton of ore handled in 1906 was $15.42, as compared with $16.21 in 1905 and $18.19 in 1904. This falling off is due to the increased quantity of copper and zinc ores treated, which are low in gold and silver values. The average value per ton in gold and silver for the siliceous ores handled in 1906 was $16.69, as compared with $11.18 in 1905.

Production of gold, silver, and associated metals in New Mexico in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−)	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	15,359.56	$317,510	14,174.80	$293,019	− 1,184.76	−$24,491
Silver..................do....	369,192	222,992	491,127	329,055	+ 121,935	+106,063
Copper.............pounds..	6,126,025	955,660	7,028,670	1,356,533	+ 902,645	+400,873
Lead..................do....	1,510,209	70,980	2,987,369	170,280	+1,477,160	+ 99,300
Zinc...................do....	15,142,254	893,393	17,292,655	1,054,852	−2,150,401	+161,459
Total.....................	....	2,460,535	....	3,203,739	....	+743,204

The above table shows that New Mexico gained $743,204 in the total value of the production of all five metals as compared with 1905. Though this is chiefly due to the greatly increased copper production, silver, lead, and zinc totals also greatly increased.

Production of gold, silver, copper, lead, and zinc in New Mexico in 1906, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Colfax.....................	9	....	701.06	$14,492	93	$62
Dona Ana..................	4	16,220	....	....	34,051	22,814
Grant......................	25	127,800	4,828.25	99,809	163,987	109,871
Lincoln....................	3	6,380	796.40	16,463	1,946	1,304
Luna.......................	8	1,994	19.98	413	11,265	7,548
Otero......................	4	268	20.46	423	533	357
San Miguel and Santa Fe...	7	229	748.08	15,464	68	46
Sierra.....................	6	3,246	873.07	18,048	8,102	5,428
Socorro....................	5	51,554	6,187.50	127,907	271,082	181,625
Total................	71	207,691	14,174.80	293,019	491,127	329,055

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Colfax................	....	....	....	....	....	....	$14,554
Dona Ana.............	434,000	$83,762	1,207,193	$68,810	....	....	175,386
Grant.................	6,388,830	1,233,044	710,895	40,521	144,656	$8,824	1,492,069
Lincoln...............	....	....	....	....	....	....	17,767
Luna..................	....	....	831,193	47,378	103,836	6,334	61,673
Otero.................	133,166	25,701	....	....	....	....	26,481
San Miguel and Santa Fe................	2,119	409	....	....	....	....	15,919
Sierra................	5,995	1,157	....	....	....	....	24,633
Socorro...............	64,560	12,460	238,088	13,571	17,044,163	1,039,694	1,375,257
Total...........	7,028,670	1,356,533	2,987,369	170,280	17,292,655	1,054,852	3,203,739

Tonnage of ore sold or treated, number of deep mines producing, and tenor of ores in New Mexico, in 1905 and 1906, by counties.

County.	Total tons of ore sold or treated.		Number of deep mines producing.	
	1906.	Increase (+) or decrease (−).	1905.	1906.
	Short tons.	*Short tons.*		
Colfax		− 13	1	
Dona Ana	16,220	+ 9,654	5	4
Grant	127,800	+46,640	17	21
Lincoln	6,380	+ 3,320	3	2
Luna	1,994	+ 648	5	8
Otero	268	+ 151	2	3
San Miguel and Santa Fe	229	− 156	6	4
Sierra	3,246	− 270	3	5
Socorro	51,554	+ 2,107	8	5
Rio Arriba, Taos, Valencia		− 19	2	
Total	207,691	+62,062	52	52
Average total value per ton			$16.21	$15.42

No new gold and silver fields were developed during 1906, but, taken as a whole, the condition of the mining interests of New Mexico is very encouraging for an increased output for 1907. The Territory is about to reap the benefit of several years of preparation, both by extensive development work at the mines and by the erection of reduction works and extension of transportation facilities. This is particularly applicable to Grant and Otero counties, in the southern end of New Mexico, where the largest operations are in progress.

Only 10 counties reported a production for last year, as compared with 13 counties in 1905; Rio Arriba, Sandoval, and Valencia counties reported only development work.

Number of mines in New Mexico, classed by chief product, in 1906, by counties.

County.	Gold placer mines.		Deep mines.							Total mines producing.
	Hydraulic.	Surface placers.	Gold.	Copper.	Zinc.	Gold-silver.	Gold-silver-copper.	Silver-lead.	Silver-copper.	
Colfax	6	3								9
Dona Ana				1				3		4
Grant		4		7	1	2	3	[a] 7	1	25
Lincoln						2				2
Luna					[b] 1			[c] 7		8
Otero		[d] 1					1		2	4
San Miguel		1		1					1	3
Santa Fe		3	2							5
Sierra		1	1			3	1			6
Socorro					[e] 4	1				5
Total	6	13	3	9	6	8	5	17	4	71

[a] One silver and one silver-lead-copper mine.
[b] Lead-zinc mine.
[c] One gold-silver-lead mine.
[d] Dry process.
[e] One silver-lead-zinc mine.

The total gold figures indicate a decrease of $24,491, due entirely to the reduced placer yield, which fell off $72,528, while the gold output from the deep mines increased $48,037. Sierra and Colfax counties are responsible for the decrease in placer gold.

It is very difficult to predict the gold production of the current year, since the placer output—the source of 31 per cent of the total gold yield in 1905—is so variable, showing a decrease of 74 per cent in 1906. But it is reasonably assured that, with the increased capacity of the reduction plants, the deep mines will show a substantial gain.

Source of gold production in New Mexico, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placer mines.	Deep mines.			Total.
		Siliceous ore.	Copper ore.	Lead ore.	
Colfax	701.06				701.06
Grant	110.78	4,363.47	346.94	7.06	4,828.25
Lincoln		796.40			796.40
Luna				19.98	19.98
Otero	9.43		11.03		20.46
San Miguel and Santa Fe	402.54	345.54			748.08
Sierra	73.00	793.06	7.01		873.07
Socorro		6,187.50			6,187.50
Total, 1906	1,296.81	12,485.97	364.98	27.04	14,174.80
Total, 1905	4,805.34	10,371.92	44.43	137.87	15,359.56
Increase (+) or decrease (−)	−3,508.53	+2,114.05	+320.55	−110.83	−1,184.76

The silver total shows a substantial increase of 121,935 fine ounces, due largely to the increased tonnage of copper ore, carrying silver, in Grant County. The Mogollon district also reported a gain over the previous year.

In 7 producing mines silver values predominate, the silver production of these mines being 310,752 fine ounces, or over 63 per cent of the total output for 1906.

Source of silver production in New Mexico, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placer mines.	Deep mines.				Total.
		Siliceous ore.	Copper ore.	Lead ore.	Lead-zinc ore.	
Colfax	93					93
Dona Ana				34,051		34,051
Grant	51	27,270	117,030	19,636		163,987
Lincoln		1,946				1,946
Luna				11,195	70	11,265
Otero			533			533
San Miguel and Santa Fe	9	50	9			68
Sierra	42	7,084	976			8,102
Socorro		268,567			2,515	271,082
Total, 1906	195	304,917	118,548	64,882	2,585	491,127
Total, 1905	662	295,484	19,962	53,084		369,192
Increase (+) or decrease (−)	−467	+9,433	+98,586	+11,798	+2,585	+121,935

Grant, Dona Ana, and Otero counties show noticeable gains in the production of copper, while Socorro and Sierra counties show a decrease. The counties rank in production in the above order, Grant County leading with a total of 6,388,830 pounds, or 91 per cent of the output of New Mexico. The above counties are grouped in the extreme southwestern corner of the Territory.

The increased output, coupled with the advance in the market price of copper, has made copper the most valuable product of the five metals in New Mexico. During 1906 its total value was nearly equal to the combined values of gold, silver, lead, and zinc.

The lead production of New Mexico for 1906 amounted to 2,987,369 pounds—almost double the output of 1905 and nearly equal to the production of 1904. There were large increases in Dona Ana, Grant, and Luna counties, but substantial decreases in Socorro and Lincoln counties. Dona Ana County nearly quadrupled its output of the previous year and again took the lead as New Mexico's foremost lead producer. The lead values constituted only about one-eighteenth of the total value of the five metals in 1906.

The production of zinc continues to gain. The output for 1906 amounted to 17,292,655 pounds, surpassing the figures of the previous year by 2,150,401 pounds. This increase was due entirely to the mines of the Magdalena district, in Socorro County, which produced 17,044,163 pounds—over 98½ per cent of New Mexico's entire output in 1906 and a gain of 2,414,112 pounds over this district's total for 1905. There was a large falling off of zinc production in Dona Ana, Grant, and Luna counties.

Zinc ore corresponding to 5,181,983 pounds of the metal are known to have been used in the manufacture of paint, so that the metallic zinc product would not exceed 12,110,672 pounds. 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.

The principal active concentrating plants were the Santa Rita Mining Company's 100-ton mill in the Central district, the Burro Mountain Copper Company's 250-ton plant at Leopold, and the 400-ton plant of the Comanche Mining and Smelting Company at Silver City, all in Grant County; the 100-ton mill belonging to the Mogollon Gold and Copper Mining Company in the Cooney district, in Socorro County, and the 50-ton plant of the Modoc Company in Dona Ana County.

The larger active gold and silver milling plants included the 100-ton mill of the Ernestine Company, in the Cooney district; the South Homestake Company's 20-stamp mill and the Eagle Mining and Improvement Company's plant, equipped with six 5-foot Huntington mills, both in Lincoln County, and the 20-stamp mill of the Empire Gold Mining Company, in Sierra County.

Subdivision of tonnage of ore sold or treated in New Mexico, in 1906, short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Total.
Dona Ana		3,200	13,020		16,220
Grant	1,903	[a] 122,752	2,978	167	127,800
Lincoln	6,380				6,380
Luna			1,793	201	1,994
Otero		268			268
San Miguel and Santa Fe	128	101			229
Sierra	3,237	9			3,246
Socorro	16,076		[b] 1,210	[c] 34,268	51,554
Total	27,724	126,330	19,001	34,636	207,691
Increase (+) or decrease (−)	−7,407	+55,884	+9,278	+4,310	+62,065
Average recovered value per ton in gold and silver	$16.69	$2.41	$2.44	$0.05	$2.99

[a] Includes 1,087 tons of copper-lead ore.
[b] Lead-zinc ore.
[c] Gold and silver values in larger mines not recovered.

NOTE.—The subdivision in this table is to some extent arbitrary, as doubts may exist concerning the classification of some ores. In round numbers, the copper ores averaged 2.7 per cent (dry copper assay); the lead ores 7.5 per cent (dry assay); and the crude zinc ores 32 per cent.

REVIEW BY COUNTIES.

Mining activity in Bernalillo and Chavez counties was confined to development work.

COLFAX COUNTY.

In 1906, nine placer mines contributed the entire output for Colfax County, which amounted to 701.06 fine ounces of gold, worth $14,492, and 93 fine ounces of silver, valued at $62. This represents a decrease of nearly 55 per cent in the gold output as compared with 1905, and a falling off of 84 per cent when compared with 1904. In the Moreno district, near Elizabethtown, the deep mines report a small amount of development work for last year. The Oro Dredging Company's dredge, below Elizabethtown, remained idle throughout the year.

DONA ANA COUNTY.

Metallic production of Dona Ana County in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	324.60	$6,710	21,776	$13,153	96,058	$14,985
1906			34,051	22,814	434,000	83,762

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	327,707	$15,402	30,000	$1,770	$52,020
1906	1,207,193	68,810			175,386

With but 4 mines producing, as compared with 5 in the previous year, Dona Ana County increased the total value of its metallic products to $175,386, which is over three times as much as in 1905.

No gold or zinc was reported for 1906, but the silver values gained over 73 per cent. The copper increased from 96,058 pounds to 434,000 pounds, and the lead from 327,707 to 1,207,193 pounds. The entire output was derived from the Organ district, about 15 miles northeast of Las Cruces. The copper ore is mainly oxidized, and occurs in contact of a metamorphosed limestone near intrusive granite. The lead ores are found in the less altered limestone a short distance from the contact.[a]

The famous Stephenson-Bennett mine made a considerable gain in its shipments of 1906. Likewise, the Torpedo mine began to make heavier shipments during the latter months of the year. The Modoc mine also greatly increased its production. This property is equipped with a 50-ton concentrator using jaw-crushers, rolls, Wilfley tables, and vanners. The Schermerhorn Mining Company made some trial shipments, and in addition stored considerable ore at the mine. Both the Dona Ana Mining Company and the Victoria Mining and Smelting Company report development work, with prospects of shipping in 1907.

GRANT COUNTY.

Metallic production of Grant County in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	2,225.60	$46,007	86,629	$52,324	5,291,222	$825,431
1906	4,828.25	99,809	163,987	109,871	6,388,830	1,233,044

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	321,035	$15,089	257,203	$15,175	$954,026
1906	710,895	40,521	144,656	8,824	1,492,069

Grant County, the source of almost 47 per cent of the total value of New Mexico's mineral output in 1906, more than doubled its gold production and almost doubled its silver output. This county ranks second in production of precious metals, with a total of $99,809 in gold and 163,987 fine ounces of silver. The placer output was considerably smaller than in previous years.

The chief product was copper, which amounted to 6,388,830 pounds, valued at $1,233,044. This represents nearly 91 per cent of the copper total, and a gain of 97,608 pounds over 1905. Lead, with a total of 710,895 pounds, more than doubled the product of 1905, but in turn the zinc output dropped off nearly one-half, and amounted to only 144,656 pounds.

Besides the 25 mines reporting a production, including the placers, 14 other mines report active development work and surface improvements. The Burro Mountain Mining Company, the Santa Rita Mining Company, and the Comanche Mining and Smelting Company are the three principal factors in making Grant County the premier

[a] Lindgren, W., and Graton, L. C., A reconnaissance of the mineral deposits of New Mexico, Bull U. S. Geol. Survey No. 285, 1906, pp. 74-86.

mining center of the Territory. To these three concerns is due the major portion of the production of the county, as well as the notable increase in tonnage, from 81,160 tons in 1905 to 127,800 tons in 1906. The Comanche Company, at Silver City, has contributed largely to the improved conditions. Its new plant, including a smelter and a 400-ton concentrating mill and narrow-gage railroad to the Pinos Altos and Burro Mountain districts, treats ores from its own mines at Pinos Altos and Chloride Flat, as well as custom ores from the Central district. The Burro Mountain Copper Company made a very large increase in its output for 1906. The ores of this section occur as chalcocite disseminated in porphyry.

Central district.—In the Central district a much greater tonnage was shipped from the famous Santa Rita mines. Some oxidized ore is still mined in this section, along with increasing quantities of chalcocite ores. The Copper Queen Consolidated Mining Company, the Hermosa Copper Company, and a number of other mines produced in this district in 1906.

Apache district.—Oxidized copper ores, carrying small values in gold and silver, were shipped from the Apache district, southeast of Hachita.

Eureka district.—Silver ores, carrying values in lead and copper, were shipped from the Eureka district, southwest of Hachita.

Increased shipments were made from each of the following districts:

Chloride Flat.—The Grand Central mine shipped crude silver-lead ores from the Chloride district, 2 miles west of Silver City, in 1905 and 1906.

Kimball district.—As in 1905, the sole producer from the Kimball district, near Steins, was the National Gold and Silver Mining Company's Beck mine, which is opened by a 300-foot vertical shaft and equipped with a 50-ton concentrator.

Pyramid district.—The Nellie Bly mine, in the Pyramid district, near Lordsburg, was acquired by the North American Copper Company, which extended the development work and increased the shipments of high-grade copper ores carrying silver.

Red Hill district.—In this district, in the southwestern corner of the county, high-grade oxidized lead-silver ores were produced from the Red Hill mine, which is opened by a 115-foot vertical shaft and a 275-foot tunnel.

San Simon district.—The Oblateese and Carbonate Hill mines, situated 4½ miles south of Steins, produced lead-silver-gold and copper-silver-gold ores. Developments on the former mine include a 70-foot shaft and on the latter a 130-foot tunnel. Reduced shipments of high-grade oxidized silver-lead ores were made from the Granite Gap mine, while a new shaft was being sunk.

Virginia district.—From near Lordsburg, in the Virginia district, copper ores, bearing some silver and gold values, were shipped from the Eighty-Five group, which are developed by a 250-foot shaft and 2,000 feet of drifts. Development work was reported from the Lordsburg mines, a group including about 65 claims.

In view of the increased transportation and reduction facilities, Grant County's tonnage of low-grade concentrating copper ore (especially of the Burro Mountain district) will probably show another very material gain during 1907.

LINCOLN COUNTY.

With but half the number of mines operating, Lincoln County made a greatly increased production of gold and silver in 1906—more than doubling the figures of 1905; but the small copper and lead output dropped off entirely. The placer production was also greatly reduced.

Bonito district.—In the Bonito district, in the southwest corner of the county, the Eagle Mining and Improvement Company operated the Hopeful mine, by open-cut work, for about three months only, reducing the ore in six 5-foot Huntington mills. A cyanide plant is being erected on this property. In the same vicinity the properties of A. L. Krouse, at Altos; the Iowa and New Mexico Mining and Milling Company and the Mescalero Mining and Milling Company both at Parsons; and the Nogal Peak Gold Mining and Milling Company, at Nogal, all report development work. The ore of the first two mines carries gold, silver, and lead, while the Mescalero ore is free milling. A few other properties in this section are semi-active.

White Oaks district.—In this district the Wild Cat Mining Company, operating the North Homestake mine, was the chief producer. The ore was run through the 20-stamp mill on the South Homestake mine. Development work continued in the Old Abe mine, at Whiteoaks. The Boston Boy and one or two other properties were active. In the White Oaks district well-defined veins and irregular sheeted zones are found, carrying rich auriferous pyrite with some quartz.[a] The Chicago and Sante Fe Smelting and Mining Company, in the Jicarilla district, and the Rising Sun property, in the Rociada district, also extended their development work during the year. Several of the larger placers were idle on account of lack of water.

LUNA COUNTY.

In Luna County the year was marked by increased productions of all metals except zinc, which fell off about one-third, while the total value of the metallic product showed a gain of more than one-third over 1905. The number of mines increased from 5 to 8 and the tonnage from 1,346 to 1,994 short tons.

Cooks Peak district.—This district, situated north of Deming, with 5 shipping mines, increased its production of both silver and lead.

Tres Hermanas district.—There was a falling off in the Tres Hermanas district, 30 miles south of Deming. Oxidized zinc ores of contact-metamorphic origin are found in large quantities in this section.

Victoria district.—Shipments of lead-silver ore were resumed from the old Rambler mine at Gage, in the Victoria district. The Jessie group reported development work.

Florida district.—Some small shipments were made from 12 miles southeast of Deming, in the Florida district, while development work was carried on at other properties, the ore being stacked on the dumps. The active mines include the Soledad, the Georgia, and the Sunny Slope.

MORA COUNTY.

No production was reported from Mora County, but considerable work was carried on at Lucero by the Republic Mines Company, which expects to produce during 1907.

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[a] Lindgren, W., and Graton, L. C., op. cit.

OTERO COUNTY.

The gain in value of the matallic product of Otero County was due mainly to increased activity in the Tularosa district. The Tularosa Mining Company has worked the Virginia mine by open cut and operated a concentrating plant. A considerable quantity of copper ore, low in silver, was shipped.

The Silver Hill district, in the vicinity of Brice, was the center of much development work. The Southwestern Smelting and Refining Company was building a concentrator and smelter, connecting the new plants with near-by properties by mine-gauge trams. The Electric Mining and Milling Company, while doing experimental work, produced a small amount of placer gold by dry process. The Calaveras Mining Association, at Brice, and the Lincoln Consolidated Copper Company, at Oro Grande, each made small shipments in 1906. Several other mines in this district were active last year.

RIO ARRIBA AND SANDOVAL COUNTIES.

Mining activity in Rio Arriba and Sandoval counties was limited to development and assessment work. In the latter county the Juratrias Copper Company, in the Nacimiento district, was developing its mine and erecting a new 50-ton furnace.

SAN MIGUEL COUNTY.

During 1906 mining in San Miguel County was limited to the Tecolote district, about 20 miles south of Las Vegas, and to the upper Pecos section. In the former district the Blake Mining, Milling, and Leaching Company remodeled its 100-ton leaching plant and resumed operations in December. In the latter the Pecos Copper Company exploited and developed the Hamilton mine, at Cowles.

SANTA FE COUNTY.

The entire production of Santa Fe County in 1906 was won from the New Placers district. At the Gold Coin mine, at Golden, some high-grade ore was extracted from the open cut and treated in a small custom Huntington mill. Likewise ore from the San Miguel and Old Timer properties, at the same place, was run as a test through a small 1½-ton mill. The Santa Fe Gold and Copper Mining Company's plant at San Pedro remained closed during the year, but resumed in 1907. Some development is reported from other mines in the district. The Gold Bullion Mining Company completed a traction dredge, which was ready to begin digging early in 1907, and the Racine Mining Company also experimented with a patented machine termed a "dry-land dredge." The Beta mine, in the Cerrillos district, reports development work.

SIERRA COUNTY.

The production in Sierra County shows a decided falling off, especially in gold and copper. The decrease in the former was $80,994, or about 82 per cent, and in the copper, 40,666 pounds, or over 87 per cent.

Black Range district.—Some gold-silver-copper ore was shipped both from the Ivanhoe and the Great Republic mines at Fairview, in the Black Range district, but most of the work was confined to development and the ore was stored on the dumps. A serious caving on the latter property ruined an 1,100-foot shaft and delayed production.

Bromide district.—This district, after a year's idleness, again made a production, two properties being worked in a small way. The silver mines of Lake Valley remain practically idle.

Las Animas district.—The Las Animas district, about Hillsboro, reports a greatly reduced output, but was the center of much activity in surface and mine development. The Empire Gold Mining and Milling Company ran their 20-stamp plate amalgamation mill only about one-half the year and used the remainder of the year to remodel it.

Pittsburg district.—Much less gold was won from the placer operations in the Pittsburg district than in 1905. Considerable work was done on the copper properties of the Victoria Chief Copper Mining and Smelting Company in opening up the mines and blocking out ore reserves preparatory to active mining in 1907. The ore is a sulphide carrying values in silver, zinc, lead, and copper. At the Nana mine some silver-lead-gold ore was sacked, but was not shipped during the year.

Cuchillo Negro district.—At the Black Knife group, in the Cuchillo Negro district, in the northern part of the county, development work resulted in placing some ore on the dump.

SOCORRO COUNTY.

Metallic production in Socorro County in 1905 and 1906.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
1905	5,680.91	$117,435	245,753	$148,435	615,175	$95,967
1906	6,187.50	127,907	271,082	181,625	64,560	12,460

Year.	Lead.		Zinc.		Total.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1905	390,000	$18,330	14,630,051	$863,173	$1,243,340
1906	238,088	13,571	17,044,163	1,039,694	1,375,257

Socorro County, with fewer mines in operation than in 1905, increased its tonnage and output of gold, silver, and zinc, as well as the total value of its metallic production, but showed large decreases in the output of copper and lead. This county is second to Grant County in the value of the total output, but holds first rank in gold, silver, and zinc production.

Cooney (or Mogollon) district.—In the Cooney (or Mogollon) district, in the southwest corner of the county, the Ernestine Mining Company was the largest operator last year. Its mine, the Last Chance, is developed by 770 feet of shafts and raises, 5,400 feet of levels, and 420 feet of cross cutting, and the surface equipment includes a 20-stamp mill and two Elspass mills, making a combined capacity of 100 tons per day. The latter mills were installed in December, 1905. Concentration is followed by cyanide treatment. The Enterprise Mining Company was engaged in developing its mine, which is equipped with a 3-stamp mill. The famous Cooney mine of the Mogollon Gold and Copper Mining Company is developed by a 625-foot vertical shaft, a 900-foot tunnel, and 4,000 feet of levels and has a 100-ton concentrating plant. A number of smaller mines confined their work to developing and stored what ore was extracted during the year.

Magdalena district.—The Magdalena district, the source of more than 98½ per cent of New Mexico's total zinc output, increased its production by shipping 35,478 tons of ore in 1906, as against 30,411 tons in 1905. There were approximately 23,000 tons of zinc carbonate ore, 11,700 tons of zinc-lead (sulphide) ore, 500 tons of lead carbonate ore, and 300 tons of copper and siliceous ores combined. Previously the bulk of the ores shipped were from shallow workings, and were oxidized, consisting of zinc, lead, and copper carbonates; but with greater depth an increasing percentage of sulphide ores, which occur as zinc blende, galena, pyrite, and chalcopyrite, are being mined. The Kelly mine, owned by the Tri-Bullion Smelting and Development Company, made a very large increase over its shipments of 1905. This property is opened by two shafts, respectively 265 and 346 feet deep.

The Graphic mine, owned by the Ozark Smelting and Mining Company (formerly the Graphic Lead and Zinc Company) made a greatly diminished output. The Juanita mine, owned by Mr. L. R. Babcock, shipped a larger amount of ore than in 1905. The workings on this claim include a 300-foot inclined shaft and a 500-foot tunnel. The shipments in 1906 included a small amount of high-grade quartzose silver ore. These properties have no reduction plants at the mines, since the ores are of high grade, averaging from 25 to 35 per cent zinc, and are shipped crude.

Other active mines in this district include the Mistletoe mine (formerly the Enterprise), which is being developed by the owners, the Ark Mining and Smelting Company; the Cavern mine, which has blocked out much ore, carrying lead, copper, and small values in gold, and which is equipped with a 50-ton concentrator; and the Wheel of Fortune mine, which was being developed during 1906.

Production of base metals in Magdalena district, Socorro County, in 1905 and 1906.

Year.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
1905	320,000	$49,920	390,000	$18,330	14,630,051	$863,173	$931,423
1906	64,560	12,460	238,088	13,571	17,044,163	1,039,694	1,065,725

There was also some activity in the Rosedale district, 30 miles north of west of San Marcial, and at Estey, in the southeastern corner of Socorro County, but no shipments were made. The principal product of the former district is gold and of the latter copper.

TAOS COUNTY.

No production was made in this county in 1906, but some development work is noted. A small quantity of low-grade copper, gold, and silver ores were mined during the year and stored on the dumps in the Rio Hondo and Red River districts, but at present the long haul to the railroad prevents these properties from being worked at a profit. The Tusas Peak Gold and Copper Mining Company, at Tres Piedras, reports 900 feet of crosscuts on 5 levels, and expects to start its 200-ton leaching plant during 1907.

OREGON.

By Charles G. Yale.

PRODUCTION.

The returns from producers show Oregon to have fallen off $91,844 in its total yield of 1906 as compared with the previous year. The decrease in gold is $38,335, in silver $1,582, in copper $51,852, and in lead $75. Consideration of platinum is omitted, it being the subject of a special report. The total metalliferous yield for the year was $1,500,312, this result being obtained from 279 productive mines, of which 74 were deep mines and 205 placers. Of these latter, 130 were hydraulic, 3 drift, and 72 surface sluicing ones. There were 598 mines reported which showed no yield for the year.

The decrease in gold and silver output is entirely from the quartz mines, and is occasioned mainly by several of the most prominent mines in both eastern and western Oregon having been operated to only a limited extent during the year. The total tonnage of ore from deep mines treated was 138,274 tons, a decrease of 11,994 tons from the previous year. Of siliceous ores treated there were 136,332 tons, a decrease of 6,342 tons from 1905. The average value of these latter in gold and silver was $7.67 per ton. The 1,942 tons of copper ore treated averaged $4.75 per ton in gold and silver.

A good water season caused an increase in output of placer gold of $109,941 over the year 1905. The most productive county was Jackson, with an output of $130,094 for the year, though this was closely followed by Josephine County with a production of $129,161. None of the other counties made a yield of as much as $100,000 from this source.

All the eastern Oregon mining camps show a decrease in output as compared with 1905. Jackson County, in southern Oregon, shows the largest increase in output. No new camps of prominence were developed during the year, nor were any new railroads built which affected the mining conditions.

The decreased output of copper was due to the difficulty in obtaining coke for the smelter of the Takilma Smelting Company at Waldo. The coke is hauled by wagon from Grants Pass.

Several new copper properties are being developed, but there were no new shippers in 1906. No production of lead was reported for the year.

The following table gives in a condensed form a statement of the comparative output of mines in Oregon for the years 1905 and 1906, with amount of increase or decrease in quantity and value of each metal:

Production of gold, silver, and associated metals in Oregon in 1905 and 1906.

Metal.	1905.		1906.		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.............fine ounces..	67,978.23	$1,405,235	66,123.79	$1,366,900	1,854.44	$38,335
Silver..................do....	90,636	54,744	79,346	53,162	11,290	1,582
Copper...............pounds..	846,815	132,102	415,803	80,250	431,012	51,852
Lead....................do....	1,610	75	....	....	1,610	75
Total..................	....	1,592,156	....	1,500,312	....	91,844

The following table gives the output in quantity and value of the respective counties of the State in 1906:

Production of gold, silver, copper, and lead in Oregon in 1906, by counties.

County.	Gold.		Silver.		Copper.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		*Pounds.*		
Baker................	33,652.22	$695,653	53,708	$35,984	185	$36	$731,673
Coos and Crook......	184.31	3,810	51	34	....	....	3,844
Curry................	362.76	7,499	71	48	....	....	7,547
Douglas..............	2,128.60	44,002	1,739	1,165	....	....	45,167
Grant................	2,665.08	55,092	3,719	2,492	42,886	8,277	65,861
Harney...............	5.32	110	....	....	....	....	110
Jackson..............	8,637.89	178,561	3,169	2,123	....	....	180,684
Josephine and Lane..	17,525.73	362,289	16,688	11,181	372,732	71,937	445,407
Malheur..............	687.26	14,207	121	81	....	....	14,288
Union and Wheeler..	234.47	4,847	75	51	....	....	4,898
Wallowa..............	40.15	830	5	3	....	....	833
Total..........	66,123.79	1,366,900	79,346	53,162	415,803	80,250	1,500,312

The following tables relate to the tonnage of ores sold or treated, concentrates produced, tailings treated, and to the character of the ores. In the first it will be noted that the largest proportion of the sulphurets are derived from Baker County, Douglas County being next in order. All the concentrates in Lane County are being held back on account of high cost of wagon freight from the mines to the railroad.

Tonnage and value of ore, concentrates, and old tailings in Oregon in 1906, by counties, in short tons

County.	Total tons of ore sold or treated.	Increase (+) or decrease (−) compared with 1905.	Concentrates produced.		Old tailings treated.	
			Tons.	Value.	Quantity.	Value.
Baker..............................	58,889	−16,164	2,556	$301,342	....	....
Coos and Crook....................	150	+ 150	....	....	....	....
Curry..............................	305	+ 280	....	....	....	....
Douglas............................	2,342	+ 2,135	121	19,148	....	....
Grant..............................	2,346	−10,316	125	12,407	200	$3,407
Jackson............................	9,644	+ 3,725	852	11,551	....	....
Josephine and Lane................	63,848	+10,641	63	5,710	500	5,050
Malheur............................	750	− 2,429	....	....	....	....
Union and Wheeler.................	....	− 16	....	....	....	....
Total..............................	138,274	−11,994	3,717	350,158	700	8,457

Subdivision of tonnage of ore sold or treated in Oregon in 1906, by counties, in short tons.

County.	Siliceous ore.	Lead ore.	Copper ore.	Total.
Baker	58,889			58,889
Coos and Crook	150			150
Curry	305			305
Douglas	2,342			2,342
Grant	911		1,435	2,346
Jackson	9,644			9,644
Josephine and Lane	63,341		507	63,848
Malheur	750			750
Total	136,332		1,942	138,274
Increase (+) or decrease (−)	−6,342	−16	−5.356	−11,894
Average value per ton in gold and silver	$7.67		$4.75	

The classification and numbers of deep and placer mines 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	164	18		11	29	22				22	51
Coos	6	1		2	3						3
Clackamas	2										
Crook	5			1	1	1				1	2
Curry	20	3		10	13	2				2	15
Douglas	40	9		8	17	3				3	20
Grant	92	10	1	4	15	10		2		12	27
Harney	5			1	1						1
Jackson	65	24		8	32	13				13	45
Josephine	99	52	2	22	76	15		1		16	92
Lake	2										
Lane	64					4				4	4
Malheur	8	6		1	7	1				1	8
Marion	5										
Union	9			1	1						1
Wallowa	10			2	2						2
Wheeler	2	7		1	8						8
Total	598	130	3	72	205	71		3		74	279

The sources of gold and silver by kinds of ore, with the amounts in fine ounces, are given in the following tables. Baker County yields the most gold from siliceous ores, while Jackson County has the most gold from placers. The largest amount of silver comes also from the siliceous ores of Baker County.

Source of gold product in Oregon, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placers.	Deep mines.			Total.
		Siliceous ores.	Copper ores.	Total.	
Baker	1,637.93	32,014.28		32,014.28	33,652.21
Coos and Crook	87.56	96.75		96.75	184.31
Curry	301.09	61.68		61.68	362.77
Douglas	453.27	1,675.32		1,675.32	2,128.59
Grant	1,562.42	941.47	161.19	1,102.66	2,665.08
Harney	5.32				5.32
Jackson	6,341.67	2,296.22		2,296.22	8,637.89
Josephine and Lane	6,248.16	11,007.40	270.17	11,277.57	17,525.73
Malheur	578.42	108.84		108.84	687.26
Union and Wheeler	234.47				234.47
Wallowa	40.15				40.15
Total	17,490.46	48,201.96	431.36	48,633.32	66,123.78
Increase (+) or decrease (−)	+5,318.40	−6,768.27	−404.58	−7,172.85	

Source of silver product in Oregon, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placers.	Deep mines.				Total.
		Siliceous ores.	Copper ores.	Lead ores.	Total.	
Baker	376	53,332			53,332	53,708
Coos and Crook	21	30			30	51
Curry	55	16			16	71
Douglas	87	1,652			1,652	1,739
Grant	415	3,155	149		3,304	3,719
Jackson	1,118	2,051			2,051	3,169
Josephine and Lane	1.103	15,280	305		15,585	16,688
Malheur	99	22			22	121
Union and Wheeler	75					75
Wallowa	5					5
Total	3,354	75,538	454		75,992	79,346
Increase (+) or decrease (−)	+1,409	−9,639	−1,371	−1,689	−12,699	−11,290

The source of the placer gold is shown in the following table. The hydraulic mines are by far the largest producers, they having yielded $305,446 in gold out of a total placer output of $361,560. The increase of gold from hydraulic mining was $78,406 for the year. The largest hydraulic output was from Jackson County, which also had the largest yield from ordinary surface placers.

Source of placer gold in Oregon in 1906, by counties.

County.	Hydraulic mines.	Surface placers, drift, and dredging.	Total value.
Baker	$21,732	$12,127	$33,859
Coos and Crook	960	850	1,810
Curry	2,253	3,971	6,224
Douglas	6,195	3,175	9,370
Grant	28,230	4,068	32,298
Harney		110	110
Jackson	116,594	14,500	131,094
Josephine and Lane	115,385	13,776	129,161
Malheur	10,872	1,085	11,957
Union and Wheeler	3,225	1,622	4,847
Wallowa		830	830
Total	305,446	56,114	361,560
Increase	78,406	31,535	109,941

REVIEW BY INDIVIDUAL COUNTIES.

BAKER COUNTY.

In Baker County, output is reported from the following districts: Baker, Virtue, Cracker Creek, Clarks Creek, Cable Cove, Cornucopia, Halfway, Connor Creek, Durkee, Geiser, Burnt River, Paddy Creek, Richland, Rye Valley, Sumpter, Weatherby, and Austin. The production of gold, silver, and copper in this county for the past two years is as follows: 1905: gold—$771,607; silver, $33,317; copper, $499; total, $805,423. 1906—gold, $695,653; silver, $35,984; copper, $36; total, $731,673.

The reduction in output for the year is thus shown to amount to $73,750. There were 58,889 tons of ore worked during the year, all siliceous, which is less by 16,164 tons than in the previous year.

Fifty-one mines reported product—22 deep gold mines and 29 placers, of which latter 18 were hydraulic and 11 sluicing mines. There were 164 nonproducing mines which reported. The total placer yield was small, amounting only to $33,859.

As usual the largest producing district in the county, and in the State, was Cracker Creek. The production of this district is not given separately, as the output of the principal producer might then be disclosed. The production, however, was slightly less than in 1905, on account of the operations of the Bourne Gold Mining Company having been confined to development work. The producers in the district in 1906 were the Eastern Oregon Mining Company (North Pole), Columbia Gold Mining Company, Mountain View Mining Company, J. B. Sipe Mining Company (Buckeye), Tabor Fraction Mines Company, and the Climax mine.

The old Cornucopia district was a large producer in 1906, the Union Companion, owned by the Cornucopia mines of Oregon, being again active and the new mill of the Stampede Mining Company being in operation. The district ranks second in output in the county. The Baker and Virtue districts only had two producers—the Virtue Mines Development Company and the Matoon Mining Company. In the Cable Cove district the only producer of note was the Imperial Gold Mining Company. In the Bonanza district the Consolidated Bonanza Gold Mining Company had a fair output, while the Pyx mine showed good results for the amount of ore treated. The only other large producing properties in Baker County were the Commercial Mining Company, in Rye Valley, which has a new 14-stamp mill, and the Connor Creek Mining and Milling Company, at Connor Creek, which operates a 50-stamp mill. Other Baker County producers are the Cincinnati, Oregon Free Gold Mining Company (Colorado), and Gold Coin Mining Company, in the Durkee district; the Vulcan, in the Paddy Creek district; the May Queen, at Rye Valley; the Danæ Gold Mining Company, in the Chicken Creek district; and the Golconda Consolidated Mines Company, at Sumpter. None of the placer properties were large producers. The largest production came from the mines in the Rye Valley, Burnt River, Clarks Creek, and Durkee districts.

COOS, CROOK, AND CURRY COUNTIES.

Only three producing deep mines reported from these counties, viz, the Mayflower at Howard, and the Cooley and Miller and the Higgins, in the Chetco district. The placers in Coos and Crook counties are few in number and have made only small outputs. There are a number of placers in Curry County, the most prominent of which are the Elk River and Big Jewel in the Sixes River district.

DOUGLAS COUNTY.

Douglas County produced $45,167 in 1906, all but a little over a thousand dollars being gold. This is an increase of $25,725 for the year, or more than double the output of 1905. The production of quartz mines was $34,632. The largest producers were the Continental Mining Company, in the Finch Creek district; the Little Chieftain mine, in the same district; and the Tina H. Mining Company, in Dothan district. The principal producing placers (none of which are large ones) are in the Green Mountain, Riddles, Olalla, Excelsior, and Myrtle Creek districts.

GRANT AND HARNEY COUNTIES.

Grant County shows a falling off of $37,493, from the previous year's record, this being due entirely to the fact that the mines of the Susanville Commercial Company were inactive. Other portions of the county—Canyon, Granite, Quartzburg, and Greenhorn—showed increased activity during the year. The most active district was the Quartzburg, which had four producers, viz, the Gold Issue Mines Company, Equity Gold and Copper Company, Present Need Gold Mines Company, and Standard Consolidated Mines Company. The only quartz producers in the Granite district were the Buffalo-Monitor, which was operated by lessees, the Ajax, and the Morris, the last being a silver property. Most of the mines in Greenhorn district were nonproductive, and those which reported any yield only milled 171 tons of ore all told. The placer mines in the Canyon and Granite districts produced $32,298 in gold. The principal ones are the Fitch and Roddich, Dart & Yorgenson, C. L. Roddich, Western Development Company, and the Steuben Placer Mining Company.

Harney County had only a nominal output from a placer property.

JACKSON COUNTY.

Jackson shows the largest increase in output for the year of any county in Oregon. The production of gold and silver for the past two years is as follows: 1905—gold, $90,100; silver, $512; total, $90,642. 1906—gold, $178,561; silver, $2,123; total, $180,684.

This shows a total increase of over $90,000 for the year. This increase came almost entirely from the placer mines of the county, which yielded $86,691 more in gold than in the previous year. The largest quartz producer is the Opp Mines Company, near Jacksonville. The Gold Hill district has four producing gold mines, viz, Condor Water and Power Company, Lucky Bart, Braden, Houch, and Bill Nye Mill and Mining Company. The Applegate, Ashland, and Willow Springs districts had a few quartz producers, but their combined output was small. Thirteen deep mines and 32 placer mines in all report production. Of the placers the greatest number are in Foots Creek district, the most important being the Glen Ditch, Carr, Black Gold Channel Mining Company, and Lance. The largest producing hydraulic mine in the State was the Sterling Mining Company, of Jacksonville. Other districts having producing placers in 1906 were Applegate, Willow Spring, Blackwell, Sardine Creek, Sams Creek, Watkins, Evans Creek, and Pleasant Creek or Woodville.

JOSEPHINE AND LANE COUNTIES.

Next to Baker the combined output of these counties is larger than any in the State of Oregon. The production of gold, silver, and copper for the past two years is as follows: 1905—gold, $401,986; silver, $3,908; copper, $131,447; total, $537,341. 1906—gold, $362,289; silver, $11,181; copper, $71,937; total, $445,407.

In this, as in other tables, the platinum output is omitted, that metal being considered in separate reports. The production of the two counties is combined to avoid making public the result of certain mining operations in one of them. The production shows a decrease in quartz output, but there is an increase of $7,771 in placer gold. There are 76 placer mines reporting product in these counties, 52 of which are hydraulic properties. Of the quartz mines 16 report output in 1906. There were more mines in operation in 1906 than previously, but litigation prevented work in some former producers, this being really the cause of the decrease in output for the year. The quartz mines output shows a decrease in both Josephine and Lane counties, owing to the partial suspension of operations at the properties of the Greenback Gold Mining Company and the Lucky Boy Mining Company, two of the largest mines in western Oregon. Still there were 63,848 tons of ore treated in the two counties, which is an increase of 10,641 tons over the previous year. The gold output was less for the year by $39,697 and the copper output by $57,510, the latter being caused by a short supply of fuel for the Takilma smelter.

Grave Creek district was the largest producer of gold both from quartz and placer mines, and had more producers than any other district. Some of the larger quartz producers in the district were the Greenback Mining Company, Martha Mining Company, and Hammersley mines. Among the most productive placers in the district were the Brownstone Creek, Crackerjack, Steam Beer, and Columbia Mines Company. In the Missouri Flat district the Mountain Lion is the most important productive property. The Althouse district has many small placer mines but no large producers. The most important of the numerous placer mines in the Galice Creek district are the Old Channel Mining Company, Stratton Creek, and Galice Consolidated Mines Company. There are three quartz producers in the district, but their output is small. The Granite Hill mine, in the Louse Creek district, operated a 20-stamp mill during the year. In Sucker Creek district there were several productive placers and one productive quartz mine, the Gold Pick. In the Josephine district the yield was almost entirely from placer properties, the principal producers being the Flint-Lock, Morrison, and Wilson hydraulic properties.

The Waldo district was quite active, although the Takilma Smelting Company did not have as large an output as in the previous year. Among the prominent placers in the district are the Deep Gravel Mining Company, Logan & Co., and Allen Gulch. The Jump-Off-Joe district reports a small output from two quartz mines and a few placers. There were many productive placer mines in the Picket Creek, Dry Diggings, Williams Creek, Selma, Murphy, and Wolf Creek districts, the largest of which were the Rubli and the Vindicator Placer Mining Company, at Wolf Creek. No placer output was reported from Lane County, while the only producing quartz mines are the Oregon Securities Company, in the Bohemian district, and the Great Northern Development Company, Lucky Boy Mining Company, and Union Mining Company, in the Blue River district.

MALHEUR, UNION, WHEELER, AND WALLOWA COUNTIES.

The combined output of these counties shows a reduction of $6,651 from the previous year. In Malheur one quartz mine reports product—the Black Eagle Mining Company—and seven placer mines, the most important of which is the Colts Brothers hydraulic property. The production in Union and Wallowa counties is confined to that of several small placers, while the only producing district in Wheeler County is the Spanish Gulch.

SOUTH DAKOTA.

By Chester Naramore.

PRODUCTION.

During the calendar year 1906 the mines of South Dakota produced 330,956.06 fine ounces of gold, equivalent to $6,841,469, and 150,875 fine ounces of silver, valued at $101,086, at the average commercial price for 1906. This is a decrease of $148,023 in gold and 31,874 fine ounces of silver from the output of 1905. In addition to the precious metals, 22,719 pounds of lead, valued at $1,219, were produced. Twenty-nine deep mines reported a production in 1906 of 1,780,674 short tons of siliceous ores, averaging $3.90 in gold and silver, as compared with 1,837,411 tons, averaging $3.86 in 1905. This is an increase of 9 mines, but a decrease of 56,737 short tons. There were only 6 active placer mines, as compared with 12 producers in 1905.

The siliceous ores are divided into the free-milling ores of the Homestake type and refractory ores, which are either cyanided or smelted.

There were 1,448,450 short tons of the former type, averaging $3.70 per ton in gold and silver values, and 332,225 short tons of the refractory ores, with an average value per ton of $4.73.

Production of gold, silver, and associated metals in South Dakota in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	338,116.70	$6,989,492	330,956.06	$6,841,469	−7,160.64	−$148,023
Silver..................do....	182,749	110,381	150,875	101,086	− 31,874	− 9,295
Lead..............pounds..	(a)	(a)	22,719	1,295	+ 22,719	+ 1,295
Total....................	....	7,099,873	....	6,943,850	....	− 156,023

a None reported.

Although the total figures show a slight falling off from those of 1905, it is not to be interpreted that there was a decline from the previous prosperous conditions. On the contrary, the year was marked by a large amount of permanent improvements made by various companies, these being especially noticeable in the number of new mills erected and alterations made in old mills.

The completion of the power plant at Pluma made electric power accessible to the different mines and mills at a reduced cost. During the year 5 additional mills began using this source of power. Another power plant is being installed below the juncture of Red Water and Crow creeks and will probably begin furnishing power to the mines and mills during 1907. Many isolated low-grade properties will derive much benefit from these installations, as the cost of hauling fuel has heretofore often been prohibitive to their successful operation.

The Standard Smelting Company at Rapid City (formerly the National Smelting Company) began operations about July 1 and continued throughout the year, thus furnishing a nearer market for the "blue ores" of the district. "Blue ores" is a local term for the unoxidized siliceous ores carrying finely disseminated pyrites.

The opening months of 1907 brought two misfortunes to the mining industry in the Black Hills. Except for the Homestake Mining Company, most of the larger mines were closed early in January because of labor troubles and failed to resume operations till the first part of June. Again, a serious fire started in the famous Homestake mine on March 25 and gained such headway that it was found necessary to flood the workings. The fire was extinguished May 29 and pumping was begun immediately; but, in consequence, the mills of the company were either closed or run on reduced tonnage of surface ores from the open cuts. These two hindrances will reduce the output for 1907 materially, while otherwise the year early gave promise of being a banner one, because of the greatly increased milling facilities.

Source of gold and silver production in South Dakota in 1906, by kinds of ore, in fine ounces, with tons of ore treated from deep mines.

County.	Gold.			Silver.			Total tonnage siliceous ore sold or treated in 1906.
	Placer.	Deep mines: Siliceous ore.	Total.	Placer.	Deep mines: Siliceous ore.	Total.	
Custer and Pennington	26.90	1,195.67	1,222.57	3	335	338	9,297
Lawrence	275.44	329,458.05	329,733.49	70	[a] 150,467	150,537	1,771,377
Total	302.34	330,653.72	330,956.06	73	150,802	150,875	1,780,674
1905 total	443.27	337,673.43	338,116.70	52	182,697	182,749	1,837,411
Increase (+) decrease (−)	−140.93	−7,029.71	−7,170.64	+21	−38,934	−38,913	−56,737

[a] Includes small amount of silver from lead ores.

The silver accredited to siliceous ores contains a small amount won from lead ores. It would not be possible to separate them without making public the productions of single mines. Custer and Pennington counties have been listed together in this table for like reasons.

PRODUCTION BY COUNTIES.

CUSTER COUNTY.

Custer County, locally spoken of as the Southern Hills, reports very little production for the year 1906. The gold output amounted to $687, as compared with $706 in 1905, and a portion of this resulted from performing annual assessment work.

A number of mines report some development work during 1906. Among the active properties may be included the New York and Custer Mining Company; the Ideal Mining and Milling Company, with properties about 12 miles northeast of Custer on Iron Mountain; the Le Roy Mining and Milling Company; the Elephant Placer mine; the Granite Reef Mining Company, 2 miles southeast of Custer on Mill Creek, and the Empire Baker group of mines. All of these concerns have their headquarters at Custer. The first two of these companies report installation of new hoists, preparatory to more active work in 1907.

The mining activity in this section during the past year was largely confined to the mica mines, with main workings located about 5 miles from Custer.

LAWRENCE COUNTY.

The production of Lawrence County, which represents nearly the entire output of South Dakota, shows a decrease of 54,800 short tons, of $139,494 in gold, and of 32,060 fine ounces of silver. The lead production amounted to 22,719 pounds and was derived from ores shipped chiefly as test runs.

Production of gold and silver in Lawrence County in 1905 and 1906, in fine ounces.

Year.	Gold.		Silver.		Total.
	Quantity.	Value.	Quantity.	Value.	
1905	336,481.53	$6,955,690	182,597	$110,289	$7,065,979
1906	329,733.49	6,816,196	150,537	100,860	6,917,056

The above production was derived from 23 deep mines and 4 placers, as against 15 deep mines and 4 placers during 1905. The decrease is due in a measure to the temporary idleness of several large mills pending alterations. Generally speaking, wet-crushing machinery superseded the old dry system, and electric power largely displaced steam plants.

Of great importance to the district was the adoption of the 8-hour schedule for all classes of labor. The Homestake Mining Company, which employs more than half the workmen in the district, conceded this, but other operators refused and a shut-down of several mines for five months ensued. The matter was finally compromised.

Of the mining companies the Homestake naturally draws first attention. This company increased its production nearly $150,000. Its ores are free milling and are handled in mills aggregating 1,000 stamps followed by 4 full-sized plates. Cone classifiers receive the tailings and send the sands to the cyanide vats and the slimes to the new filter-press plant. This last, erected at a cost of about half a million dollars, was completed late in the year. It has been so often described in the technical journals that it need only be added that with 10 of the 26 large new filter presses in operation, handling about 650 tons per day, it was demonstrated that the plant would accomplish the task planned for it and make the savings desired.

Following are the cyanide plants of Lawrence County:

The Golden Reward Company's mines at Bald Mountain and Ruby Basin held their own in production during the year, in spite of the fact that it closed its 200-ton cyanide mill at Deadwood in the fall, in order to change from dry to wet crushing, and thereby increase its capacity somewhat. This company's smelter at Deadwood was idle throughout the year.

The Gilt Edge Maid Gold Mining Company operated its property at Strawberry Gulch, 2 miles west of Galena, about seven months during 1906, and changed its mill from fine wet crushing to coarse dry crushing, increasing its capacity to 200 tons per day. The ores are refractory.

The Wasp No. 2 Mining Company, on Yellow Creek, near Kirk, increased its production slightly over that of 1905. This company enlarged its cyanide mill from a 125-ton to a 200-ton dry-crushing plant. It operates principally on quartzite ores from the Potsdam.

The Spearfish Gold Mining and Reduction Company furnishes a printed report, in which the statement is made that its mine at Cyanide, in the Ragged Top district, is practically worked out. This will close a 200-ton cyanide mill.

The two 200-ton mills of the Eleventh Hour and Victoria companies, which were completed in the spring of 1906, shut down after a short campaign. The former is a dry-crushing cyanide plant. The mines of both these companies are situated in Ida Gray district.

The output of the properties of the Maitland Company, at the town of Maitland, with a 40-stamp wet-crushing cyanide plant, decreased about one-half. The management attributes this falling off almost entirely to the inability of the railroads to furnish sufficient fuel. This company operates on the Potsdam siliceous ores, both oxidized and blue (or unoxidized) ores being found. The former only is sent to the cyanide plant.

The Golden Crest Mining Company, near Galena, has installed electric power in its 50-ton mill and resumed operations.

The Lundberg, Dorr & Wilson mill operated the entire year.

The Clinton Mining and Mineral Company and the Portland Mining Company, at Portland, in the Bald Mountain district, are operating under one management. Both properties were regular shippers in 1905 to the Lundberg, Dorr & Wilson cyanide mill and to the smelters.

The Dakota Mining and Milling Company produced about the same quantity and grade of ore from its mines at Bald Mountain as in 1905. This concern has a 100-ton wet-crushing cyanide mill in Deadwood.

The Imperial Gold Mining Company, besides doing a large amount of development work at the mine on Bald Mountain, made a slight increase in tonnage and a notable gain in values saved per ton at its 150-ton dry-crushing cyanide mill at Deadwood.

The Reliance Gold Mining Company began operations in its new 150-ton wet-crushing cyanide mill on December 10, but closed down on account of labor troubles early in January. This mill differs from the majority of the mills of the Black Hills in being located at the mine on Bald Mountain.

The Mogul Mining Company (formerly the Horseshoe Mining Company) shipped a greatly reduced tonnage from its mines in Bear Gulch and Ruby Basin, on Bald Mountain, to the Lundberg, Dorr & Wilson cyanide mill and to the smelters, but by handling only the higher grade stuff the total values saved almost equaled the figures of the previous year. This reorganized company remodeled the old Kildonan mill at Pluma (originally a chlorination plant, and later a dry-crushing cyanide plant) into a modern wet-crushing cyanide mill, in which the slimes are treated by a modification of the Moore process.

A 20-stamp mill, followed by concentration and cyaniding, is being operated by the Puritan Mining and Milling Company.

The Branch Mint Gold Mining Company, at Galena, spent an active year in equipping its property, including the construction of 3 miles of railroad and a 120-stamp wet-crushing cyanide mill.

The property of the Hidden Fortune Gold Mining Company, which adjoins the north end of the Homestake, has been taken over by the neighboring concern, the Columbus Consolidated Mining Company. Both these mines have ore similar in character to the Homestake.

In addition, the following mines reported development work in 1906: Coolgardie mine, Eliptic Mining Company, Gold Hill Mining Company, Gregory Gold Mining Company, Gordelia Mining Company, Hidden Treasure Gold Mining and Milling Company, King Solomon Mining Company, Minnesota Mining Company (erecting a 200-ton cyanide mill), and Tinton Mining Company.

PENNINGTON COUNTY.

Pennington County, locally referred to as the Central Hills, produced 1,189.34 fine ounces of gold, worth $24,586, and 335 fine ounces of silver, valued at $224, from 9,281 short tons of ore. This is a decrease of 1,939 tons and $8,510 in gold, but an increase of 186 fine ounces of silver. The 1906 production was obtained from 6 mines, as compared with 8 producers the year before, but there were more deep mines in operation, while the placer output fell off considerably.

The past year witnessed the reopening of the smelter at Rapid City after two years of idleness, the completion of the Crouch Railroad between Rapid City and Mystic, and a moderate amount of development work in the old mines. The smelter depends upon the Bald Mountain section of Lawrence County for the bulk of its ores, while the copper ores are brought in from other States.

Considerable notice has been given to the production of pig tin by a small experimental plant, consisting of stamps, concentrating tables, and a small furnace, which was erected at the Gertie mine, formerly belonging to the famous Harney Peak Company.

Early in the year 1906 the reorganization of the old Holy Terror-Keystone property at Keystone was effected, with the Egyptian mine included in the new company. Several improvements were installed and considerable development work undertaken, but the property did not begin producing regularly during the year.

The Benedict mine, of the Golden West Mining Company, located about 4 miles southwest of Rochford, was operated about three months in 1906. This property is equipped with a 100-ton Chilian mill, and the ore is free milling.

Considerable work was done on the holdings of the Clara Belle Mining Company, on Mineral Ridge, including the erection of a new hoist and the sinking of a double compartment shaft for 250 feet. The equipment includes one 2-stamp and one 10-stamp mill, both using plate amalgamation. These mills were operated a portion of the year. A cyanide plant is being erected.

THE SOUTHERN APPALACHIAN STATES.

By H. D. McCaskey.

INTRODUCTION.

The precious metals obtained from the Southern Appalachians are found in placers and in lenticular quartz veins and are also recovered from ores of a number of copper mines. Some of the most important gold ore deposits in the central Carolinas and in the Dahlonega district of Georgia have been recently described by Graton and Lindgren,[a] and are thought by the former author to belong to two types—fissure veins and replacement deposits. Among other recent writers whose general contributions to the subject of the southern ore deposits are important are Becker,[b] Nitze and Wilkens,[c] Weed,[d] and Eckel.[e]

Although silver ores have been rare and relatively unimportant, they have been reported from certain North Carolina mines, notably the Silver Hill, where native silver and argentiferous galena occur. The silver obtained is usually found in intimate association with gold, copper, or lead, and is not from the characteristic ores of this metal. Chalcopyrite is found as the chief copper ore, associated with pyrrhotite and pyrite. The original sulphide ore bodies have been largely oxidized near the surface, and secondary enrichment has taken place, notably at Ducktown, Tenn. The raw sulphides generally form the ores worked at the present time.

PRODUCTION.

The total production of gold and silver in the Appalachian States from 1800 to 1900 has been placed at $47,000,000. This would average $470,000 per year. The following has been the production for the last six years:

Production of gold and silver (silver at commercial value).

1900	$307, 017
1901	362, 953
1902	378, 953
1903	307, 266
1904	430, 482
1905	454, 376
Total	2, 241, 047
Average	373. 508

The total production of gold and silver for the Southern Appalachians for the year 1906, as obtained by the Survey from direct information from the producers, supplemented in some cases by information courteously given by the Charlotte (N. C.) assay office, and by the Director of the Mint, amounted to $295,535, showing a decrease from the production of 1905 of $158,841. Of this decrease a comparison of the tables below with those given last year shows a decrease in gold of $146,670 and in silver of $12,171.

The falling off in annual average production of the Southern Appalachians is probably due to several causes, among which may be noted: (1) Decreased interest, not always deserved, perhaps, due to discoveries of greater immediate promise elsewhere, or to failure from ineffectual management; (2) increased difficulty with depth in many cases in mining and treating the ores at a profit; (3) temporary sus-

[a] Graton, L. C., Reconnaissance of some gold and tin deposits of the Southern Appalachians, with notes on the Dahlonega mines by Waldemar Lindgren: Bull. U. S. Geol. Survey No. 293, 1906.

[b] Becker, G. F., Gold fields of the Southern Appalachians: 16 Ann. Rept. U. S. Geol. Survey, pt. 3, 1895, pp. 251-331.

[c] Nitze, H. B. C., and Wilkens, H. A. J., The present condition of gold mining in the Southern Appalachian States: Trans. Am. Inst. Min. Engrs., vol. 25, 1896, pp. 661-796, 1021, 1025.

[d] Weed, W. H., Types of copper deposits in the southern United States: Trans. Am. Inst. Min. Engrs., vol. 30, 1901, pp. 449-504.

[e] Eckel, E. C., Gold and pyrite deposits of the Dahlonega district, Georgia: Bull. U. S. Geol. Survey No. 213, 1903, pp. 57-64.

pension of all but development work for the purpose of increasing the capacity or profit of metallurgical processes involved; (4) in some cases the impoverishment of the ore bodies; and (5) lack of labor.

Production of gold and silver in Southern Appalachian States in 1906, by States, in fine ounces.

State.	Gold.		Silver.		Total value.	Increase (+) or decrease (−) in value compared with 1905.	
	Quantity.	Value.	Quantity.	Value.		Gold.	Silver.
Alabama	1,205.51	$24,921	124	$83	$25,004	−$16,609	− $120
Georgia	1,502.05	31,050	599	402	31,452	− 65,860	− 226
Maryland						− 14,821	− 56
North Carolina	3,973.16	82,131	30,769	20,615	102,746	− 43,554	+ 8,396
South Carolina	3,819.63	78,959	92	62	79,021	− 16,152	− 5
Tennessee	234.06	4,838	55,931	37,474	42,312	+ 476	−20,221
Virginia	717.50	14,832	250	168	15,000	+ 9,850	+ 61
Total	11,451.91	236,731	87,765	58,804	295,535	−146,670	−12,171

Number of producing mines, ore production, and average value of gold and silver per ton in Southern Appalachian States in 1906, by States.

State.	Number of mines.			Ore production from deep mines, and average value in gold and silver, per short ton mined.				
				Total short tons from deep mines.	Dry or siliceous ores.		Copper ores.	
	Placer.	Deep.	Total.		Short tons.	Average value.	Short tons.	Average value.
Alabama and Virginia		2	2	9,565	9,565	$4.17		
Georgia	8	6	14	2,150	1,880	6.00	270	$10.32
North Carolina	9	15	24	20,368	8,074	7.70	12,294	2.12
South Carolina	2	4	6	49,327	49,327	1.60		
Tennessee	1	2	3	538,141			538,141	[a].08
Total	20	29	49	619,551	68,846	2.79	550,705	.13

[a] Average value extracted electrolytically only.

In the consideration of the average values in gold and silver of the copper ores it should be noted that a portion of the copper is not electrolytically refined, but is made into casting copper, and that some of it is exported before the recovery of the precious metals, and that therefore whatever gold and silver may later be obtained from it is not known. The average commercial value of silver was $0.67 per ounce during 1906.

Source of gold and silver in Southern Appalachian States in 1906, by States, in fine ounces.

State.	Gold.			Silver.		
	Placers.	Dry or siliceous ores.	Copper ores.	Placers.	Dry or siliceous ores.	Copper ores.
Alabama		1,205.57			124	
Georgia	839.48	545.17	117.40	34	28	537
Maryland						
North Carolina	575.96	3,010.70	386.50	133	623	30,013
South Carolina	13.06	3,806.57		2	90	
Tennessee	52.06		182.00			55,931
Virginia		717.50			250	
Total	1,480.56	9,285.51	685.90	169	1,115	86,481
Increase (+) or decrease (−)	−553.44	−6,576.49	+34.96	−41	−2,864	−26,839

PRODUCTION BY STATES.

ALABAMA.

The State of Alabama produced, in 1906, 1,205.51 fine ounces of gold, valued at $24,921, and 124 fine ounces of silver, valued at $83. This shows a decrease of $16,609 in gold and of $120 in silver, as compared with 1905.

Alabama produces no copper, lead, or zinc, the entire extraction being of dry or siliceous ores.

The southern gold belt crosses the east-central part of the Georgia-Alabama line and terminates in the center of the State. Both gold-quartz veins and placers have been productive in the past, but the yield reported for 1906 has been from deep mining alone. The quartz veins occur in gneisses, schists, and slates, as fissures or in bedded and lenticular form. The general strike of the veins and of the inclosing rocks is northeast-southwest. Of the gold-producing counties, which are Chilton, Clay, Cleburne, Coosa, Elmore, Randolph, Talladega, and Tallapoosa, including an area of about 3,500 miles, the latter alone was productive in 1906.

Much detailed information on the gold districts of Alabama may be had from bulletins of the State survey.[a]

In Clay County the Idaho mine has not been in operation for four years. In Cleburne County the placers of Arbacooche and Chulafinney and the Mossback and Lucky Joe mines have reported no production for the past year, and the Gold Ridge mines have confined their work to development, the ore extracted in the driving of an inclined shaft not yet having been treated. At Clear Creek there is a dredge from whose operations returns have not yet been made. At the Mossback and at the Lucky Joe mines of the Turkey Heaven district there are 10-stamp mills and at the Gold Hill mine there is a steam 2-stamp mill. In Randolph County, at the Pinetuckey mine, there is a 20-stamp mill equipped with Wilfley tables, but production has been suspended while making changes in process of extraction. This mine had been developed in 1905 by two vertical shafts, 80 and 125 feet in depth, one incline shaft, and about 600 feet of tunnels. In Tallapoosa County the extraction at the Dutch Bend mine was small owing to the suspension of operations in the middle of the year. This mine is equipped with a 20-stamp mill and a cyanide plant. The Tallapoosa Mining Company, which produced in 1905 and began again in 1907, reported no output for 1906. A 5-stamp mill with 1,050 pound stamps and a 20-ton cyanide plant were in course of erection in 1906. This mine was opened by a 100-foot shaft and a 185-foot slope. At the Hog Mountain mine, which was a producer during 1906, the Hillabee Mining Company treat their ore in a 40-ton dry-crushing plant and by the cyanide process. The mine is developed by a 100-foot shaft and by 350 feet of drifts.

GEORGIA.

The production of Georgia for 1906 is given as 1,502.05 ounces of gold, valued at $31,050, and 599 ounces of silver, equivalent to $402.

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[a] Phillips, W. B., Bull. Geol. Survey, Alabama, No. 3; Brewer, Wm. A., Bull. Geol. Survey Alabama-No. 5.

This shows a decrease in the gold output of $65,860 and in the silver of $226 as compared with the production of the previous year. It is estimated that there were 8 placer and 6 deep mines in operation during the year, and that a total of 2,150 short tons were extracted from the deep mines. Of this, 1,880 tons, with an average extraction in precious metals of $6, were dry or siliceous ores, and 270 tons, with an average extraction in gold and silver of $10.32, were copper ores. Of the gold production, 839.48 fine ounces were obtained from placers, 545.17 ounces were from dry or siliceous ores, and 117.40 ounces were from copper ores. Of the silver, 34 ounces came from the placers, 28 ounces from the dry or siliceous ores, and 537 from the copper ores. Georgia is also to be credited during 1906 with a production of 26,198 pounds of copper, valued at $5,057, and 9,750 pounds of lead, valued at $556, the total value of the production of gold, silver, copper, and lead being estimated at $37,065.

The Appalachian gold belt crosses approximately the middle third of the Alabama-Georgia line and expands to its greatest width in Georgia, including the greater part of the upper half of the State. The northern boundary passes in a northeasterly direction from Anniston, Ala., to near Cartersville, Ga., where it turns north toward Dalton, excluding the northwestern corner of the State, and, crossing the State line, includes the extreme southeastern part of Tennessee. The southern boundary runs easterly near Macon to Milledgeville, where it turns to the northeast, crossing the Georgia-South Carolina line a few miles north of Augusta. This broad area includes in Georgia: Carroll, Cherokee, Cobb, Fannin, Forsyth, Hall, Haralson, Lincoln, Lumpkin, McDuffie, Murray, Towns, Union, White, and Wilkes counties. The principal belt extends from near Edwardsville, in Cleburne County, Ala., northeastward through Haralson, Paulding, Cobb, Bartow, Cherokee, Forsyth, Dawson, Lumpkin, White, Habersham, and Rabun counties, into Macon County, N. C. This well-defined belt broadens to include the entire southern half of Lumpkin County, where are the Dahlonega mines, the most important producers in the State. Southeast of the main belt, and roughly parallel to it, lie several smaller belts, including the Seminole copper mine in Lincoln County; and northwest of it lie scattered gold deposits and the copper ores of Fannin County, which are related to the adjacent well-known deposits of Ducktown, Tenn.

An important contribution on the ore deposits of Georgia is the report of Yeates, McCallie, and King,[a] published in 1906.

In Cherokee County the Franklin (formerly the Creighton) mine of the Franklin Gold, Pyrite, and Power Development Company has been developed during the year, and adjacent property has been acquired. A modern mill and cyanide plant are planned to replace the present concentrating, roasting, and chlorinating plant. The placers in Carroll, Cobb, Forsyth, and Fannin counties have produced 54.93 fine ounces of gold, valued at $1,135, according to reports to the Director of the Mint. In Haralson County the Georgia and Tennessee Copper Company are reported to have produced cement copper, without gold or silver, during the year. In Lincoln County the Sale and Lamar and Pascal mines have been idle, but the Seminole mine has been a producer of gold, silver, copper, and lead. Scarcity

[a] Yeates, W. S., McCallie, S. W., and King, F. P. A. Preliminary report on a part of the gold deposits of Georgia: Bull. Georgia Geol. Survey. No. 4-A.

of labor, however, has restricted operations largely to development. This mine is equipped with a 40-ton concentration plant, a reverberatory roasting furnace, and a 15-ton blast furnace. Development is by 4 vertical shafts, the deepest being 225 feet. In Lumpkin County the Crown Mountain mine and the McAfee-Lind have been idle, and the Etowah mine confined operations to the erection of a 20-stamp mill and an electric power plant. The Battle Branch mine has produced. The Standard mine, which is developed by 3 shafts, down to 174 feet, and by 3 inclines, reaching 150 feet in depth, and which is equipped with one 20-stamp mill with 700-pound stamps and Wilfley concentrators and a 10-stamp mill with 1,000-pound stamps, has been a producer, although the mill has been but little run during the year. The dredge of the Bunker Hill Gold Mining and Dredging Company, on the Chestatee River, has also produced in 1906. The total production of Lumpkin County for 1906 is estimated at $10,471, of which $10,450 was gold. McDuffie and Murray counties had no production in 1906, although the Columbia mine, in the former county, reports considerable recent development work. In Union County the Legal Tender mine has been idle, but some placer gold has been obtained from Coosa Creek. In White County the Loud and Cherokee Chief mines have produced little, but the Blow dredges working on the Chattahoochee River and placer mines on a small scale have brought the total production of the county to a value of $10,131.

Much of the data relating to the production of placer gold was obtained from the Director of the Mint and the Charlotte assay office.

MARYLAND.

Maryland, in which State terminates the northeastern limit of the southern Appalachian gold belt, and which produced $14,821 in gold and 93 ounces of silver in 1905, reported no production for the year 1906.

NORTH CAROLINA.

The total production of the precious metals in North Carolina in 1906 was valued at $102,746. The production of gold was 3,973.16 fine ounces, worth $82,131, and of silver 30,769 ounces, valued at $20,615. This is a decrease in gold of $43,554 and an increase in silver of $8,396, as compared with 1905.

There were 9 placer and 15 deep mines, not including smaller workings, in operation in 1906. From the deep mines a reported and estimated tonnage of 20,368 short tons was raised. Of this, 8,074 short tons, with an average extraction in gold and silver of $7.70, were dry or siliceous ores, and 12,294 tons, with an average extraction of the precious metals of $2.12, were copper ores.

Of the gold product, 575.96 fine ounces were derived from placers, 3,010.70 ounces from dry or siliceous ores, and 386.50 ounces from copper ores. The placers also yielded 133 fine ounces of silver, whereas 623 ounces were derived from dry or siliceous ores, and 30,013 ounces came from copper ores.

In addition to the precious metals, North Carolina produced, in 1906, 703,775 pounds of copper, valued at $135,829. This is an increase of 223,775 pounds and an increased value of $60,949 in copper (or nearly 47 per cent in tonnage and 81 per cent in value) over the reported production of 1905, and it is to this marked improvement that the increase in silver production of North Carolina is chiefly due.

As noted last year, the most convenient division of the southern Appalachian gold belt in North Carolina is that of H. B. C. Nitze,[a] which recognizes five distinct belts, some of which extend into the adjoining States.

1. *Eastern belt.*—This belt, contained wholly in North Carolina, reported no production during the past year. The mine and machinery of the Mann-Arrington Company, in Nash County, are reported to have recently changed hands.

2. *Carolina slate belt.*—This belt extends from Virginia southwest through Granville, Person, Alamance, Orange, Chatham, Randolph, Davidson, Montgomery, Rowan, Cabarrus, Stanly, and Union counties, and includes the principal gold, silver, and copper mines and the chief silver mine and the deepest workings, those of Silver Hill. In Granville, Orange, Alamance, Chatham, and Stanly counties no production is reported for the past year. In Person County the Durgy or Yancey mine of the Person Consolidated Copper and Gold Mines Company has been an important producer of copper, silver, and gold, though the mine has been operated but a part of the year. In Randolph County the Scarlett mine has been worked but part of the year, producing copper with a little gold and silver; the operators are awaiting the erection of a reduction plant. The Boson, Southern Homestake, and Sawyer mines did not produce. At the latter some development work was done and a cyanide plant is contemplated. In Davidson County the Emmons mine of the Hercules Gold and Copper Company has produced copper, gold, and silver during development work. This mine is developed by an inclined shaft 600 feet deep, and is equipped with a 50-ton smelter, not now operated, and a 10-stamp mill. The Empire Mining Company did development work on the Lafflin mine and produced a small amount of gold. The Silver Hill mine, noted for the occurrence of native silver and argentiferous galena, has been idle, but operations were to be resumed in the near future. The Silver Valley and Empire mines report no production for 1906. In Montgomery County there was a total production in gold and silver valued at $59,314, of which $58,906 was gold. There were no copper nor lead mines reported in 1906. The Iola mine remains the most important gold producer of North Carolina. The shaft has been extended to a depth of 329 feet, and 1,660 feet of levels have been driven. The plant consists of a 20-stamp plate-amalgamation mill and a 40-ton cyanide plant. The Montgomery mine, developed by a shaft 225 feet deep and equipped with a 10-stamp plate-amalgamation mill and a cyanide plant, has been a slight producer, as has the Troy mine, which is developed by 5 vertical shafts (up to 75 feet deep) and by crosscuts and open cuts, and which is equipped with a 75-ton crushing and washing plant and a new 50-ton cyanide plant. The Briscoe, Cotton Stone Mountain, Cox, and Russel mines have been idle during the year. Stanly County reported no production for 1906. In Rowan County the Union mine has remained during the past year the most important copper and silver producer of the State and has brought the copper production of North Carolina to the highest mark reached since 1900,

[a] Bull. North Carolina Geol. Survey No. 3, 1896.

with the exception of 1902. This mine is developed by a 600-foot shaft and is equipped with a 100-ton concentrating mill and a 50-ton smelter. The latter were not used in 1906, however, as the Union Copper Mines Company shipped all their ores. The Gold Hill Copper group, including the Randolph, Barnhardt, and Miller mines, developed by vertical shafts 833, 435, and 160 feet deep, respectively, and by many miles of drifts, crosscuts, and winzes, has been actively developed during the year. The ores will be treated in the 40-stamp plate-amalgamation mill, equipped with 12 Wilfley concentrators. This group has been important producers in the past and under new management promise a large output of copper and gold for 1907. In Cabarrus County, where lies the continuation of the copper belt, the Yadkin mine has been idle. In Union County, the Black mine of the Indian Trail Mining Company has been idle. The Colossus mine has produced some gold and silver, but has been chiefly occupied in development work, which has been actively pushed with a full force. A new 3-compartment shaft, now 275 feet deep, is being sunk, and crosscuts and levels are being driven with a view to a thorough exploration of the ore body.

3. *North Carolina igneous belt.*—This belt lies immediately west of the slate belt and, like it, extends through the State, from northeast to southwest. The rocks are principally granites and diorites, intrusive into the slates and accompanying schists.

In Guilford County the Fentress mine, which is developed by an incline shaft 280 feet deep and is equipped with a 10-stamp plate-amalgamation mill with concentrators, was a producer during the latter part of the year. The Deep River mine was idle. In Cabarrus County the Phoenix produced some copper and gold. This mine is developed by 2 nearly vertical shafts 600 feet deep and is equipped with a 10-stamp plate-amalgamation mill and concentrators. The process after amalgamation has been chlorination of the concentrates and cyanidation of the tailings. In Mecklenburg County the Brawley, Capps, Johnston, and Surface Hill mines have been idle and the Rudisill and St. Catherine mines have produced but little, as these two properties are being developed and a mill of daily capacity of 50 tons is being erected. The Frederick and Yellow Dog mines have also produced gold and silver.

4. *Kings Mountain belt.*—This belt of crystalline schists and gneisses, with occasional quartzites, considered by Nitze to be probably Cambrian, is immediately west of the preceding igneous belt and includes parts of Gaston, Lincoln, Catawba, Davie, and Yadkin counties. The Butler mine of Davie County was idle in 1906. The placer mines of Gaston and Catawba counties produced, however, $7,994 in gold and $74 in silver during the year.

5. *South Mountain belt.*—This belt of gneisses and schists, with granite, pegmatite, and diorite, lies just west of the preceding and is about 25 miles long and 10 to 12 miles wide, being found in Burke, McDowell, Rutherford, and Polk counties. Gold was first found in Burke County in 1828 in placer deposits, and for many years thereafter a considerable output was maintained.

The Packes Hill mine, in Burke County, and the Red Springs and Splawn mines, in Polk County, report no production for 1906, but small placer operations in Burke and McDowell counties contributed $859 in gold during the year.

Along the extreme western border of the State lie deposits of copper in gneisses, in Alleghany, Ashe, Wilkes, and Watauga counties toward Virginia, and in Jackson and Macon counties near Georgia; gold deposits, also in gneisses, occur in Cherokee County in the southwestern corner of the State not far from the Tennessee-Georgia-North Carolina junction. In the last county miscellaneous placers reported a production of $883 in gold.

SOUTH CAROLINA.

The production of South Carolina in 1906 was 3,819.63 fine ounces of gold, valued at $78,959, and 92 ounces of silver, valued at $62, giving a total of $79,021. This shows a decrease, as compared with the production of 1905, of $16,152 in gold and $5 in silver. Six mines were reported active in 1906, of which 2 were placer and 4 were deep mines. From the latter, 49,327 short tons of dry or siliceous ores, with an average extraction in gold and silver of $1.60 per ton, were raised. From the placers, 13.06 fine ounces, and from the dry or siliceous ores, 3,806.57 fine ounces of gold were obtained. Of the silver production, 2 ounces were from the placers and 90 ounces from the dry or siliceous ores. South Carolina produced no copper, lead, or zinc, and it will be noted from the above that the precious-metal product is almost exclusively gold.

The Appalachian gold belt covers the northwestern third of South Carolina and is represented by granites, gneisses, schists, and slates, striking northeast-southwest. In this area lie Abbeville, Anderson, Cherokee, Chesterfield, Greenville, Greenwood, Lancaster, Laurens, Oconee, Pickens, Spartanburg, Union, and York counties, the greater part of which were unproductive in 1906.

In Chesterfield County there was a slight production of placer gold. In Lancaster County lie the well-known Blackmon and Haile mines, which together produced over 97 per cent of the gold and silver output of the State in 1906. The latter, the most important gold producer of the South, has recently been described in some detail by Graton,[a] as a replacement deposit. The country rock is a quartz-sericite schist. The ore bodies are large but of low grade and the gold is found partly free, partly in the sulphides. The processes of extraction have been adjusted to prevailing conditions with extreme nicety and total costs of production have been brought down to $1.60 per ton. The mine is developed by great open cuts and by vertical shafts 100 to 480 feet deep, and is equipped with a 60-stamp plate-amalgamation mill with concentration and chlorination plants. The Blackmon mine now closed down is developed by a shaft 175 feet deep and is equipped with a 20-stamp plate-amalgamation mill. In Spartanburg County the Jackson mine and the Hammett placer mine have been idle during the year, as have the Ferguson and Wilson mines of York County. The latter is developed by 3 shafts, each 106 feet deep, and is equipped with a stamp mill.

TENNESSEE.

During 1906 this State produced 234.06 fine ounces of gold, valued at $4,838, and 55,931 fine ounces of silver, valued at $37,474. This shows an increase for the year, as compared with the production of

[a] Graton, L. C., op. cit., pp. 77-87.

1905, of $476 in gold and a decrease of $20,221 in silver. As in 1905 the production of the precious metals is from one placer mine and two deep copper mines. The amount of ore raised from the latter was 538,141 short tons, this ore giving an approximate average extraction of 8 cents per ton in silver and gold. Although this is the total extraction reported, it is known to be somewhat low, as some of the Tennessee copper is not electrolytically refined, another part of it is refined abroad, and the amount of gold and silver recovered is not available for purposes of computation. From the Tennessee placers 52.06 fine ounces of gold were obtained, and from the copper ores of the deep mines 182 ounces of gold and 55,931 ounces of silver were obtained.

The most important metallic product of Tennessee is of course copper, of which 17,979,317 pounds, valued at $3,470,008, were produced in 1906.

The Southern Appalachian gold belt, including the copper deposits, extends from North Carolina across the southeastern border of Tennessee into Georgia and crosses the two producing counties of Tennessee—Polk and Monroe. The deposits are lenticular in form and occur in the Ocoee slates, whose age as determined by Keith[a] is shown to be Cambrian. The copper deposits are great bodies of the low-grade sulphides, pyrrhotite, and chalcopyrite, containing a little gold and silver; as is well known, these deposits were famous for the rich secondary ores now almost mined out.

The well-known Ducktown district of Polk County yielded all of the copper and silver and over three-fourths of the gold produced in Tennessee in 1906. In this county are the Polk County, Burra Burra, and London mines of the Tennessee Copper Company, and the Mary and Calloway mines of the Ducktown Sulphur, Copper, and Iron Company (Limited), an English concern. The former group of mines are developed by three shafts, 300, 700, and 600 feet in depth, respectively, and by crosscuts, raises, winzes, and stopes, and are provided with a 1,500-ton smelter with converting plant, where the ore is treated, the Bessemer copper being exported to Europe. The latter group are developed by two shafts, 350 and 330 feet deep. The plant consists of two 250-ton furnaces and one 125-ton furnace, in which matte only is produced. In Monroe County are a number of placer deposits. The Cooper mine was idle and the Coker Creek Mining and Power Company has not yet operated its dredge. The Lonsdale Gold Mining Company has done 2,000 feet of drifting and tunneling in a surface deposit and is contemplating the erection of a stamp mill, considering a large amount of ore to be in sight. The Unaka Mining and Development Company has been obtaining some gold by hydraulicking and is expecting important returns from its new dredge on Coker Creek.

VIRGINIA.

In 1906 Virginia produced 717.50 fine ounces of gold, valued at $14,832, and 250 ounces of silver, valued at $168. This shows an increase over the production for 1905 of $9,850 in gold and $61 in silver. The total of short tons of ore raised was 9,565, all of dry or

[a] Keith, Arthur, Geologic Atlas U. S., folio 143, U. S. Geol. Survey. 1907, p. 3.

siliceous ores, yielding an average extraction of $4.17. There were no placer mines reporting production last year, and there was no production of copper, lead, or zinc.

The gold belt extends from near the Great Falls of the Potomac southwestward through Virginia to the middle of the Virginia-North Carolina line, crossing Fairfax, Loudoun, Fauquier, Stafford, Culpeper, Orange, Louisa, Albemarle, Fluvanna, Goochland, Buckingham, Pittsylvania, and Halifax counties; and a copper belt farther to the westward is thought to extend through Floyd, Carroll, and Grayson counties into North Carolina and Tennessee. The belt is from 20 to 30 miles wide, and the deposits are very largely the prevailing lens-shaped quartz veins in the schists.

In Fauquier County the Liepold mine of the Virginia Mining and Development Company, which is developed by two shallow shafts and is equipped with a 10-stamp plate-amalgamation mill without concentrators, reports no production for 1906. In Orange County the Piedmont Mining and Milling Company reports no production from the Grasty and Chicago mines, but contemplates operations in 1907. In Albemarle County the Faber mine, of the Albemarle Zinc and Lead Company, has been developed by a shaft 292 feet deep and a tunnel 150 feet long. This mine is equipped with a 100-ton grinding and dry-concentrating mill for zinc and lead. The ore is of zinc and lead carrying only traces of gold and silver, and there was no prodction in 1906. In Fluvanna County the Hughes mine, and in Buckingham County the Anaconda placer mine, report no production in 1906. In Halifax County the 5-stamp mill of the Tallyhill mine operated by Howard Brothers and Luce, began operations in December and but a small production is reported from this mine. The Pontiac mine of the Pontiac Mining Company was idle. The Seaboard copper mine of the Seaboard Copper Company reports no production during the year. The Gold Banks mine of the Virgilina Mining Company was the most important producer in Virginia during the year. This mine is developed by a vertical shaft 156 feet deep and by 300 feet of tunnel and is equipped with a 10-stamp plate-amalgamation mill and a cyanide plant for the treatment of the tailings. It is expected that the capacity of the mill will be doubled. The vein is reported to be from 3 to 6 feet wide. In Floyd County the Brush Creek placer mine was not operated during the past year.

TEXAS.

By H. D. McCaskey.

PRODUCTION.

The State of Texas during the year 1906 produced 77 fine ounces of gold, valued at $1,592, and 301,772 ounces of silver, valued at $202,187, a total production of the precious metals of $203,779. Compared with the production for 1905 these figures show an increase in gold of 65 ounces, valued at $1,344, and a decrease in silver of 85,634 ounces, valued at $31,867. In addition to this, Texas produced 49,030 pounds of lead, valued at $2,795, an increase over the amount reported for 1905.

The precious metals obtained were all from lead ores, of which 24,567 short tons were raised. The average extraction was therefore \$0.06 in gold and \$8.23 in silver, a total of \$8.29 per ton.

During the past year no production of gold and silver was reported from El Paso County, where are located several small mines. Presidio County reported two producers, the only mine of present importance being the Shafter, which has had a steady output for several years. This mine is developed by a vertical shaft 700 feet deep, and is equipped with a 15-stamp pan-amalgamation mill. Considerable lead and silver are recovered by concentration of the tailings of this mill and a few tons of concentrates were shipped.

The silver and lead ores from the Shafter mine are chiefly silver chlorides and cerussite, together with argentiferous galena. The ore deposits are irregular bodies in the Cibolo limestone, probably of Upper Carboniferous age.[a] Sphalerite, quartz, and malachite are also found.

Copper and tin ores are found in El Paso County, and quicksilver is obtained from cinnabar mined in the Terlingua district of Brewster County, but these do not contribute to the production of silver and gold.

UTAH.

By V. C. Heikes.

PRODUCTION.

The gold production of Utah for 1906, as reported by the producers, amounted to 252,439.42 fine ounces, corresponding to \$5,218,386, an increase of \$77,466 over 1905. Of silver, 11,550,634 fine ounces were reported, equivalent to \$7,738,925, an increase of 514,163 ounces, or \$1,072,897, over 1905.

Returns were received from 133 mines, including 7 placers. The 126 deep mines yielded 2,348,819 short tons of ore having an average of \$5.51 in gold and silver, compared with \$5.41 in 1905. The total average value, computing base metals at New York average prices, was \$13.37 against \$11.90 in 1905. The total yield of gold, silver, copper, lead, and zinc in 1906 was \$31,419,365, an increase of \$5,594,978 over the figures for 1905. The output of lead and zinc has been greatly stimulated, but somewhat less copper was produced in 1906 than in 1905, in spite of the higher price of the metal in 1906. The production for 1905 and 1906 is as follows:

Production of gold, silver, and associated metals in Utah in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold ....fine ounces..	248,692	\$5,140,920	252,439.42	\$5,218,386	+ 3,747.42	+ \$77,466
Silver..............do....	11,036,471	6,666,028	11,550,634	7,738,925	+ 514,163	+1,072,897
Copper...........pounds..	57,298,054	8,938,496	56,593,576	10,922,560	− 704,478	+1,984,064
Lead...............do....	103,882,009	4,882,454	125,342,836	7,144,542	+21,460,827	+2,262,088
Zinc...............do....	3,330,327	196,489	6,474,615	394,952	+ 3,144,288	+ 198,463
Total..............	....	25,824,387	....	31,419,365	....	+5,594,978

[a] Udden, J. A., Bull. Univ. Texas Mineral Survey No. 8, p. 54.

The ore output of Utah in 1906 was 2,348,819 short tons, worth $13.37 a ton, as against 2,181,061 short tons, valued at $11.90 a ton in 1905, showing a net increase of 167,758 short tons and an increased value of $1.47 per ton.

The mining industry of the State is in a flourishing condition, as is shown by the fact that 167,758 more tons were mined in 1906 than in 1905. Although this increase in the tonnage is considerably greater than in former years, growth has only commenced, as next year's report will include an enormous daily output of low-grade porphyry ores by the Bingham mines in the West Mountain mining district. It was expected that the tonnage output figures for 1905 would be almost doubled for 1906, but on account of delay in constructing the great concentrating mills at Garfield, and in completing the railway for handling the product, the expected increase did not appear. At the writing of this report, the first unit of one of the great mills is in operation and that of the second will be ready before the close of 1907. The tonnage of the State for the past five years and the value in gold and silver of ores sold or treated is shown as follows:

Total tons of ore sold or treated in Utah in 1902–1906, in short tons.

Year.	Quantity.	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	11,806,148
1906	2,348,819	12,948,660

GOLD.

The value of the gold production in 1906 was $5,218,386, an increase over 1905 of $77,466. The additional yield was due to the auriferous copper ores shipped from Beaver County and the West Mountain (Bingham) district in Salt Lake County. Other counties from which satisfactory yields are recorded are Boxelder, Juab, Piute, Tooele, Summit, and Utah. The placer-gold industry of the southern counties in 1906 yielded 416.63 ounces, or $8,612.49 in value, mainly reported and estimated from Grand River in Grand County and San Juan River in San Juan County. Other counties contributing placer gold were Garfield and Uinta counties. The bulk of the gold, or 120,766.53 ounces, is derived from copper-bearing ores, principally from Juab and Salt Lake counties, which produce nearly half of the total output of the State. Only 62,866.25 ounces are derived from siliceous ores, which came chiefly from Boxelder, Piute, and Tooele counties, and 12,785.54 ounces from lead ores from Juab, Salt Lake, Tooele, Utah and Summit counties, the last named leading in production. Gold from zinc-lead ores amounted to 555.77 ounces and from copper-lead ores to 50,215.63 ounces. Juab County led in each of these, while Summit County led in the production of copper-lead-zinc ores. From the Tintic district in Juab County was obtained $1,925,066, against $2,086,656 in 1905; from the West Mountain (Bingham) district $1,631,786, against $1,316,817 in 1905; from Tooele County $922,658, against $926,532 in 1905; from the Park City district, Summit and Wasatch counties, $245,678, against $306,088 in 1905.

Source of gold production of Utah by kinds of ore in 1906, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.
Beaver, Emery, Piute, and Sevier	....	15,921.75	2,165.10	3.28
Boxelder, Millard, Morgan, and Washington	....	1,882.75	....	....
Grand, Garfield, San Juan, and Uinta	416.63	14.00	....	....
Juab	....	1,062.00	52,648.13	616.09
Salt Lake	....	....	65,946.78	244.33
Summit and Wasatch	....	....	6.52	8,115.10
Tooele	....	43,985.75	....	259.69
Utah	....	....	....	3,547.05
Total	416.63	62,866.25	120,766.53	12,785.54
Total of 1905	322.00	64,383.00	125,897.00	17,805.00
Increase (+) or decrease (−)	+94.63	−1,516.75	−5,130.47	−5,019.46

County.	Zinc ore.	Mixed ores. Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver, Emery, Piute, and Sevier	50.00	....	489.66	....	18,629.79
Boxelder, Millard, Morgan, and Washington	....	....	....	....	1,882.75
Grand, Garfield, San Juan, and Uinta	....	....	....	....	430.63
Juab	....	....	36,933.19	423.45	91,682.86
Salt Lake	....	877.41	12,679.58	....	79,748.10
Summit and Wasatch	....	3,704.79	47.00	11.25	11,884.66
Tooele	....	200.87	66.20	121.07	44,633.58
Utah	....	....	....	....	3,547.05
Total	50.00	4,783.07	50,215.63	555.77	252,439.42
Total of 1905	95.00	1,682.00	36,818.00	1,690.00	248,692.00
Increase (+) or decrease (−)	−45.00	+3,101.07	+13,397.63	−1,134.23	+3,747.42

SILVER.

Silver shows an increase of 514,163 ounces, as compared with the output for 1905; in value it increased $1,072,897. Increases were noted in Beaver, Juab, Tooele, and Utah counties, but principally in Juab County, where the copper-lead ores of the Tintic district yielded most of the silver.

Source of silver production of Utah, by kinds of ore, in 1906, by counties, in fine ounces.

County.	Placers.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Mixed ores. Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Beaver, Emery, Piute, and Sevier	......	55,324	45,271	20,081	10,416	....	248,189	....	379,281
Boxelder, Millard, Morgan, and Washington	......	590	4,315	4,412	....	....	....	....	9,317
Garfield, Grand, San Juan, and Uinta	57	....	....	....	....	....	....	....	57
Juab	......	53,100	1,257,531	419,197	....	....	2,451,316	80,749	4,261,893
Salt Lake	......	....	724,954	23,905	....	43,865	1,479,728	....	2,272,452
Summit and Wasatch	......	....	134	1,687,033	....	2,041,284	20,325	6,563	3,755,339
Tooele	......	2,600	....	20,514	....	205,288	55,395	75,016	358,813
Utah	......	....	....	513,482	....	....	....	....	513,482
Total	57	111,614	2,032,205	2,688,624	10,416	2,290,437	4,254,953	162,328	11,550,634
Total of 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 (−)	−4	+17,117	−269,144	−415,751	−7,692	+201,143	+1,054,125	−65,631	+514,163

COPPER.

According to reports from mining companies for 1906, the copper production remains nearly the same as for the previous year. The output decreased from 57,298,054 pounds, valued at $8,938,496, in 1905, to 56,593,576 pounds, valued at $10,922,560, in 1906, a decrease in quantity of 704,478 pounds, but an increase in value of $1,984,064. The greatest production of copper was in the West Mountain district, at Bingham, the increase being 204,542 pounds over 1905. The greatest increases in production occurred in Beaver County, amounting to 1,850,150 pounds. The total ore mined and treated in Utah during 1906 was 2,348,819 tons; out of this amount 1,143,021 tons were treated more especially for its copper content. Sixty-nine per cent of the amount came from Bingham Camp from the mines of 4 great mining companies. The Park City district produced 179,085 tons of copper-lead-zinc ore out of a total of 224,468 pounds produced in the State, and Bingham 202,346 tons of copper-lead ore out of a total of 347,857 tons for the State. The average gold and silver content per ton of the copper ore was $3.38, of copper-lead-zinc ore $7.27, and of copper-lead ore, $11.18. Construction work was begun on the new concentration plants of the Utah Copper Company and the Boston Consolidated Copper Mining Company near Garfield, on the shores of the Great Salt Lake. These plants will treat the bulk of the low-grade porphyry ore of Bingham Camp. The Garfield Smelting Company did not put its furnaces into commission until late in the year and consequently was only a small producer.

LEAD.

The production of lead in Utah increased from 103,882,009 pounds, valued at $4,882,454, in 1905, to 125,342,836 pounds, valued at $7,144,542, in 1906. The increase was greatest in Juab County, which produced 16,049,863 pounds in 1905 and 24,249,776 pounds in 1906, a gain of 8,199,913 pounds, accounted for by the activity of the mines in the eastern part of the Tintic district, the Beck Tunnel mine being the largest producer. Other important increases are recorded in Tooele, Utah, and Beaver counties. Summit and Salt Lake counties remain about the same tor 1906 as during the previous year.

ZINC.

This metal was produced in Summit, Tooele, and Beaver counties. The output increased from 3,330,327 pounds, valued at $196,489, in 1905, to 6,474,615 pounds, valued at $394,952, in 1906, a total increase of 3,144,288 pounds in quantity and of $198,463 in value. The increase was caused principally by Tooele County becoming a producer, its output coming largely from the Scranton mine, while Summit County continues to rely on the Daly-Judge mine and Beaver County on the Horn Silver property. With several important new producers in Beaver County in 1907, and improvements made in the milling plants at Park City, Utah's zinc production should be greatly increased during the coming year.

QUICKSILVER.

Tooele County continues to produce quicksilver from the Camp Floyd district at Mercur. The output increased from 67,500 pounds, valued at $36,000, in 1905, to 102,075 pounds, valued at $52,339.50, in 1906, an increase of 34,575 pounds in quantity and of $17,701.90 in value.

MINING INDUSTRY OF UTAH, 1906.

The past year has witnessed unusual activity in the mining industries of Utah, stimulated by high metal prices and lower smelting and freight rates on certain grades of ore. Twenty-one mining companies contributed toward the payment of over $5,000,000 in dividends.

In the West Mountain district, at Bingham, a tremendous amount of development work was carried on preparatory to ore extraction on a much larger scale in order to supply the great milling plants under construction at Garfield. The Tintic Smelting Company, allied to the Utah Smelting Company, which operates a small copper smelter near Ogden, plans the erection of a lead smelter in the Tintic district near Eureka.

The recent decision by the United States court at Salt Lake City, granting an injunction against all the smelters in the Salt Lake Valley on the ground that their operation is injurious to other interests, especially agriculture, because of sulphurous gas discharged into the atmosphere, is a serious matter. The court held that the smelters could not escape injunction because of the benefits arising in many respects from their operation, which could not be considered as an offset to the damage inflicted by them. The smelters of the Salt Lake Valley include the American Smelting and Refining Company, Utah Consolidated, Bingham Consolidated, and United States Smelting Company. According to the terms of the injunction they may not smelt any ore containing more than 10 per cent of sulphur, by which it is understood that no ore of higher sulphur content may be roasted, and that similarly no ore, or rather furnace charge, of higher sulphur content may be smelted directly in the blast furnace. The enforcement of this injunction has been postponed six months by appeal by the smelters, but in the meanwhile plans must be seriously considered for readjusting their practice on a new basis. However, this is not a new matter, some action having been anticipated for a long time and elaborate experiments for the neutralization of the sulphuric-acid fumes having been conducted by several companies.

In the following table is shown the output of gold, silver, copper, lead, and zinc for the year 1906, by counties:

Production of gold, silver, copper, lead, and zinc in Utah in 1906, by counties.

County.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Fine ozs.		*Fine ozs.*		*Pounds.*	
Beaver, Emery, Piute, and Sevier	18,629.79	$385,112	379,281	$254,119	5,406,525	$1,043,459
Boxelder, Millard, Morgan, and Washington	1,882.75	38,920	9,317	6,242	482,656	93,152
Grand, Garfield, San Juan, and Uinta	430.63	8,901	57	38		
Juab	91,682.86	1,895,253	4,261,893	2,855,468	7,321,471	1,413,044
Salt Lake	79,748.10	1,648,540	2,272,452	1,522,543	40,618,019	7,839,278
Summit and Wasatch	11,884.66	245,678	3,755,339	2,516,077	1,194,216	230,484
Tooele	44,633.58	922,658	358,813	240,405	1,570,689	303,143
Utah	3,547.05	73,324	513,482	344,033		
Total	252,439.42	5,218,386	11,550,634	7,738,925	56,593,576	10,922,560

Production of gold, silver, copper, lead, and zinc in Utah in 1906, by counties—Con.

County.	Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Beaver, Emery, Piute, and Sevier	5,324,726	$303,510	780,276	$47,597	$2,033,797
Boxelder, Millard, Morgan, and Washington	288,158	16,425			154,739
Grand, Garfield, San Juan, and Uinta					8,939
Juab	24,249,776	1,382,237			7,546,002
Salt Lake	24,849,937	1,416,446			12,426,807
Summit and Wasatch	46,511,176	2,651,137	3,518,139	214,607	5,857,983
Tooele	13,347,160	760,788	2,176,200	132,748	2,359,742
Utah	10,771,903	613,999			1,031,356
Total	125,342,836	7,144,542	6,474,615	394,952	31,419,365

Tonnage of ore sold or treated, number of producing mines, and tenor of ores in Utah in 1905 and 1906, by counties, in 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.	
	1906.	Increase (+) or decrease (−).	1905.	1906.	1905.	1906.	1905.	1906.
Beaver, Emery, Piute, and Sevier	318,773	+109,619	9	19	$6.79	$6.38	$2.80	$2.00
Boxelder, Millard, Morgan, Washington, and Weber [a]	6,555	+ 1,411	9	5	19.82	23.60	5.99	6.89
Grand, Garfield, San Juan, and Uinta	16		1	1	18.06	18.06	18.06	18.06
Juab	301,721	+ 42,008	32	30	26.73	25.01	17.00	15.75
Salt Lake	1,016,922	− 21,090	27	35	9.82	12.22	2.65	3.12
Summit and Wasatch	264,792	+ 36,650	14	15	22.62	22.12	11.93	10.43
Tooele	420,085	− 10,368	15	13	4.10	5.61	2.61	2.76
Utah	19,955	+ 9,528	7	8	36.88	51.68	15.92	20.91
Total	2,348,819	+167,758	114	126	11.90	13.37	5.41	5.51

[a] Weber County was a producer in 1905 only.

Subdivision of tonnage, by kinds, of ore sold or treated from Utah in 1906, by counties, in short tons.

County.	Siliceous ore.	Copper ore.	Lead ore.	Zinc ore.	Mixed ore.		
					Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.
Beaver, Emery, Piute, and Sevier	74,016	227,850	1,336	1,736		13,835	
Boxelder, Millard, Morgan, and Washington	3,931	1,912	712				
Grand, Garfield, San Juan, and Uinta	16						
Juab	26,550	113,474	24,477			125,838	11,382
Salt Lake		799,619	5,404		9,553	202,346	
Summit and Wasatch		166	79,565		179,085	351	5,625
Tooele	334,755		4,483		35,830	5,487	39,532
Utah			19,953				
Total for 1906	439,268	1,143,021	135,930	1,736	224,468	347,857	56,539
Value per ton in gold and silver	$3.13	$3.38	$15.20	$4.61	$7.27	$11.18	$2.13
Total for 1905	421,319	1,049,167	132,783	3,018	163,935	357,279	53,560

Tonnage of milling and smelting ore and concentrates, with value of gold and quantity of silver contained in bullion, produced in Utah in 1906, by counties.

County.	Ore to gold and silver mills.			Ore to concentrating mills and concentrates produced.			
	Quantity.	Gold in bullion.	Silver in bullion.	Quantity.	Quantity.	Gold.	Silver.
	Short tons.	*Value.*	*Fine ozs.*	*Short tons.*	*Short tons.*	*Value.*	*Fine ozs.*
Beaver, Emery, Piute, and Sevier	73,981	$328,284	52,506	221,002	20,359	$43,436	42,670
Boxelder, Millard, Morgan, and Washington		30,758	488	3,931	59	8,162	102
Grand, Garfield, San Juan, and Uinta	16	289					
Juab				12,714	2,328	2,564	26,171
Salt Lake				295,024	21,355	46,858	81,191
Summit and Wasatch				188,297	36,975	92,658	1,282,150
Tooele	334,715	909,208		69,529	22,366	8,028	264,753
Utah							
Total	408,712	1,268,539	52,994	790,497	103,442	201,706	1,697,037
Per ton		3.10	.13			1.94	16

County.	Crude ore to smelter.			Old tailings treated.		
	Quantity.	Gold.	Silver.	Quantity.[a]	Gold.	Silver.
	Short tons.	*Value.*	*Fine ozs.*	*Short tons.*	*Value.*	*Fine ozs.*
Beaver, Emery, Piute, and Sevier	23,790	$13,392	284,105			
Boxelder, Millard, Morgan, and Washington	2,624		8,727			
Grand, Garfield, San Juan, and Uinta						
Juab	289,007	1,892,689	4,235,722			
Salt Lake	721,898	1,601,682	2,191,261			
Summit and Wasatch	59,949	153,020	2,473,189	16,546		
Tooele	15,841	5,422	94,060			
Utah	19,955	73,324	513,482			
Total	1,133,064	3,739,529	9,800,546	16,546		
Per ton		3.30	8			

[a] Values included in concentrates.

The following table gives for 1906 the number of mines classified according to their chief products:

Number of mines classified by chief products in Utah, in 1906, by counties.

County.	Mines reporting product.	Gold placer mines, hydraulic.	Deep mines.							
			Gold.	Silver.	Gold and silver.	Gold, silver, copper.	Gold, silver, copper, lead.	Gold, silver, lead.	Silver and lead.	Silver, lead, and zinc.
Beaver, Emery, Piute, and Sevier	19		1		4	[a] 6	[b] 3	2	3	
Boxelder, Morgan, Millard, Washington	5				1	2			2	
Grand, Garfield, San Juan, and Uinta	8	7	1							
Juab	30				1	5	14	7	3	
Salt Lake	35					8	19	6	1	[c] 1
Summit and Wasatch	15					1	[d] 6	[d] 8		
Tooele	13		2		1		4	5		1
Utah	8							8		
Total	133	7	4		7	22	46	36	9	2

[a] Two contain only copper. [b] One contains also zinc. [c] Some copper. [d] Some zinc.

Out of 27 counties in Utah, 18 reported production of metals in 1906. Out of 133 mining districts, 33 reported production.

REVIEW BY INDIVIDUAL COUNTIES.

BEAVER COUNTY.

This section of the State became productive at a very early date—in 1858—and soon after several smelters were built. When the rich surface ores had been extracted mining received a set back, and not until 1906 has the industry really recovered.

San Francisco district.—This district was organized in 1871. The San Francisco range, in which the district is situated, strikes north and south, and is about 15 miles long; its average width is 3 miles, and several of its peaks attain an altitude of over 1,000 feet above the adjoining valleys, which are nearly level and about 6,400 feet above the sea.

There are no running streams in the canyons, and all the water obtained in the district is found in a few very feeble springs. In this range are exposed sedimentary beds to a thickness of several thousand feet, consisting of limestone, shales, and quartzites. Through, between, and overlying these sedimentary rocks are masses of eruptive rocks, intruded at different periods, which consist of andesite and monzonite, the andesite being the older. The geologic structure is very complicated and is disturbed by faults.

The Horn silver mine produced originally silver, lead, and a little gold; but in recent years it has yielded substantial quantities of zinc and copper. The favorable condition of the market for zinc has enabled the management to move a large tonnage of that class of ore to the zinc smelters of Kansas, in addition to the lead ores with silver and copper values forwarded to the Salt Lake Valley smelters. The old stopes afforded much ore during 1906 that did not pay in earlier days. In stripping the low-grade ores, considerable high-grade lead-silver ore is found. The Centrifugal Concentrating Company, owner of the Peck patents, constructed an expensive plant during 1905 to treat the tailings of the mill and low-grade ores of the mine, but it proved a failure, owing to the character of the minerals, for which the plant was not adapted. The published annual report of the Horn Silver Mining Company for 1906 gives the following data: Zinc ore was sold amounting to 1,664 net tons, assaying 29.60 to 34.48 per cent zinc, 13 to 20.70 per cent lead, and 7.40 to 15.20 ounces silver. The selling price varied from $8.15 to $16 per ton, and the total amount was $22,037, an average of $13.40 per ton. The output of zinc for 1906 was 1,041,701 pounds. The sales of copper ore amounted to 129 tons, assaying 15.40 to 20.30 per cent copper, 12.90 to 16.60 per cent lead, and 2.60 to 4.30 ounces silver, with a little gold. The selling price was $34.61 to $58 per ton, making the total amount $6,420, an average extraction of $49.70 per ton. The production of copper for 1906 was 53,315 pounds. There were also mined for shipment in 1906, 12,394 net tons of crude ore, containing from 6.60 to 83.40 ounces of silver, up to 28.60 per cent of lead, and a little gold, which was sold for $147,964, an average of $11.79 per ton. The output of lease ore amounted to 807 net tons, containing from 7.10 to 19.70 ounces of silver, 14.50 to 27.14 per cent of lead, and a little gold, realizing when sold $13,497, an average yield of $16.61 per ton. It cost $3.99 to produce 1 ton of crude ore. In addition there were sales of 63 net tons of concentrates, assaying 19.60 ounces of silver, 16.10 per cent of lead, and 0.03 ounce of gold, which brought $758 or an average of $12.03 per ton.

The Blackbird Gold and Copper Mining Company owns about 70 mining claims. These claims bound the Cactus mine on three sides. There are 2 shafts down each about 300 feet; one tunnel about 400 feet. Nothing but assessment work has been done on this property.

The Cactus mine,[a] owned and operated by the Newhouse Mines and Smelters, is located at the town of Newhouse, on the western slope of the San Francisco Mountains, about 4½ miles north of Frisco. The mine is developed by a tunnel 6,200 feet long, driven to connect with the main shaft at a depth of 600 feet. The ore is loaded on steel cars and hauled by electric motor to the storage bins, then loaded on railway cars and transported to the mill. Great activity has prevailed at this mine during the past year, since the discovery of an entirely new and distinct ore body, carrying higher grade ores than had heretofore been found. The principal vein, on which the development has been done, strikes northeast-southwest. Both walls are of granite, carrying chalcopyrite ore, which concentrates well under good millwork. It is reported the milling capacity will be increased from 800 tons to 1,200 tons of ore daily, and with this in view, 10 new jigs and a number of new tables of the Wilfley type will be manufactured on the premises. A fourth boiler of 300 horsepower capacity is also being added, and the mine is being equipped with electric hoists, one for the main shaft and one for the new shaft, which will be sunk below the tunnel level. Preparations to put this shaft down with great rapidity are being made. Early in the year a steam shovel was installed at the surface and used in the removal of the overburden of earth which covers the ore body. After this was done, two "glory holes" were started, from which about half of the tonnage of the mines is now taken. This is, beyond question, the cheapest mining work that is being done in Utah, the month of October having shown a product of 10,000 tons from the "glory holes," which cost only 19 cents per ton for the actual mining. It is by such means as these that the immense low-grade product of the Cactus mine is made profitable. Three hundred and fifty men find employment in the mills and mines of this property, and from 40 to 50 cars of concentrates are sent to the Salt Lake smelter every month. On December 1 the wages of all the employees of the Newhouse properties were voluntarily raised 25 cents per day.

The Frisco Contact Mining Company owns 18 patented claims adjoining the Horn silver mine on the north. The geologic features in the Frisco ground are similar to those of its neighbor. The strike of the contact is north and south and dips to the east about 80 degrees in an irregular way, as indicated by all the croppings and fully determined by all the underground workings in the Horn silver mine. The main working shaft of the Frisco is down 500 feet, and from this level a drift is headed for one of the most prominent east-west faults.

The Imperial Gold and Copper Company shipped to the smelter during the year 3 cars of copper ore, which gave returns of from 8 to 15 per cent of copper, and some silver. Sixteen lessees were at work part of the year, and the principal work by the company consisted in driving a tunnel, now in 1,155 feet, to tap the old workings.

The Lulu Mining Company, the claims of which adjoin the Horn silver mine on the south, has opened ore bodies showing good shipping

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[a] Emmons, S. F., Cactus copper mine, Utah: Bull. U. S. Geol. Survey No. 260, 1904, pp. 242-248.

values on the 450-foot level. The mine is equipped with a gasoline hoist, which is being replaced by a steam hoist. The property should become a shipper during 1908.

The property of the Indian Queen Mining Company is being developed by tunnel. A vein of ore was encountered in a crosscut at a depth of 350 feet.

In the 2 drifts opened up by the Leland Mining and Milling Company during the year some good lead-silver ore was disclosed.

Star district.—The Talisman Mining Company, with about 220 acres of mining ground located 12 miles southwest of Milford, has been pushing development work and making a few shipments of high-grade silver-lead ore during the year. It is intended to make use of the old workings, from which a large quantity of rich ore was reported by the first owners.

The Cedar Mining Company owns property adjoining the Talisman mine. The work of reopening this property was begun in March. A total depth of 275 feet has been reached, where ore carrying lead and silver was encountered by crosscutting. One car of ore recently shipped to the smelter is reported to have netted the company $2,351.66 for the silver and lead contents.

The Burning Moscow Mining Company shipped a number of carloads of ore containing lead, copper, gold, and silver. The property has large bodies of zinc-sulphide ore exposed that report an assay of 30 to 42 per cent in zinc. A new vertical shaft has been started that is to be 400 feet deep. The old workings are opened to a depth of 200 feet. In this district a number of other properties are being developed; these are the Hub, Commonwealth, and Progressive.

BOXELDER COUNTY.

Lucin district.—The Salt Lake Copper Company controls about 18 mining claims located 2 miles from the Utah-Nevada line and within 5 miles of the Southern Pacific Railroad, from which a spur is building to the terminus of a Leschen aerial tramway with which the mine is equipped. The company began shipping in November, 1906, to the United States Smelting Company at Salt Lake City. At the present time the output is only about 50 tons of copper ore a day. It is reported that 150,000 tons, which will average high in copper, are exposed.

Park Valley district.—The district has experienced a quiet year in the way of production, though a great deal of development work has been done. The Century Mining Company operated its stamp mill on ores of good grade and produced bullion and concentrates which paid the stockholders a small dividend and furnished funds for additional development work in the mine. The Sunrise Mining Company demonstrated the value of this property last year by making a test run at the Century plant. Development work is in progress. The Great Buffalo Company is steadily developing its property in a systematic way.

Sierra Madre district.—Considerable development work was carried on in this district during 1906, but no shipments were made. The mining companies of the district have met with many discouraging conditions, and on account of the almost inaccessible canyons it has become a necessity to provide approaches in the way of wide trails cut out along the mountain sides preliminary to the construction of tramways from the mine workings to the railway station $2\frac{1}{2}$ miles west at Hot Springs, at which point a smelter is located for the treatment of copper ores. The principal development work has been carried on in the Eldorado group of claims, and on the Napoleon and the Santa Maria properties. In all of these properties some ore has been opened up that will bear shipment and carries values in gold, silver, and copper.

EMERY COUNTY.

Lost Spring district.—The Frandsen property made a small shipment of ore carrying copper, lead, gold, and silver.

GARFIELD COUNTY.

White Canyon district.—The placers, known as the Bank of Ticaboo, located near Hite on Colorado River, produced gold in 1906 by ground sluicing. This bar is from 30 to 50 feet above the river. The concentrates contain much magnetite sand.

GRAND COUNTY.

Grand River district.—Considerable attention has been drawn to the placer deposits on Wilson mesa. It is reported that there are hundreds of acres of placer lands that will pan coarse and flake gold in abundance. The usual method of operation has been with a sluice box, and it is reported that these small operations have been cleaning up an average of an ounce of gold per day. A number of operators produced placer gold along the river, among them the Big Six Mining Company operating the Hamlin Bars. The output of the district is estimated at 157.22 ounces, according to reports of producers and dealers.

IRON COUNTY.

At Gold Springs, 14 miles westerly from Modena on the "Salt Lake Route," are located several gold properties, which may make productive a region that has lain dormant for several years. The prevailing rocks are limestone, with dykes of rhyolite and andesite. The fissure veins having a northwesterly trend are said to yield the best values.

The Jennie Gold Mining Company owns 9 claims on the Utah-Nevada line adjoining the Snowflake group, on the Nevada side in the Eagle Valley Mining district, in Lincoln County. The principal ore bodies are on the Matine ledge, and the main shaft is situated about 60 feet from the boundary line between the two States. Throughout the entire width of the lower drift, and for a distance of 120 feet, the ores encountered are reported to assay from \$9 to \$38 in gold. This body of ore extends to a depth of 130 feet, and from the development work performed enough ore has been extracted to pay for the amalgamation mill now under construction. The mine is equipped with a 40-horsepower gasoline engine, and sinking is progressing to the 200-foot level.

The Uvada Gold Mining Company adjoins the Jennie and part of the Snowflake group on the north. The property is being developed by a tunnel now in 340 feet. It is expected that the Jennie ledge will be cut at 540 feet. The Snowflake mine lies to the west of the Jennie in Nevada and has not been operated during the past year except for assessment work. The property is in litigation.

The Big 14 group of claims at Stateline has been worked under lease and has produced some high-grade ore during the year. However, no ore was shipped from the district during 1906.

JUAB COUNTY.

Fish Springs district.—About 25 miles southerly from the Dugway district in Tooele County is Fish Springs mining camp, at which is located the Utah mine, which has a dividend record. This property has continued regular shipments throughout the year, and has paid dividends averaging about $3,000 a month to its stockholders. At the present time only high-grade ores are shipped by wagon a distance of 65 miles to Oasis, on the "Salt Lake Route," the nearest railroad point. The workings have attained 900 feet. Several carload shipments made from the property have reported assays as high as 140 ounces of silver and 45 per cent of lead.

Tintic district.—Since the discovery of the old Eureka Hill mine in the year 1870, the great mining district of Tintic has never been in as prosperous a condition as it is at present, this being due principally to the steady advance in the price of metals, and also to increased development work and intelligent application of the more modern methods of mining.

Production of gold, silver, and associated metals in the Tintic district, Juab and Utah counties, Utah, in 1905 and 1906, with increases and decreases.

Metal.	1905.		1906.		Increase (+) or decrease (—).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold..........fine ounces..	100,942	$2,086,656	93,125.09	$1,925,066	− 7,816.91	− $161,590
Silver..........do....	3,951,348	2,386,614	4,610,794	3,089,232	+ 659,446	+ 702,618
Copper..........pounds..	10,982,751	1,713,309	7,321,471	1,413,044	− 3,661,280	− 300,265
Lead..........do....	18,702,573	879,021	32,022,190	1,825,265	+13,319,617	+ 946,244
Total..........	....	7,065,600	....	8,252,607	....	+1,187,007

The production of ore in the Tintic district, Juab and Utah counties, Utah, in 1906, amounted to 317,576 short tons, worth $25.98 per ton, as against 266,761 tons, worth $26.48 per ton, in 1905, a net increase of 50,815 short tons and a decrease of $0.50 in value per ton.

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 and Utah counties, Utah, in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold..........	1905	132	77,610.00	1,379.00	20,503.00	1,318.00	100,942.00
	1906	1,062	52,648.13	2,058.32	36,933.19	423.45	93,125.09
Silver..........	1905	6,600	1,656,391.00	310,435.00	1,818,174.00	159,748.00	3,951,348.00
	1906	53,100	1,257,531.00	768,098.00	2,451,316.00	80,749.00	4,610,794.00

The property of the Centennial-Eureka Mining Company was opened up in 1876 and has been a producer almost from the beginning. The holdings of the company consist of 230 acres of mining ground, developed by more than 15 miles of underground workings. The main shaft is 2,144 feet deep. The ore in the lower workings is of high grade, and the bodies are as large as on the upper levels. The mine produced during the year 86,420 tons of ore containing gold, silver, and copper. This company is one of the subsidiary companies of the United States Smelting and Refining Company.

The property of the Bullion Beck and Champion Mining Company has been brought into a prosperous condition by adopting the leasing system, which was begun about four years ago, since when it is known that the lessors have taken about $300,000 in profits. Under this system of mining every miner working on leases earns an average of over $4 per day, and the old underground workings of the mine, supposed to have been stripped of ore, have yielded very substantial returns. The number of shipments from this property during the year is reported to be 392 cars of crude ore. The shaft is 1,300 feet deep. This is one of the old producers of the district, and its ores carry principally lead, with good values in copper, gold, and silver.

The Eureka-Hill Mining Company has its property developed by a vertical shaft 1,500 feet deep. Most of the ore shipped is mined by lessees. The principal metal is lead, with good values in copper, gold, and silver. A 100-stamp concentration and amalgamating mill of 200 tons capacity on the property was not in use during 1906.

To the south, on the opposite side of the mountain from the properties of the last two companies mentioned, the Victoria Mining Company, which has become a producer within the last two years, reported about 200 cars of good grade copper-silver ore during the year, and dividends to the amount of $125,000 to its shareholders, making a total since the mine began to produce of $162,500. Developments are carried on through a vertical shaft 1,600 feet deep.

The Gemini Mining Company ranks second in importance in Tintic shipments, having sent to the smelters during the year 697 cars of ore containing gold, silver, copper, and lead. The property is worked by a vertical shaft 1,700 feet deep.

During the year the Ridge and Valley Mining Company is credited with shipping 89 cars of silver-lead ore. The mine has been developed and operated through the Gemini Mining Company's shaft.

The Uncle Sam Consolidated Mining Company shipped 146 cars of lead-silver ore. The old 90-foot incline shaft is being sunk to a depth of 250 feet, and for this purpose the company is at present engaged in putting in an electric hoist.

The Yankee Consolidated Mining Company experienced a severe loss by having almost its entire plant destroyed by fire. However, it shipped 176 cars of crude ore during the year. The property is developed by a tunnel 2,000 feet long and a 45-degree incline shaft 500 feet deep.

The Mammoth Mining and Milling Company states that it will abandon its shaft, the deepest in the district and at present 2,225 feet deep, because stoping has been carried too close to the shaft for safety. It is said that a new shaft will be sunk farther up the gulch, east of the present hoisting plant. The mine has a record of shipping during the year 641 cars of crude ore, which contained mainly copper, with lead, gold, and silver, its greatest value being in gold.

The Victor Consolidated Mining Company, owning the property adjoining the Carisa mine, continued sinking its shaft from the 500-foot level and expects to go 300 feet deeper. Sixteen carloads of crude ore shipped from the property during the year carried its principal values in copper, with some in lead, gold, and silver.

The May Day Mining and Milling Company maintained its regular course of shipments with good results and also carried forward a great amount of development work during the year. Shipments have been made from the 300 and 400 foot levels; on the latter fully 1,600 feet of development work was done, the company employing from 40 to 50 men and several machine drills to push the work ahead.

The Ajax Mining Company has development consisting of a 3-compartment vertical shaft with 5 levels 100 feet apart. The property is a steady producer of ore carrying principally copper with gold and silver.

The Carisa Copper and Gold Mining Company has produced from the 300-foot level in the last few years considerable ore, carrying mainly copper with gold and silver.

The Laclede Mining Company has a vertical shaft on the property 500 feet deep. The principal metal contained in the ore is copper with lead, gold, and silver.

The Grand Central Mining Company, owning property adjoining the Mammoth mine, is a regular producer of ores carrying mainly lead and copper with gold and silver.

The Joe Bowers Mining Company has sunk its shaft 400 feet deep. The property was operated under lease for a few months in 1906, shipping lead ore containing gold and silver.

The Lower Mammoth Mining Company did considerable development work during the past year and blocked out much ore between the 1,500-foot and 1,750-foot levels that promise to make the property a producer for many years.

The Undine mine was in the hands of lessees and produced lead ore carrying copper, gold, and silver.

The Beck Tunnel Consolidated Mining and Milling Company reported during the past year 342 cars of crude ore with lead and silver values, and dividends amounting to $305,000. This property has been the sensation of the district, opening up as it does a new area of productive mineral territory. Other properties with allied interests are the Colorado, Iron Blossom, and Crown Point. The Colorado will be a producer in 1907; the others will be developed. The ore body in the Beck Tunnel mine is said to be similar to the large body of galena occurring in the Humbug ground of the Uncle Sam Mining Company a number of years ago. This latter body was 50 feet long, 13 to 20 feet wide, and 50 to 60 feet high, and was formed entirely of almost pure lead-sulphide, averaging 75 per cent lead and 50 ounces of silver per ton.

The Brooklyn Consolidated Mining Company and the Tintic Iron Company are producers of iron ore with about 59½ per cent of metallic iron.

The Victoria Mining Company operated through the Grand Central Mining Company's shaft and has shipped during the year considerable lead ore. Its principal values are silver, with some gold.

The Black Jack Mining Company made shipments of ore from its property carrying lead, silver, and gold.

The West Morning Glory Mining Company has its property developed by a shaft 500 feet deep, but has been idle for several years, and the ore shipped during the year was taken from the dump. It contained mainly copper, with gold and silver.

The Eagle and Blue Bell Mining Company has sunk a shaft on its property 1,100 feet deep and has driven a tunnel 1,200 feet. The copper-lead ore shipped last year has its greatest values in gold and silver.

The South Swansea Mining Company turned its property over to lessees, who took out several shipments of lead ore carrying values in gold and silver.

The Star Consolidated Mining Company produced lead-copper ore carrying gold and silver.

The Swansea Mining Company, with a vertical shaft sunk 1,050 feet deep, shipped considerable lead ore containing gold and silver and paid $18,000 in dividends during the year. Its operations have been and still are confined to ore bodies above the water level. Developments indicate large bodies of low-grade iron sulphides interspersed with better grade of ore.

MILLARD COUNTY.

Leamington district.—The Yellowstone claim, which is developed by an incline shaft 200 feet deep, produced some lead ore carrying silver.

MORGAN COUNTY.

Argenta district.—The Carbonate Hill Mining Company shipped a number of carloads of lead ore carrying silver to the Salt Lake smelter.

PIUTE COUNTY.

Gold Mountain district.—The Annie Laurie Mining Company develops its property by 3 tunnels, each of which is over 3,000 feet long. The property is equipped with a 250-ton dry-crushing amalgamation and cyanide mill. The bullion shipped has its greatest values in gold. This property was closed down in August and went into the hands of a receiver.

The Sevier Consolidated Mining, Milling and Power Company is developing by 6 tunnels which aggregate $1\frac{1}{4}$ miles in length. The mill is equipped with 18 Merrals stamps and a cyanide plant having a capacity of 100 tons of ore per day.

SALT LAKE COUNTY.

Little and Big Cottonwood districts.—In 1906 these two districts mined and shipped 20,801 tons of ore, with a value of $587,934 for the gold, silver, copper, and lead content, the production coming from 10 properties, an increase of 4 reporting over the preceding year. Comparing the figures with those for 1905, the ore decreased 5,202 short tons while the value increased $135,959. The gold in these two districts is obtained from lead ore, 54.44 ounces; copper-lead-zinc ore, 686.80 ounces; copper-lead ore, 20.83 ounces; a total of 762.07 ounces. The silver is secured from copper ore, 91 ounces; lead ore, 4,577 ounces; copper-lead-zinc ore, 13,062 ounces; copper-lead ore, 327,372 ounces;

a total of 345,102 ounces. Five claims, formerly known as the Snowstorm, Peosta, and Merrill-Soules, were consolidated in 1906 with the 12 claims of the City Rocks Mining Company. Thirty years ago shipments from the surface deposits of the former properties carried silver and lead in paying quantities. Much of the ore carried high copper contents, which at that time were penalized by the smelting companies. During the last few years lessees of the property have made many profitable shipments. Within the last few months the company has abolished the leasing system and is itself working the property. Three tunnels of 1,500, 2,000, and 2,500 feet, respectively, were extended toward the vein with the purpose of intersecting ore bodies proved to exist in the discovery shaft. A fourth tunnel has been planned which will be 6,000 feet long and will be started 700 feet below the 2,500-foot tunnel. On account of a scarcity of teams for hauling ore to the railroad, the output for 1906 was greatly lessened.

The South Columbus Consolidated Company was newly organized during the year and acquired the holdings of the South Columbus and Alta-Quincy Mining companies. Development work is being carried on by the projection of a tunnel which will cut the contact nearly 1,000 feet below the surface. Since the consolidation the ore bodies have been explored successfully through the Quincy tunnel, from which crosscuts are developing ore carrying gold, silver, and copper. A great quantity of milling ore has been opened up, which is reported to have between 3 and 4 per cent copper.

The Columbus Consolidated Mining Company reports mining and shipping 6,134.6 tons of first-class ore, which netted the company \$284,212, or an average of \$46.33 per ton. There were also mined 12,299 tons of milling ore having a gross value of \$11.15 per ton. Development work during the year consisted of 3,304 feet of tunnels, drifts, and prospects, 238 feet of shaft sinking, and 582 feet of up-raises. The total development work on the property during the year was 4,124 feet, at an average cost of \$16.99 per foot.

The West Columbus Mining Company made its first shipment of ore in September and obtained substantial values in copper and silver. The company owns the Silver Dipper and Leroy group of claims.

The Continental-Alta Mines Company is a regular shipper of lead ore containing some copper, with good values in silver and gold.

The Albion Mining Company shipped 1 carload of ore carrying lead containing gold and silver. The Silver King Group shipped ore carrying lead, copper, and silver.

The Consolidated Flagstaff Mines Company made a number of shipments of lead ore carrying gold and silver. Development work was carried on by a tunnel 120 feet long.

The Copper Apex Mining Company, in the Big Cottonwood district, is developing its property by an incline shaft 150 feet deep. Some ore was shipped during the year giving values in lead, copper, and silver. The Scottish Chief mine is developed through an incline shaft 700 feet deep. The ore shipped contained lead, copper, silver, and gold. The Maxfield Mining Company shipped considerable lead ore carrying some copper, gold, and silver during the year.

West Mountain (Bingham) district.—The production of Bingham Camp for 1905 and 1906 is given in the following table:

Production of gold, silver, and associated metals in West Mountain or Bingham district, Salt Lake County, Utah, in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	63,701	$1,316,817	78,986.03	$1,632,786	+15,285.03	+ $315,969
Silver..................do....	1,980,583	1,196,272	1,927,350	1,291,325	− 53,233	+ 95,053
Copper..............pounds..	39,219,734	6,118,279	39,424,276	7,608,885	+ 204,542	+1,490,606
Lead....................do....	23,494,879	1,104,259	22,927,661	1,306,877	− 567,218	+ 202,618
Total....................	....	9,735,627	....	11,839,873	....	+2,104,246

The production of ore in the Bingham district, Utah, in 1906 was 996,121 tons, worth $11.88 per ton, as against 1,012,009 tons, worth $9.62 per ton, in 1905, a net decrease of 15,888 short tons and an increase of $2.26 per ton.

The number of producers in 1906 was 25. As shown in the above table, the production of gold and copper increased and silver and lead decreased, but the values of all metals show a substantial increase on account of the high prices paid for them during the year. Copper ores contain the larger part of the gold produced in the district and the copper-lead ores most of the silver. This is shown in the following table, which gives the origin of the precious metals by kinds of ore:

Source of gold and silver production in the West Mountain or Bingham district, Salt Lake County, Utah, in 1905 and 1906, in fine ounces.

Metal.	Year.	Copper ore.	Lead ore.	Copper-lead-zinc ore.	Copper-lead ore.	Total.
Gold........................	1905	46,910.00	1,873.00	....	14,918.00	63,701.00
	1906	65,946.78	189.89	190.61	12,658.75	78,986.03
Silver........................	1905	608,235.00	526,466.00	....	845,882.00	1,980,583.00
	1906	724,863.00	19,328.00	30,803.00	1,152,356.00	1,927,350.00

The producers of the district are: Utah Consolidated Mining Company, United States Mining Company, Utah Copper Company, Bingham Consolidated Mining and Smelting Company, Boston Consolidated Mining Company, Tintic Mining and Development Company, Bingham-New Haven Mining Company, Ohio Copper Company, Phoenix Mining Company, Sampson Mining Company, Fortuna Mining Company, Utah Apex Mining Company, New Red Wing Gold Mining Company, Butler Liberal Consolidated Mining Company, Cluster Mining Company, Silver Shield Mining and Milling Company, New England Gold and Copper Mining Company, Massasoit Mining Company, Strickley-Montezuma Mining Company, United Bingham Mines Company, Bingham Group Mining Company, Frieda and Pappea claims, and Winnamuck mine. The principal producers of the district are mentioned in the following paragraphs;

The Utah Consolidated Mining Company reports a general scarcity of labor throughout the year 1906 at both mine and smelter. While this did not necessitate a shut down of any part of the company's works, it retarded operations. The fuel shortage during the last months of the year also affected the capacity of the smelting plant. According to the annual report of this company, the developments continue to be satisfactory. There were mined during the year 277,874 tons of sulphide copper ore, 677 tons of oxidized gold ore, and 235 tons of lead ore. The copper and gold ore was shipped to the company's smelter and the lead ore was sold in the open market. There were treated 279,737 tons of sulphide ore, 677 tons of oxidized ore, and 16,576 tons of custom ore, an average of 766.4 tons per day of sulphide ore. The product of the ore was 18,994,816 pounds of bullion, which yielded 18,533,974 pounds of fine copper, 457,812.24 ounces of fine silver, and 42,601.22 ounces of fine gold. Of the above refined product, the custom ore yielded 170,000 pounds of fine copper, 3,271 ounces of fine silver, and 15,110 ounces of fine gold. Practically all of the above product came from the workings above No. 5 level, the exception being about 50,000 tons taken out in No. 1 ore body, on stopes on 6 and 7 levels, and from one of the smaller western ore bodies, which was stoped on 6 level. Stoping was by the square-set system, with filling where necessary. The contract system in the employment of labor was continued. During the year 10,732 feet of exploring and development work was done, 8,007 feet of which was in rock and 2,725 feet in ore. This work was confined principally to the upper levels, and resulted in the development of about 280,000 tons of copper sulphide ore. The most important development of the year has been what is known as the "Pacific ore body" in the western end of the present workings, and at an elevation of about 150 feet above No. 5 level. Here a large, flat ore body of exceptionally good grade was opened up, and about 175,000 tons mined from it during the year. Apparently this ore body extends extends westward beyond a well-defined fault line, into ground never before proved productive, and makes the territory to the west very promising. The mine equipment has been kept in good repair and the cost charged to operating. An aerial tramway, for transporting supplies to the upper mine workings from the present upper tramway terminal, is in course of construction. The tonnage of sulphide copper ore in sight is estimated at 1,100,000 tons. Accounts to December 31, 1906, show a net profit for the year of $2,835,008.57 ($9.45 per share), out of which $1,650,000 ($5.50 per share) was declared in dividends.

The original properties of the United States Mining Company were known as the Old Jordan and Old Telegraph mines, comprising more than 750 acres through which runs the Old Jordan lime belt, so called, for a distance of 2½ miles. This vein, opened in 1863, has been worked continuously since that time and, as reported, has produced more than $50,000,000 gross value of lead, silver, copper, and gold ores. More than 30 miles of tunnels and drifts have been run and the deepest workings are but 150 feet underneath the lowest tunnel. These mines have produced during the past year 95,270 tons of ore, which have been transported about 3 miles over the company's aerial tramway to a connection with the railroad, and thence about 10 miles to the company's smelter at Bingham Junction, 12 miles south of Salt Lake City

The Utah Copper Company's operations have been chiefly directed toward the further development of its ore bodies by preparing the property for enlarged operation and by erecting the new reduction works at Garfield, about 14 miles west of Salt Lake City. The mining property of the company is situated on the northeast and southwest sides of Bingham Canyon, a short distance above Carr Fork. The ore body is an immense mass of porphyry carrying cupriferous pyrite, which is found both in small stringers and disseminated throughout the rock. The sulphides carry a small amount of gold and silver. The development on the southwestern side of the creek consists of a main tunnel driven into the hill. On the northeast side of the creek, a similar plan of development has been adopted and the workings of both sides of the creek have been connected by drifts under the creek bed. Electricity for lighting and haulage is used throughout the property. The ore is hauled to bins alongside the "Copper Belt" railroad, loaded by gravity into railroad cars and hauled to the experimental mill, which has a capacity of 800 tons of ore per day, and concentrates it 20 into 1; this ore comes mostly from development work and is said to average about $5 per ton in copper, gold, and silver. The mill has been hampered by lack of proper railroad service and is therefore unable to handle the tonnage needed for constant operation. The first unit of the Garfield plant of this company went into operation in March, 1907. It is expected the first unit will produce 2,000,000 pounds of copper per month, while the mill in Bingham Canyon should produce 500,000 pounds of copper monthly.

The Bingham Consolidated Mining and Smelting Company owns the Dalton and Lark, Antelope, Brooklyn, Commercial, Miner's Dream, Sampson, Old Hickory, Vernard, Bingham, and sundry other mines and claims in this and other counties of Utah. The Bingham properties have a considerable variety of ores; at and near the surface principally sulphides with gold and silver-lead values are found. The company owns a smelting plant at West Jordan, Utah, 13 miles from the mine. The mines have lately been taken over by the same interest which controls the Ohio Copper Company property. The Mascotte tunnel of the Dalton and Lark mine, which is about 8,000 feet long, will be driven on to a connection with the ore bodies of the Ohio mine, as well as with those of the Commercial mine belonging to this company. To reach this point, the tunnel will have to be extended about 7,000 feet.

The Boston Consolidated Mining Company owns about 365 acres of mining property, with a general northeast-southwest trend, in the heart of the Bingham camp. The southwesterly portion includes the limestone and quartzite in which the sulphide ore bodies are situated, and from which 600 to 700 tons of sulphide ore are being shipped daily. The northeastern portion of the property, which is reported to cover 75 acres of the copper-bearing porphyry, rises in a mountain 700 feet above creek level, and from results of diamond-drill holes, is believed to warrant mining for 300 to 400 feet below the creek level. It is purposed to extract daily 400 to 500 tons of this low-grade ore; and, on its becoming evident that no ordinary method of mining would meet the necessities of the case, on June 24 a 95-ton Vulcan steam shovel with a 3-yard dipper was brought into use, this company being the first to commence actual shoveling in the camp. This shovel loads into 4-yard, side-dump, narrow-gage cars in trains of 10 cars each, pulled by an 18-ton saddle-back engine. Four engines are used in attending the shovel and one other is in reserve. About October 1, a second steam shovel of the 90-ton Marion type was placed in commission. To the mine equipment has been added an electric locomotive for use in one of the tunnels, and a 20-drill air compressor, for which power was furnished by the Telluride Power Company.

At Garfield, at close proximity to the plant of the Garfield Smelting Company, a site was secured for the largest gravity stamp mill in the world. It is estimated that 3,400 tons of structural steel material will be used in its construction. The mill will contain 360 Nissen independent stamps, with provision for an additional 360 Nissen stamps after completion of the first installment, and when completed will handle 6,000 tons per day. It is expected that the entire plant will be placed in commission during 1907.

The Tintic Mining and Development Company owns the Yampa group of claims, and is also allied with the Yampa Smelting Company. The mining property adjoins the Highland Boy mine of the Utah Consolidated. The mine has upwards of 2 miles of underground workings, being developed by 2 tunnels and a 1,700-foot shaft, which has 7 levels and connects at the bottom with the Craig tunnel, 3,248 feet long, through which the ore is removed. The ore is similar to that found in the Utah Consolidated property.

According to the report to the stockholders for the fiscal year ending September 1, 1906, the Bingham-New Haven Copper and Gold Mining Company shipped 10,795 dry tons of ore, for which $190,657, or $17.66 per ton, was received. The ore contains lead, silver, zinc, copper, and some gold. The veins are contacts of quartzite and limestone, striking east-west with a dip to the north. The ores occur at the intersections of these contacts with north-south fissures.

The Ohio Copper Company's property adjoins that of the Utah Copper Company on the southeast. The ore is a quartzite carrying cupriferous pyrite, malachite, azurite, and some native copper. This ore body has been opened up for a distance of 800 feet in length by 100 feet in depth by means of a series of drifts and crosscuts and by a winze. The ore is of 2 classes—a milling ore, which will average about 4 per cent copper, with some gold, and a shipping ore, which assays from 15 per cent to 20 per cent copper. The latter ore occurs as a streak in the mill ore from 18 to 36 inches wide. The company owns the milling plant of 200 tons daily capacity located on the old "Winnamuck" mine, to which the ore is hauled by the "Copper Belt" Railroad. A new mill is planned near the mouth of the Mascotte tunnel of the Dalton and Lark mine. The capacity will be 2,000 tons of ore per day.

The Phoenix Mining Company owns a group of claims covering about 70 acres, situated on Upper Carr Fork, adjoining the property of the Utah Apex mine. A new tunnel has been driven for 1,600 feet, in which 3 fissures have been encountered carrying values in copper and lead. The main ore body is about 8 feet wide; from it considerable milling ore has been treated and concentrates shipped to the smelter during the year. A new concentrating mill, erected near the mine during the last year, treated 15 tons of ore per shift of 8 hours. About 15 tons of concentrates have been shipped each month, averaging 40 to 55 per cent lead, 9 ounces silver, $1 in gold, and 15 per cent excess in iron.

SAN JUAN COUNTY.

Colorado River district.—The Goodenough Placer was operated and reports handling 1,400 cubic yards of material. The output of the district was largely estimated, having been reported by merchants.

San Juan River district.—Gold-bearing gravels and sand exist in the southeastern part of this county on the San Juan River for a distance of more than 200 miles, commencing near the headwaters of West Mancos Creek and extending more than 100 miles west of Bluff City. This region has been almost inaccessible, but much prospecting was done in it in 1906. The Nugget Canyon Placer and Dredging Company is planning dredging operations on a large scale. The dredging machinery will be carried in from Winslow, Ariz.

SEVIER COUNTY.

Henry district.—Two shipments of ore carrying gold and silver were made by the B. W. and H. Company, which has continued to develop its property located near Richfield, Utah.

SUMMIT AND WASATCH COUNTIES.

The Park City mining region extends into both Summit and Wasatch counties. The greatest and most productive area lies in Summit County; only one producer reported from Wasatch County for 1906. The gold production of the Park City region in 1906 was $245,678, a decrease of $60,410 as compared with 1905; the silver production was 3,755,339 ounces, a decrease of 242,826 ounces from the figures of 1905; copper also decreased, but lead and zinc show quite important increases. The metals were extracted from ores produced by 14 mines, which yielded 264,792 tons. In 1905 the same number of mines yielded 228,142 tons. From this region, ores milled or shipped direct to the smelters during 1906 amounted to 264,792 short tons, valued at $5,857,983, an average value per ton of $22.12; in 1905 the mines yielded 228,142 tons of ore, an increase for 1906 of 36,650 tons in quantity and of $696,791 in value, due almost entirely to the increased output of lead and zinc. Concentrates were shipped amounting to 36,975 short tons, and containing $92,658 in gold and 1,282,150 ounces of silver. From 16,546 tons of old tailings, concentrates were shipped valued in gold and silver at $64,372.

The production of metals in the region in 1905 and 1906 is shown in the following table:

Production of gold, silver, and associated metals in Park City mining region, Summit and Wasatch counties, Utah, 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	14,807	$306,088	11,884.66	$245,678	− 2,922.34	−$60,410
Silver..................do....	3,998,165	2,414,891	3,755,339	2,516,077	− 242,826	+101,186
Copper...............pounds..	1,254,153	195,648	1,194,216	230,484	− 59,937	+ 34,836
Lead....................do....	45,280,817	2,128,198	46,511,176	2,651,137	+1,230,359	+522,939
Zinc....................do....	1,972,327	116,367	3,518,139	214,607	−1,545,812	+ 98,240
Total....................	....	5,161,192	....	5,857,983	....	+696,791

The production of ore in the Park City mining region, Utah, in 1906 amounted to 264,792 short tons, worth $22.12, against 228,142 short tons, valued at $22.62, in 1905, a net increase of 36,650 short tons and a decrease of 50 cents per ton.

The gold and silver originated chiefly in the lead ores, and their production from this source for the last five 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, 1905, and 1906.

Metal.	1902.	1903.	1904.	1905.	1906.
Gold........................fine ounces..	15,025	14,744	13,643	14,807	11,884.66
Silver................................do....	7,967,296	6,835,908	5,814,386	3,998,165	3,755,339.00

The producers of the region for 1906 are as follows: Silver King Mining Company, Daly-West Mining Company, Daly-Judge Mining Company, Little Bell Consolidated Mining Company, Kearns-Keith Mining Company, Ontario Silver Mining Company, New York Bonanza Mining Company, Daly Mining Company, Creole Mining Company, Jupiter Mining Company, Odin Mining Company, American Flag Mining Company, and miscellaneous tailings plants on Silver Creek. The reports of 3 of the principal producers in the region are summarized below.

The shaft of the Silver King Mining Company is now 1,500 feet deep, and the vein has been prospected for nearly 2,500 feet. Last year's developments show the ore body to extend far above the 700-foot level. Two veins are known to exist in the mine; one, known as the "Gold Vein," has not been opened to any extent, while the other lies at a contact between limestone and quartzite and varies in width from a few feet to over 100 feet. The contact vein has yielded in the neighborhood of $30,000,000, of which dividends have been paid amounting to $10,625,000. The company during last year added about 160 mining claims to its territory. The mine is equipped with a fine hoisting plant, the engine being of the Bullock-Corliss type, with double reels, each carrying 2,000 feet of flat 6-inch cable. A large cylinder Ingersoll-Sergeant compressor supplies air for power drills. The mine has its own machine shop, where its cages and cars are made. The mill, which was completed in 1899, is lighted by electricity and heated by steam. It is of 200 tons daily capacity. The ore is discharged over grizzlies into 2 sets of Blake crushers; from here it is screened, passed through Cornish rolls, and through the jigs, of which there are 16 of different mesh. The jig tailings are crushed by 4 Huntington mills, elevated to the classifier and then distributed on 15 Wilfley tables, while the finer material is treated on Frue vanners. The slimes are caught in a unique slime-pressing department and shipped as a separate product. The company owns its own sampling works, which are located at the railroad terminus and are connected with the mine and mill by an aerial tramway of the Finleyson type. Before the installation of the tramway the company paid out $1 per ton for hauling its ores to the smelter and $2 per ton for coal. The cost of the ore hauling is now less than one-fifth of this figure, and the coal is hauled up with practically no cost at all.

The Daly-West Mining Company in its published report gives the following information:

A large amount of exploration and development work has been done during the year with generally favorable results. On the lowest levels but little work of this nature was done, owing to the fear of encountering water, conditions at the Ontario drain tunnel being unchanged. The Ontario drain tunnel has been reopened to within 500 feet of the Ontario No. 2 shaft, and it is hoped that the tunnel will shortly be entirely opened up, which will give the Daly-West Company an opportunity to extend its drifts on the 1,200, 1,400, 1,500, and 1,550 levels to its western boundary, and also to open up its property to a considerably greater depth. The physical condition of the mine is better than it has been for some time past. The most important developments of the year were in the quartzite above the 900-foot level, opening up the Daly and parallel fissures on the 1,200-foot level and on the Little Bell contact, which will afford a considerable tonnage.

The ore shipments for the year 1906 are as follows:

Ore shipments of the Daly-West Mining Company in 1906, in short tons.

	Quantity.	Value.	Per ton.
Crude ore	11,544	$417,899.97	$36.20
Concentrates	11,212	528,850.88	47.17
Miscellaneous	3,311	66,687.69	20.14
Total	26,067	1,013,448.54	34.50

The mill has only been in operation during the day shift, and during June the plant was entirely idle owing to labor troubles. The amount of ore treated by the mill during the year was 75,745 dry tons. There was rejected by hand picking from the sorting belt 4,489 tons of waste; thus the actual tonnage crushed and milled amounted to 71,256. Much closer sorting is done in the mine than heretofore, so that early in the year the sorting out of first-class ore was entirely stopped and the pickers devoted their entire attention to the rejection of waste. The mill produced from the 75,745 tons of ore treated 11,212 tons of marketable product, containing by average assay 30.33 per cent of lead and 49.62 ounces of silver per ton. The average assay of the ore crushed and milled showed lead 4.77 per cent and silver 10.52 ounces. During the year there was marketed 554 tons of previously stored slime tailings. The mill treated during each day of service 416 dry tons. There were concentrated 6.86 tons of crude ore into 1 ton of concentrates with a recovery of 98.44 per cent of the lead and 73.04 per cent of the silver. Of the silver lost in the tailings it was found that 33½ per cent was in the form of a chloride that can not be recovered by concentration.

The Daly-Judge Mining Company in its annual report to stockholders gives the following interesting data: During the year 63,322 tons of ore were mined; of this, 13,011 were of a shipping grade. The amount of crude ore treated in the mill was 58,845 tons, including some ore mined before January 1, 1906, which was reduced to 9,838 tons of lead concentrates and 8,320 tons of iron and zinc middlings, showing 1 ton of concentrates produced from each 3.2 tons of crude ore. The crude ore averaged 20.67 ounces of silver, 0.091 ounces of gold, 24.61 per cent of lead, 0.41 per cent of copper, 14.62 per cent of zinc, and 16.04 per cent of iron. It sold for $28.72 per ton. The concentrates averaged 18.40 ounces of silver, 0.070 ounces of gold, 33.33 per cent of lead, 0.17 per cent of copper, 7 per cent of zinc, and 19.64 per cent of iron. They sold for $36.71 per ton. The zinc middlings sold for an average of $5.95 per ton and the iron middlings for $10.05. The average amount of ore treated per day was 165 tons.

During the year approximately 2,000 feet of development work was done exclusive of the prospecting work in the ore bodies. The drifting was done mostly on the 1,500-foot level. Some fine ore bodies were encountered, notably one on the 1,500-foot level, where a strong shoot 10 to 30 feet wide by 250 feet long was opened. This ore is practically free from zinc, but high in iron. A good part of the crude ore shipped during the year came from this stope, and as similar ore bodies are opened on the 1,300 and 1,400 foot levels above, it is expected to find good stoping ground between these levels. In the McSorley drift, just above the 1,200-foot level, the ore bodies have improved westerly toward Bonanza Flat. The face of the stope now measures fully 50 feet and is largely of milling grade, but a fair tonnage of shipping ore is sorted from it. This ore shoot is opened in places for several hundred feet southwest from the point where it is now being mined, and has varied from 10 to 25 feet in width and from 30 to 50 feet in height.

TOOELE COUNTY.

The greatest developments continue to be confined to the Camp Floyd, Stockton, and Ophir districts in this county, and to the North Tintic district in the southern part of the county. The Camp Floyd district relies mainly for its production on the Consolidated Mercur mines, all other properties being practically idle. It is understood that the properties at Sunshine will be opened up and the mills will be put into operation again with a new patent filter press.

At Stockton many of the mines were unable to keep up operation the entire year, in some cases on account of shortage of fuel, in others because of shortage of cars, and this reason also applies to the decrease in production in the Ophir district.

The county is credited with an ore production in 1906 of 420,085 short tons, valued at $2,359,742 (exclusive of iron and mercury). Compared with the production of 430,453 short tons, valued at $1,680,588, in 1905, this is a decrease of 10,368 tons in quantity and an increase of $679,154 in value.

The production of gold, silver, etc., in Tooele County in 1905 and 1906, exclusive of iron and mercury, is as follows:

Production of gold, silver, and associated metals in Tooele County, Utah, in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold............fine ounces..	44,821	$926,532	44,633.58	$922,658	− 187.42	− $3,874
Silver..................do....	327,556	197,844	358,813	240,405	+ 31,257	+ 42,561
Copper..............pounds..	1,093,197	170,539	1,570,689	303,143	+ 477,492	+ 132,604
Lead....................do....	8,205,814	385,673	13,347,160	760,788	+ 5,141,346	+ 375,115
Zinc....................do....	....	....	2,176,200	132,748	+ 2,176,200	+ 132,748
Total..................	....	1,680,588	....	2,359,742	....	+ 679,154

The production of ore in Tooele County, Utah, in 1906 amounted to 420,085 short tons, valued at $5.61 per ton, against 430,453 short tons, valued at $3.90 per ton, in 1905, a net decrease of 10,368 short tons and an increase of $1.71 per ton.

The following table shows the source of gold and silver in 1905 and 1906, by kinds of ore:

Source of gold and silver in Tooele County, Utah, in 1905 and 1906, by kinds of ore, in fine ounces.

Metal.	Year.	Siliceous ore.	Copper ore.	Lead ore.	Copper-lead-zinc ore.	Copper-lead ore.	Lead-zinc ore.	Total.
Gold	1905	44,292.00	2	127.00	176.00	1.00	223.00	44,821.00
	1906	43,985.75	....	259.69	200.87	66.20	121.07	44,633.58
Silver	1905	456.00	250	39,474.00	254,908.00	429.00	32,039.00	327,556.00
	1906	2,600.00	....	20,514.0Q	205,288.00	55,395.00	75,016.00	358,813.00

Camp Floyd district.—The only companies operating in the district are the Consolidated Mercur and the Sacramento. Both have experienced a fairly prosperous year. In addition to paying $100,000 in dividends, the Consolidated Mercur Company has met the cost of making changes in its process that will effect an additional saving of $0.50 per ton in the value of the ores mined and treated. It had the misfortune to suffer considerable loss from fire and consequent curtailment of output for a brief season. Lessees have done a little work on the Northern Light property, and a few shipments of ore have been made. The report of the Consolidated Mercur Gold Mines Company covers the year ending June 30, 1906. In general the results of the year's work have been to economize in working expenses, to reduce the loss of gold in the tailings, and to restore the mine to much of its original productiveness. Development during the year was largely confined to reopening abandoned and caved stopes. Development in new ground has resulted in proving ore bodies, the boundaries of which had previously been determined. Much excellent ore was located in this way. The amount of ore mined and sent to mill was 302,806 tons, of which 126,538 tons, or 42 per cent, was base ore, needing to be roasted, and the remainder, 58 per cent, was oxidized ore, which required no treatment before cyaniding. The average value of all the ore treated was $3.76 per ton, 19 cents lower than during the previous year. This is explained by the larger proportion of ore contributed by the Magazine vein, which is of low grade, but so easily mined and treated as to be profitable, although on a narrow margin. The cost of mining and prospecting amounted to $1.41 per ton, or 10 cents less than during the previous year. A total of $428,464 was spent for mining. The average recovery from both Golden Gate and Manning mills was $2.88 per ton. The average value of the tailings during the year was $0.956 per ton, a somewhat lower average than during the previous year. Exhaustive experiments are under way looking to a still further reduction in loss of gold in the tailings. Milling at the Golden Gate mill cost $1.07 per ton, a reduction of 5 cents from the previous year. The Manning mill was run for only a short time, after a lease given to outside parties had been abandoned. The roasting plant now includes 6 roasters, the average daily output of which was 68 tons. The roasting cost is $1 per ton; the fuel is slack coal, which costs $5.25 delivered. The gold produced amounted to $870,887, or $2.88 per ton. The net profit was $104,122, or $0.36 per ton. During the year $100,000 was distributed in dividends. The company's total dividends since its organization have been $1,155,000 on $1,000,000 of capital stock. Adding the dividends paid by the old Mercur and De Lamar companies previous to their consolidation into the present company makes a total of $3,335,313 distributed from the earnings of these mines. Experiments in the leaching department have led to the conclusion that lime can be more economically and satisfactorily used than caustic soda. Accordingly, a limekiln has been built, and the lime has been used almost alone for several months. One result of its use has been the reduction in the consumption of cyanide used from 0.88 pound to 0.59 pound per ton of ore. Zinc dust is used for precipitating. The mill was closed during part of December on account of lack of coal.

The Sacramento Gold Mining Company maintained its production throughout the season. Practically all the quicksilver that the State produces comes from the Sacramento. The sum of $40,000 was distributed to stockholders during the year.

The Overland Mining Company has been in the hands of a receiver for several months, and, under such management, sank a new shaft, cutting, at a depth of 860 feet, ore reported to average $3.25 per ton in gold. The mill, of 300 tons capacity, equipped for the cyanide process, was operated a short period during the year for the purpose of getting the accumulated ores out of the way.

Clifton district.—This district, lying about 50 miles north of Fish Springs district, is about 12 miles square, and is bounded on the south by the Overland Canyon, the old route to California. Clifton Gulch is about the center of the camp, and at different times has had 2 smelters in operation in the past thirty years. On the Gold Hill property a smelter was built and operated in the early days and produced some lead bullion; afterwards it was abandoned as the ores turned to free-milling gold. Later an amalgamation mill was installed.

During the past year the Western Utah Copper Company has taken over the most important properties at Gold Hill, and has developed them to a depth of 450 feet. Important ore bodies are said to have been opened in this mine. The ores of the camp, which have a gross value of about $20 per ton, are almost entirely copper bearing with characteristic values in gold and silver. It is expected that the Western Pacific Railway will build a branch line into this district some time during next year.

Dugway district.—The formation in the Dugway district is principally limestone underlaid by quartzite and cut by porphyry dikes. The ores carry lead, copper, silver, and gold. The Buckhorn group of claims was the first to attract the attention of prospectors. From it has been shipped some very good silver ores that were taken from the surface. The following are some of the promising properties of the district: Yellow Jacket, Buckhorn, Silver King, Golconda, Metallic Hill, St. George, Utahna, Dugway Mine, Eureka-Golconda Pennant, Black Warrior, Francis Bryan, Red Metal, Sunday, Four Metals, Ocean, and many others.

North Tintic district.—The Scranton Mining and Milling Company, with headquarters in Scranton, Pa., which owns the property formerly known as the Tiernan iron mine, about 10 miles north of Eureka, Utah, has shown considerable activity during the past year in the production of lead and zinc ore. On the tunnel level an ore body has been followed for 300 feet, and the ore shipped during development work, amounting to 40 tons per day, has been taken out in running the various drifts. Two-thirds of this is a zinc silicate, with 30 to 40 per cent zinc, that goes to the Kansas furnaces, while the balance is a good grade of lead ore of about 45 per cent lead, which goes to the Salt Lake smelters. The product is hauled to Del Monte, the nearest shipping point on the "Salt Lake Route." The property is equipped with a compressor and other machinery. Encouraging reports come from the neighboring properties. Among the promising properties are the Comet and Oxford groups, which are said to be located on the strike of the Scranton ore chute. The New Bullion, a mile distant from the Scranton, promises to be a regular shipper in the near future.

Ophir district.—The largest producer located in the district is the Ophir Hill Consolidated Mining Company, which has been producing steadily through the year, and whose concentrating plant, enlarged to 150 tons daily capacity, has been kept in motion on an ore, which, though of low grade, is suitable for concentration. Electric power is used exclusively. Adjoining the Ophir property is that of the Cliff Mining Company, formerly known as the Buckhorn mine. A force of 60 men worked during the year, doing mainly development work. Three long tunnels have been driven, developing the lead-silver ores; and an aerial tramway 1 mile long has been installed to connect the mine with the railroad tracks.

Rush Valley or Stockton district.—This district lies but a few miles west from Bingham. During 1906 much prospecting and development work was in progress. Stockton was discovered during the early sixties and is one of the pioneer mining camps of Utah. After the mining of the rich surface ores of silver and lead, deeper mining was too expensive without some means of unwatering the mines other than pumping, and for a number of years the camp was dormant until the Honerine drain tunnel of nearly 11,000 feet was driven at a cost of more than $250,000. The tunnel connected the Honerine mine, the Black Diamond, and the Southport. The adit is still being continued and will eventually furnish an outlet for the ores of the Galena King and intermediate properties. During the year the New Stockton Mining and Milling Company was the principal producer of lead-silver ores, and succeeded in opening up some very extensive bodies of mill ores and a limited quantity of high-grade ore. The Black Diamond Mining Company has been making headway in the development and extraction of ore. The Southport Mining Company is one of the few new incorporations effected in 1906. The Katherine Mining Company is actively developing its ground, and recently began suit against the Honerine Company, charging trespass and unlawful extraction of ore. The Honerine Company operated its great mill during a short period and was a shipper of concentrates.

UINTA COUNTY.

Green River district.—Placer-mining operations were carried on in a small way by several operators; the output was reported by purchasers of bullion. Near the mouth of Cub Creek, the Uintah Placer Mining, Irrigation and Exploration Company is testing the old river channels and reports finding values in the gravel from 10 cents to $2 per yard. The gold is in very fine flakes.

UTAH COUNTY.

The Tintic mining district of Juab county overlaps this county and includes several important producers. The figures of production are included in the Tintic table.

American Fork district.—This district is situated at the head of American Fork Canyon, within the boundaries of a national forest. It is bounded on the northeast by Park City district in Summit County, and on the north by Alta or the Little Cottonwood district in Salt Lake County. It is reached by a good wagon road up American Fork Canyon, a drive of about 25 miles to the summit of Millar Hill, where the principal mines are located. In the seventies a narrow-gage railroad was built from the mouth of the American Fork Canyon to the mines and a smelter was erected and operated for a few years, treating the lead ores of the Millar and Dutchman mines. These old properties were abandoned after the immense surface deposits of carbonate lead ores had been exhausted. Freight is hauled to American Fork, the nearest railroad station. Eleven mining companies are operating in the district; three are shipping and the balance developing for lead ores. Two electric-power plants have been constructed in the canyon, and two more are planned.

The Wyoming or Millar mine has been actively worked for the past three years, and has about 12,000 tons of lead carbonate ore sacked and ready for shipment to the smelters. On account of the severe winter season this ore can only be handled during the summer months. The property is developed by tunnels, drifts, and raises, and belongs to the Aspinwall estate, of New York City.

The Dutchman mine has had some very extensive workings for 250 feet above the main tunnel, which has been driven 900 feet and is still in very fair condition, though all of the old stopes of the mine are caved. The ore taken from near the surface was carbonate of lead.

The Pacific Gold Mining and Milling Company, developing the Blue Rock group of claims, is located about a mile northeast of the Dutchman mine. A tunnel has been driven about 800 feet into the hill, gaining a depth of about 300 feet. The ore occurs in a carbonaceous shale between quartzite and limestone. The width of the ore-bearing shale between the two rocks forming the contact is from 12 to 40 feet.

The Pittsburg mine, located about 2 miles north of the Blue Rock claims, has had considerable development work performed upon it. The company owning the property plans the construction of an electric-power plant.

The Bog Iron group has been opened by a tunnel 400 feet long. Some high-grade ore and 19 tons of second-class ore were shipped in 1906, and the latter was said to assay 26 ounces of silver per ton, 13 per cent of lead, and 14 per cent of zinc.

WASHINGTON COUNTY.

Tutsagubet district.—The output of copper bullion of the Utah and Eastern Copper Company, owner of the famous old Dixie mines, a few miles from St. George in the southwestern part of the State, had its output materially reduced by a series of difficulties. The road built at great expense between the railroad and the company's smelting works at Shem for the use of traction engines to haul out the bullion and take in supplies of coke, etc., was washed out and much of it had to be reconstructed. When effort was made to start the smelter and the freight traffic on the railroads became congested, it was found impossible to get fuel enough to remain in operation.

The Paymaster properties, adjoining the Dixie, have been operated under bond during the year, and reports from the property indicate satisfactory results. Considerable work was done on gold properties in the western edge of the county during the year, and it is stated that mines of merit are being developed there.

VERMONT.

By H. D. McCaskey.

PRODUCTION.

During 1906 the State of Vermont produced 1,323 fine ounces of silver valued at $886. This output was entirely from copper ores, of which 7,399 short tons were treated, 765 tons being sent as crude ore to be smelted, and 6,634 tons being concentrated, resulting in 421 tons of concentrates. The production of copper from the high-grade ore and concentrates amounted to 240,315 pounds, valued at $46,381, thus giving a total value of silver and copper of $47,267. No gold was reported from Vermont in 1906. The average extraction of silver per ton of ore treated may, therefore, be placed at 0.18 fine ounce, valued at $0.12.

The well-known mines of Corinth, Copperfield, and Strafford are located in Orange County. The Pike Hill group, near Corinth, is developed by an incline shaft and an adit and is equipped with a 50-ton magnetic concentrator.

These copper deposits are large bodies of low-grade pyritic ores in mica schists thought to be metamorphosed sediments and of unknown age. In general characteristics they much resemble the famous Ducktown deposits of Tennessee. The Ely mine of Copperfield, the Union of Corinth, and the Elizabeth of Strafford have produced considerable copper in the past, and could probably be made to pay again with improvement of economic conditions in mining and treating large quantities of low-grade ore.

WASHINGTON.

By Charles G. Yale.

PRODUCTION.

The returns received from producers in the State of Washington for the calendar year 1906 show a yield of $221,648 in gold, $30,738 in silver, $45,360 in copper, and $52,787 in lead. The decrease in total values for the year is quite marked, the output being $175,667 less than in 1905. This falling off is entirely in the gold and silver output, both the copper and lead values showing a decided increase.

The gold output is less by $183,430 than in the previous year and the silver product less by $44,989. This is due to a general falling off in production, notably in Chelan, Ferry, King, Okanogan, Snohomish, Stevens, and Whatcom counties. Some prominent mines which were producers in 1905 did nothing last year, while several of the larger ones are holding back their ores for cheaper means of transportation. The decrease is due almost entirely to the less quantities of siliceous ores treated, the falling off in that class being 29,042 tons. The increase in output of copper ores brought little added gold or silver; and the lead ores treated were nonargentiferous. The increase in the production of copper and lead is natural, owing to the comparatively high prices of those metals during 1906. The copper output of 1906 is more than double that of the previous year, having increased by 126,321 pounds. The lead output is one-half greater, having increased by 321,057 pounds. The copper-producing counties, in order of amount of output, are Snohomish, Stevens, and Okanogan, while the entire lead yield was from Stevens County. The leading gold-producing county is Stevens, followed closely by Ferry, which latter produced also over half the entire silver of the State.

Washington, taken as a whole, is a State in which base or "refractory" ores predominate. It has very little free-milling ore, except in Whatcom County, and but few placers, and the majority of the miners and mining companies are therefore almost entirely dependent upon transportation and custom-smelting companies. In order that the mines may be worked at a profit, they must be located reasonably near a railroad line or some navigable waterway. The ore must be of comparatively high grade, or else freight and treatment charges must be very low; otherwise the mine must be an extensive one, capable of running and maintaining its own smelter and railway. These conditions are met in but few instances in the mining districts of Washington. Many of the important mineral-bearing counties are virtually without railways, and the ores in many camps are such that high charges for treatment are necessary. Under these prevailing conditions mining operations in the State are for the present more or less restricted.

In Washington during 1906 only $19,209 in gold and $95 in silver was derived from placer mines, and $28,671 in gold and $356 in silver recovered by milling and amalgamation, leaving the difference of $173,768 gold and $30,287 in silver to be accounted for by smelting operations.

Of the 52 mines reporting production, 38 are deep mines and 14 placers. Of these latter, 8 are surface or sluicing mines, 3 drift, and 3 hydraulic. Of the deep mines, 23 are gold properties, 10 copper, 33 lead, and 2 silver mines, this classification being made on the basis of chief product of each. Ferry and Stevens counties each have 10 producing deep mines, with no producing placers, and Kittitas has more placers than any of the other counties.

Returns were received from 549 nonproducing mines in Washington, of which Okanogan County reported the largest number, 128, followed in order by Stevens County with 94, Ferry 62, Snohomish 52, Whatcom 47, and Chelan 38. It will be noted that the proportion is very large as compared with the number of producers. In fact, only 8.65 per cent of the known mines in Washington are shown by these returns to have made any production, large or small. Doubtless many others could be made producers at once were it not for the circumstances previously referred to.

For the advancement of its mining industry Washington must look to new railroads, several of which are now in process of construction or are being planned. The new line of the Great Northern, following Columbia River from near Wenatchee, Chelan County, to Pasco, Franklin County, is assured, and will doubtless be of some benefit.

The new line entering Seattle and Tacoma should help relieve congestion and reduce freight charges. Besides these a new railroad, operated by electric power, is being planned to open up Okanogan County; and there is serious talk of a road from Newport to tap the Metalline mining district of Stevens County.

The following table shows the comparative production of gold, silver, and associated metals for the past two years, with the increase or decrease:

Production of gold, silver, and associated metals in Washington in 1905 and 1906.

Metal.	1905.		1906.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold................fine ounces..	19,595.63	$405,078	10,722.22	$221,648	−8,873.41	−$183,430
Silver........................do....	125,376	75,727	45,878	30,738	− 79,498	− 44,989
Copper....................pounds..	108,709	16,958	235,030	45,360	+ 126,321	+ 28,402
Lead.........................do....	605,043	28,437	926,100	52,787	+ 321,057	+ 24,350
Total..........................	....	526,200	....	350,533	....	− 175,667

To show the number of producing mines, 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 1906, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Asotin..........................	2	....	47.55	$983	18	$12
Chelan..........................	3	3	14.03	290	2	1
Clark..........................	1	....	4.84	100	....	....
Ferry..........................	10	6,364	3,422.14	70,742	26,463	17,730
King..........................	1	600	1,055.93	21,828	916	614
Kittitas..........................	9	28				
Okanogan..........................	7	1,175	425.65	8,799	6,558	4,394
Snohomish..........................	4	3,793	138.98	2,873	5,084	3,406
Stevens..........................	10	12,270	3,765.37	77,837	6,372	4,269
Whatcom..........................	5	2,900	1,847.73	38,196	465	312
Total..........................	52	27,133	10,722.22	221,648	45,878	30,738

County.	Copper.		Lead.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
Asotin..........................	....	....	....	....	$995
Chelan..........................	....	....	....	....	291
Clark..........................	....	....	....	....	100
Ferry..........................	52	$10	....	....	88,482
King..........................					22,442
Kittitas..........................	....	....	....	....	
Okanogan..........................	24,363	4,702	....	....	17,895
Snohomish..........................	138,302	26,692	....	....	32,971
Stevens..........................	72,313	13,956	926,100	$52,787	148,849
Whatcom..........................	....	....	....	....	38,508
Total..........................	235,030	45,360	926,100	52,787	350,533

The series of tables which follow, the nature of each of which is indicated by the heading, gives details, by counties, which show in condensed form the condition of mining in Washington during the year 1906:

Tonnage of ore sold or treated in Washington in 1906, by kinds of ores and by counties, in short tons.

Counties.	Dry or siliceous ores.	Copper ores.	Lead ores.	Total.	Increase (+) or decrease (−) as compared with 1905.
Asotin, Chelan, and Clark	3			3	− 355
Ferry and Franklin	6,363	1		6,364	− 3,176
King and Kittitas	628			628	− 439
Okanogan	975	200		1,175	+ 670
Skamania and Snohomish		3,793		3,793	− 1,371
Stevens	4,160	7,174	936	12,270	+ 254
Whatcom	2,900			2,900	−15,100
Total	15,029	11,168	936	27,133	−19,517
Increase (+) or decrease (−)	−29,042	+9,636	−111		
Average value in gold and silver per ton	$14.55	$1.25	$0.41		

Number of mines classified by chief product in Washington in 1906, by counties.

County.	Non-producing mines.	Mines reporting production.	Gold placer mines.				Deep mines.				
			Hydraulic.	Drift.	Sluice.	Total.	Gold.	Silver.	Copper.	Lead.	Total.
Asotin	5	2			2	2					
Chelan	38	3			1	1	2				2
Clark	3	1			1	1					
Cowlitz	3										
Ferry	62	10					9		1		10
Franklin	1										
King	32	1					1				1
Kittitas	46	9	2	3	1	6	3				3
Lewis	6										
Lincoln	6										
Okanogan	128	7			1	1	4	1	1		6
Skagit	12										
Skamania	9										
Snohomish	52	4							4		4
Stevens	94	10					2	1	4	3	10
Whatcom	47	5	1		2	3	2				2
Yakima	5										
Total	549	52	3	3	8	14	23	2	10	3	38

Source of gold production in Washington, by kinds of ore, in 1906, by counties, in fine ounces.

Counties.	Placers.	Deep mines.				Total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Total.	
Asotin, Chelan, and Clark	62.07	4.35			4.35	66.42
Ferry and Franklin		3,422.05	0.10		3,422.15	3,422.15
King and Kittitas	133.08	922.85			922.85	1,055.93
Okanogan	29.51	367.12	29.03		396.15	425.66
Skamania and Snohomish			138.98		138.98	138.98
Stevens		3,489.24	276.12		3,765.36	3,765.36
Whatcom	704.58	1,143.15			1,143.15	1,847.73
Total	929.24	9,348.76	444.23		9,792.99	10,722.23
Increase (+) or decrease (−)	+617.76	−9,645.23	+153.98		−9,491.25	−8,873.49

Source of silver production in Washington, by kinds of ore, in 1906, by counties, in fine ounces.

Counties.	Placers.	Deep mines.				Total.
		Dry or siliceous ores.	Copper ores.	Lead ores.	Total.	
Asotin, Chelan, and Clark	19					19
Ferry and Franklin		26,458	5		26,463	26,463
King and Kittitas	39	877			877	916
Okanogan	6	5,656	896		6,552	6,558
Skamania and Snohomish			5,084		5,084	5,084
Stevens		4,600	1,193	579	6,372	6,372
Whatcom	78	388			388	466
Total	141	37,979	7,178	579	45,736	45,877
Increase (+) or decrease (−)	+81	−69,758	+804	−10,626	−79,580	−79,499

REVIEW BY INDIVIDUAL COUNTIES.

ASOTIN AND CLARK COUNTIES.

There are 3 producing mines in these two counties, all surface placers with small outputs.

CHELAN AND FRANKLIN COUNTIES.

One placer and 2 quartz mines reported production from Chelan County in 1906. The county shows a very material falling off from the 1905 output, owing to the fact that the La Rica Consolidated Mining Company did not operate its mill during the year.

No producing mines are reported from Franklin County for the year.

FERRY COUNTY.

Ferry County reports 9 gold mines and 1 copper mine operated productively in 1906. The output for the year shows a decrease of $15,311 in gold and $3,377 in silver as compared with 1905. There were no productive placers in the county, the output having been from quartz and copper mines. There are three districts in the county—Meteor, Danville, and Republic, the latter being the only one of much importance, the others having yielded only nominal amounts from a small quantity of ore.

Republic district.—In this district 6,323 tons of ore were worked, yielding $69,957 in gold and $17,653 in silver—less than in the previous year. The ore treated averaged $11.12 per ton in gold and $2.79 in silver. The principal producers were the Ben Hur, Pearl Consolidated, and Quilp. A good deal of the ore was shipped to British Columbia smelters for treatment. The largest producer of both gold and silver is the Ben Hur, although the Pearl Consolidated had the largest tonnage. Although Republic is considered one of the best camps in the State the mines were quite generally closed during 1906, awaiting a cheaper means of treating their ore. The ore is siliceous with good values in gold and silver and practically no copper. It is supposed that the ore will yield to fine grinding and cyaniding, and it is understood that a company has been organized to erect a plant of this character. At present the cost of freight and treatment leaves too small a profit to the miners for many mines to be worked.

KING AND KITTITAS COUNTIES.

King County had but one productive mine during the year—the Apex, near Berlin, Money Creek district. Kittitas had 9 producers, of which 6 were placers and 3 deep mines. The placers are all worked in a small way, and there were only 628 tons of quartz worked. The total output of the two counties amounted to $22,442, or $2,948 more than in 1906. No copper was produced though there was a small output of the metal the previous year. The placers were all in the Swauk district, as were the deep mines. There are no specially prominent producers, either placer or quartz. Reports were received from 32 nonproductive mines in King County and 46 in Kittitas County.

OKANOGAN COUNTY.

This county, while reporting output from one placer mine and 6 deep ones, sent in returns of 128 nonproductive properties, the largest number of this class of any county in the State. The placer is in the Chesaw district, and the quartz mines in the Bodie, Chesaw (or Myers Creek), Loomis, and Wannicut Lake districts. The greatest tonnage is from the Bodie, but the greatest production is from the Myers Creek. The principal gold mine is the Butcher Boy at Myers Creek. The Prize Mining Company at Nighthawk is the largest silver producer. The output of gold shows an increase of $2,063 as compared with 1905. The county shows an output of 24,363 pounds of copper in 1906 as against none the previous year. The entire county suffers from lack of railway transportation facilities.

SNOHOMISH COUNTY.

In this county are 4 productive mines, all of which have copper as their principal product; 52 nonproductive mines are also reported. The total output of gold was $2,873, silver $3,406, and copper $26,692, a total of $32,971. The principal mines are the Bunker Hill Mining and Smelting Company at Index, the Ethel Consolidated at the same place, the Bonanza Queen at Silverton, and the Wayside at Granite Falls. The county shows a material falling off of output for the year.

STEVENS COUNTY.

This continues to be the most productive mining county in Washington. In 1906 there were 10 producing mines, all deep ones, and 94 which were nonproducers. The 10 active mines yielded a total of $148,849, of which $77,837 was gold, $4,269 silver, $13,950 copper, and $52,787 lead. The total output was about 75 per cent of that of 1905. The falling off was largely in gold, the output of that metal being less than in 1905 by $88,026; the silver shows a falling off of $11,553. In this county are the districts of Chewelah, Deer Trail, Marcus, Pierre Lake, Kettle Falls, Metalline, Northport, and Springdale. By far the largest gold producer is the First Thought mine of the Pierre Lake district.

The greatest amount of silver is yielded by the Deer Trail mine in the Deer Trail district. The copper comes mainly from the Napoleon mine at Marcus, and the principal lead producer is the Last Chance mine of the Jupiter Lead Company at Northport. This latter is a nonargentiferous ore, which is shipped direct to Joplin, Mo. In common with the other counties of the State, the production of copper in Stevens County has increased, the increase amounting to 56,869 pounds, four times that of the previous year.

WHATCOM COUNTY.

This is the principal placer-mining county of the State, the output of its placer mines of Slate Creek district amounting to $14,617 out of a total for the State of $19,304. It also has a production of considerable quartz gold, the amount being $23,631 for the past year from the districts of Slate Creek and Mount Baker, the latter yielding the larger proportion. Most of the quartz mines, however, are in the development stage. The Ruby Creek mine, operated by the Granite Creek Gold Mining Company, is the largest producing placer mine, and the Mount Baker, in the Mount Baker district, is the principal quartz property. The output of the county is $52,830 less than in 1905, this being mainly due to the less extensive operations of the principal quartz-mining company.

WYOMING.

By Chester Naramore.

PRODUCTION.

According to the returns received by the Geological Survey, Wyoming produced, during 1906, 315.46 fine ounces of gold, equivalent to $6,521; 136 fine ounces of silver, valued at $91; and 24,000 pounds of copper, worth $4,632.

This production was obtained from 10 mines, of which 4 were placer and 6 deep, as compared with 7 placers and 6 deep mines in 1905. The deep mines produced 518 tons of ore in 1906, as compared with 31,007 tons in 1905. Of this, 60 tons were of copper ore, while the balance, 458 tons, would be classified as siliceous and averaged $12.05 in gold and silver values. From the latter the gold savings amounted to $5,136, leaving $1,385 as the total gold won by the year's placer operations in Wyoming. The copper ore contained no gold nor silver.

Production of gold, silver, and copper in Wyoming in 1905 and 1906.

Metal.	1905.		1906.		Decrease.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold .... fine ounces..	1,293.81	$26,745	315.46	$6,521	978.35	$20,224
Silver .... do	3,655	2,208	136	91	3,519	2,117
Copper .... pounds..	2,394,008	373,465	24.000	4,632	2,370,008	368,833
Total	....	$402,418	....	11,244	....	391,174

The above table reveals a decrease of $20,224 in gold, 3,519 fine ounces of silver, and 2,370,008 pounds of copper, or a total falling off in value of $391,174.

The reduction in gold is due principally to a falling off in Fremont and Carbon counties. In the former, the idleness of one large producer, coupled with a greatly diminished output from the other mines, reduced the county total to about one-quarter of the production of 1905. The large decrease in the production of silver and copper is due to the fact that the mines of Carbon County were without smelter or transportation facilities during the year 1906.

The smelter report for 1906 indicates a larger production of silver and copper than stated above, but this probably represents ore mined in 1905 and held in stock and smelted in 1906.

Source of gold and silver production in Wyoming in 1906.

	Tonnage.	Gold.		Silver.		Total value.
		Quantity.	Value.	Quantity.	Value.	
	Short tons.	*Fine ounces.*		*Fine ounces.*		
Deep mines	a 518	248.45	$5,136	127	$85	$5,221
Placer mines	....	67.01	1,385	9	6	1,391
Total	518	315.46	6,521	136	91	6,612

a 458 tons of siliceous ore, containing no base metal values, and 60 tons of copper ore, containing no gold and silver.

Production of gold, silver, and copper in Wyoming in 1906, by counties.

County.	Producing mines.	Gold.		Silver.		Copper.		Total value.
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Fine ounces.		*Fine ounces.*		*Pounds.*		
Albany-Carbon	3	3.00	$62	....	....	24,000	$4,632	$4,694
Crook	3	47.66	985	9	$6	....	....	991
Fremont and Uinta	4	264.80	5,474	127	85	....	....	5,559
Total	10	315.46	6,521	136	91	24,000	4,632	11,244

PRODUCTION BY COUNTIES.

ALBANY AND CARBON COUNTIES.

In comparing the sources of the production of 1905 and 1906 by counties, it will be noted that there were 3 mines producing in Albany and Carbon counties in 1906, against 4 mines the previous year, and that the gold production amounted to only $62 as against $4,926. The silver fell off 3,559 ounces, and the copper output decreased from 2,394,008 to 24,000 pounds.

ALBANY COUNTY.

There was but little production from the mines of Albany County, the La Plata district furnishing small shipments. Mining activity was confined almost wholly to development work, and in this respect Douglas Creek was the most active section.

The Douglas Consolidated Placer Mining Company leased its property to the Suffolk Exploration Company, which erected a plant capable of handling 1,500 cubic yards of gravel per day, and expects to make a large production in 1907.

Work has been resumed at the Rambler mine, at Holmes, after two years of idleness, and a production is expected for 1907. The

Industrial Mining Company, operating the Big Nell mine; the Merchants Copper Company, and the Wyoming Gold and Copper Company also report development work.

The Strong Copper Mining Company, in the Horse Creek district, intends to build a 50-ton concentrator and begin shipments during 1907.

The Utopia Mining Company is pushing the development of its property in the Centennial district, by tunnel.

Only assessment work is reported from the Jelm Mountain district.

CARBON QOUNTY.

Carbon County, the mainstay of Wyoming's production during 1905, made a total output of only a few thousand pounds of copper in 1906. The output of this county is derived principally from the Battle Lake district, commonly termed the Encampment district. Since the mines of this entire section depend, in a large measure, on the Penn-Wyoming Company at Encampment for a market for their ores, the closing of the smelter of this concern meant the stopping of the output of the whole district.

On March 28, 1906, fire destroyed the concentrator, power house, and electric-light plant of this company. The works had been closed down for the winter on account of heavy snows, and with this disaster it was impossible to handle any ore during the balance of 1906. The company immediately began to replace the destroyed structures.

The completion of the railroad which the Penn-Wyoming Company is building into the district from Walcott, on the Union Pacific, will mean much to the entire section.

In spite of the misfortune mentioned above, about 20 mines reported development work during 1906, including the Charter Oak Copper Mining Company, the Itmay Mining Company, the Elkhorn mine, the Jack Pot Mining and Milling Company, the Azurite Mining Company, the Congo Mining Company, the Dill Gold and Copper Mining Company, the Pluto Gold and Copper Mining Company, the Snake River Consolidated Mining Company, the Wyoming Copper and Gold Mining Company, and the Independence Mining Company. The last-named company reports the occurrence of a rather high percentage of nickel in its ore.

It is stated that the Stemp Spring Coal and Power Company will erect a 250-ton smelter at Dillon during 1907.

BIG HORN COUNTY.

During 1906 the companies controlling the most desirable prospects in Big Horn County devoted their energies to further development, while considerable prospecting was also carried on. Many of the holdings of the Wood River district belong to residents of Lead, S. Dak.

CROOK COUNTY.

The output from Crook County was derived from 3 placer mines, the same number as in 1905, and amounted to \$985 in gold and 9 fine ounces of silver, a decrease in gold of \$302.

There was increased activity among the deep mines of this county in 1906, 1 in Bear Lodge district and 3 in Hurricane district reporting development work. In addition 2 of the latter district state that they expect to begin shipments during 1907.

The entire placer output was derived from the Hurricane district, located about 10 miles northeast of Sundance, near the South Dakota line.

FREMONT COUNTY.

During 1906 Fremont County produced gold to the value of $5,474 and 127 fine ounces of silver, or about five-sixths of the total gold and practically all of the silver produced in Wyoming. There were 3 deep mines and 1 placer in operation.

In the Copper Mountain district the Wind River Mining and Milling Company is installing a small stamp mill.

The Black Diamond mine, the Lost Cabin Mining Company, and the Thermopolis Copper Mining Company also report development. At present this section is greatly handicapped, as are other camps of this State, by lack of transportation facilities.

The Federal Gold Mining Company operated the Carissa mine, in the South Pass district, and development work has been started at the Lone Star mine, in the Atlantic district.

JOHNSON COUNTY.

Work has been resumed by the Kelly Creek Mining Company, of Buffalo, after a period of idleness extending over four years. Difficulties have been experienced in saving the values. The Bull Camp Mining Company has also begun working on their property.

LARAMIE COUNTY.

There was no production reported last year from this county, but development work was carried on at a few places, with prospect of shipping in 1907.

NATRONA COUNTY.

Development work was continued at the Blue Cap mine, Casper Mountain district, and more ore mined than in 1905, but no shipments were made.

UINTA COUNTY.

The Jackson Hole Mining Company reports the construction of about 6 miles of ditch, preparatory to operating their placers in the Jackson Hole district. A small quantity of placer gold was derived from bench gravels on the east side of Snake River.

COPPER.

By L. C. Graton.

INTRODUCTION.

The collection of copper statistics for the Geological Survey has, until recently, been in the hands of Mr. Charles Kirchhoff, of New York, who organized this work in 1883, carried it on most successfully, and built up a set of statistics which came to be regarded as the most authentic in the country. In 1906, when Mr. Kirchhoff, owing to the pressure of other business, relinquished this work, it was transferred to the writer, who takes this opportunity to express to his predecessor his great obligation for much assistance and his appreciation for the condition in which the work was turned over to him.

In the transformation from copper ore to pure metal there are in general three successive processes—mining, smelting, and refining. In the process of smelting a part of the copper contained in the ore is lost, and loss likewise occurs in refining the product of the smelters. Furthermore, as these processes are applied to the same material at successive times, a fluctuation in the mine production does not appear in the smelter production till a later date, and it is still later in the refinery production. Figures representing the output from these several operations during any year will therefore differ, and each set of figures, if properly explained or qualified, may be taken to represent the production of copper in that year. The significance of each set of figures and the advantages and disadvantages which each possesses as a means of recording the progress of the copper industry are outlined in the following pages.

MINE PRODUCTION.

As a measure of the actual quantity of copper taken from the ground in a given year, the figures of production should show the total copper content, by exact assay, of all ores mined in that year. Such figures would have very little practical value, however, and they are in most instances unobtainable.

Of far greater importance are those figures, reported by the mines, which are based on the smelter returns to the mining companies on all ore shipped from the mines during the year. Unfortunately, the components of this total can not in all cases be obtained on the same basis. For example, mining companies which operate their own smelters commonly report the year's smelter production as the production of the mine; other companies give actual assay content of those ores shipped which contained sufficient copper to be paid for; and perhaps the greater number of mines that ship to custom smelters report only the quantity of copper for which payment is received. This quantity is computed on the basis of the "dry assay," which is the actual content by wet assay of the ores or other materials minus a deduction assumed to represent or to cover the loss attendant on smelting. This deduction is in some cases on a sliding scale of percentage which varies with the grade of ore, the deduction being proportionately greater the lower the grade. More commonly it is an arbitrary deduction of a fixed number of units from the percentage of copper in the ore as determined by wet assay, in which case also the deduction is greatest on the lowest grades of ore. A figure often used as this arbitrary deduction is 1.3; this represents about the minimum claimed for loss, except in a few cases of special contract. On this basis no payment is made for copper in an ore carrying 1.3 per cent or less; in an ore carrying 2.6 per cent of copper only half of the metal is paid for; and in a 13 per cent ore payment is made for 90 per cent of the copper. Deductions of this magnitude undoubtedly cover the losses in nearly, if not quite all, kinds of materials smelted, possible exceptions being lead-bearing ores high in copper, lead mattes, and rich fines, particularly of oxidized ores, which give high flue-dust losses. Such deductions are becoming increasingly favorable to the smelters, because the average grade of ore smelted decreases year by year as a result of expanding facilities for transportation of improvements in smelting practice, and of general lowering of costs of production, and especially under the influence of a high copper market, as during 1906. Returns to the mines on such a basis are, in other words, generally lower than the actual recovery, and the total of mine reports in States where most of the ore is treated at custom plants is lower than the reports for such States from the smelters themselves. This is especially true in the case of States whose ores average low in copper and are marketed because of values in other metals.

This method of mine report of copper production based on smelter returns to the mines is the one followed by the Geological Survey in giving the figures for copper output included in the report on gold and silver. Such a method allows the most exact distribution of the production according to original source, not only among the States, but also among counties and mining districts that it is possible to reach.

The possibility of error entering into the figures is a little greater than in the case of smelter and refinery figures. This is due partly to the great number of producing mines as compared with the number of reduction works, and partly to the fact that many small producers do not keep as careful records of production as could be desired. Experience has shown, however, that the mine returns are, on the whole, very reliable.

SMELTER PRODUCTION.

Almost 75 per cent of the copper at present produced in the United States first passes through the stage of copper matte, which is then further concentrated by converting or bessemerizing it into blister copper. The matte is distinctly an intermediate or transition product, and as in present practice a great proportion of the matte produced is transferred while molten from the blast or reverberatory furnaces to the converters, it is impossible to ascertain and unessential to know the actual copper content of all matte produced in the country during the year. Of blister copper, however, it is possible to learn very accurately the fine copper content, for practically all plants which turn out this product measure their production in such terms.

The production of copper in blister shows how much of that metal was recovered from the ores; and as the loss in refining is small, it also represents approximately the quantity of refined copper that will ultimately be recovered from the ores that were smelted during the year. In addition to this difference between actual recovery on the one hand and actual ore content or assumed recovery on the other, disparity in the smelter and the mine figures of production is due also to two other conditions. One of these is the fact that the copper content of material in transit between mine and smelter is likely to differ at the beginning and at the end of the year; the other is the fact that the quantity of copper in raw or unfinished material in stock at the smelter, commonly differs at the beginning and at the end of the year. Regularity in mine and smelter production, and uniformity in transportation conditions tend to minimize the difference resulting from these last two facts.

The plants that produce blister copper are comparatively numerous, and most of them are situated at or near the principal mining districts and receive directly from the mines the great proportion of the material which they treat, the only important exception being the receipt of matte from the relatively few smelters that do not operate converting plants. The smelter figures are therefore well adapted to division according to original sources of the copper. By the exercise of proper care[a] totals can be compiled for each State which are very nearly accurate. So far as distribution is concerned, however, the smelter figures can not be made as accurate as the mine figures, and it is impracticable to obtain through the smelters further wholly precise division into county and district production, as may be done from the mine returns.

With the exception of a small quantity which is refined electrolytically, the native copper of Michigan, known as "Lake copper," is smelted and refined by essentially one operation, without the production of either matte or blister. This refined Lake copper therefore bears the same relation to the ores from which it is derived as blister copper does to ores of the West and South, and the smelter production of Lake copper is accordingly added to the blister production to arrive at the total smelter production of the country.

REFINERY PRODUCTION.

Nearly 95 per cent of the blister copper of the United States is subjected to electrolytic refining both to recover the gold and silver that it contains and to remove deleterious elements. The product, known as electrolytic copper, is turned out not only in the requisite condition of purity but in shapes, such as wire bars, ingots, etc., best

[a] There is no question that certain figures of production based on smelter returns, which have been published for 1906 and previously, have been inaccurate in distribution because of failure to consider the source of materials treated in plants whose final product is matte. For exampl , smelter A, which makes matte only, may draw its ores from several States; smelter B, to which this matte is shipped for conversion, is not aware of the first source of the material and erroneously credits the entire copper recovery from this matte to the State in which smelter A is situated. It is necessary, therefore, to learn from both A and B the sources of their receipts, and it is necessary to learn from A at what converting plant or plants its matte is treated.

adapted for the principal consuming industries. The appearance of this product marks the end of the complex process of copper production, and the quantity produced in a given year, plus the production of Lake copper and a small quantity of casting copper,[a] represents the year's addition to the supply of marketable copper. The refinery production differs from the smelter production in three particulars just as the smelter and mine productions differ; these are loss in refining, which, however, is much smaller than smelting losses; difference in quantities in transit between smelter and refinery at the beginning and at the end of year; and difference, at the same dates, in stocks of unfinished material at the refinery.

To the dealer and the consumer this refinery production, representing marketable copper, is the one which possesses most significance, the productions of mines and smelters indicating possibilities of future months rather than final results accomplished to date. From this point of view refinery figures are the best and most accurate measure of the copper production of the year. There are certain disadvantages, however, connected with figures reported by the refineries. The refining plants are few in number and most of them handle the product of many smelters, from which they are far distant. The books of the refiner credit the refined copper produced to the States in which are located the smelters from which he derives his blister. Distribution of the final product to the States where the ore was actually mined can not, therefore, be made with the degree of accuracy of which the smelter figures are capable, and in this report no such distribution is attempted. Every precaution must be taken, on the other hand, to exclude from production reported as domestic by the refineries, the copper contained in foreign ores smelted in the plants of this country and shipped to the refineries indiscriminately along with the product of domestic ores.

SUMMARY.

It appears, then, that the production reported by the mines, that reported by the smelters, and that reported by the refineries each measures a different phase or step in copper production and each adds something to a knowledge of the progress of the copper-producing industry. The mine production is of primary interest to the first producer, the miner, and also permits the distribution of total production according to counties and mining districts as well as to States. The smelter production is probably, considering distribution and recovery, the most accurate measure of the actual copper production of the country and of each State. The refinery production shows the quantity of copper from domestic materials actually prepared for consumption during the year, but does not permit the most accurate distribution by States, and is liable to slight error through the possible inclusion of scrap copper and of the foreign material smelted in this country.

Figures representing all three stages of copper production have been compiled and are published in this report. The smelter pro-

[a] A small percentage of the blister copper produced is sufficiently free from impurities for certain uses and does not contain enough gold and silver to pay for their recovery by electrolysis. This is accordingly refined, like Lake copper, by the furnace process and by "poling." It is commonly not suitable for electrical purposes nor for brass manufacture, and is used mainly for making copper castings. On the market, therefore, it is known as casting copper.

duction—that is the production of blister and Lake copper—is chosen as the most significant of these for the reasons outlined. This basis of reporting production, moreover, is the one most in use for compiling and comparing the production of different countries and of the world from year to year.

SUMMARY OF STATISTICS

The following statistical statement summarizes the copper industry in the United States in 1906.

Summary of statistics of the copper industry in the United States in 1906.

Production of copper:			
Smelter output	pounds		917,805,682
Value of domestic production of copper			$177,595,888
Mine production	pounds		916,971,387
Refinery production:			
Electrolytic	pounds	648,614,592	
Lake	do	205,608,382	
Casting	do	33,459,413	
Total domestic	pounds		887,682,387
Total domestic and foreign	do		1,079,052,409
Total ore treated	short tons		19,743,000
Average yield of copper	per cent		2.15
Copper ore treated	short tons		18,000,000
Average yield of copper	per cent		2.50
Imports, in terms of refined copper	pounds		215,402,841
Exports, in terms of refined copper	do		446,750,711
Consumption:			
Electrical purposes	pounds	340,000,000	
Brass manufacture	do	210,000,000	
Copper sheets, etc	do	35,000,000	
Castings, etc	do	100,000,000	
Total	pounds		685,000,000
Prices of refined copper:			
Electrolytic	cents per pound		19.30
Lake	do		19.55
Casting	do		19.10
World's production	pounds		1,596,973,700

PRODUCTION.

GENERAL CONDITIONS OF INDUSTRY.

The copper industry of the United States experienced unusual conditions during the year 1906. Prices generally better than 15 cents per pound, which had prevailed for more than a year previously, had warranted increase in capacity in many plants. Unprecedented prosperity of the country at large was accompanied by still higher prices for copper, which began even before the year opened. A decrease in exports was more than balanced by a decided growth in home consumption, which, bringing an almost steady advance in price during the year, caused producers to put forth every effort toward further increasing their output. At the beginning and up to the last quarter of 1906 a marked increase in the production for the year was universally expected. Conservative authorities predicted an increase of at least 50,000,000 to 75,000,000 pounds.

But the prosperity which had made possible such promise of growth became by very excess the cause which prevented its achievement. Increased demand for labor in all the basal industries became too great to be fully met, especially as the year advanced, and nowhere was the shortage felt more keenly than in the great copper-producing districts. The railroads were taxed as never before. In the West freight traffic became greatly congested, affecting not only the movement of raw material and finished product, but greatly delaying the receipt of machinery, supplies, and fuel. In the later months of the year the shortage of coal, coke, and fuel oil became extreme in many of the Western States.

These adverse conditions, coupled with accidents, and in some quarters with labor troubles, caused the year's smelter production to fall considerably short of what had been anticipated, and to exceed the production of 1905 by less than 16,000,000 pounds.

Consumers realized near the close of the year that this reduction in output and the conditions which caused it would affect the supply not only immediately, but for several months of 1907. Impelled also by the urgency of demands which had been held back as long as possible in the hope of a decline in price, they hastened to cover their requirements under whatever conditions they could.

The year closed with electrolytic copper selling at 23.8 cents, the highest price in twenty-six years. Plans for increased output were generally in contemplation or in course of execution in most of the important districts.

Increase in wages, averaging about 10 per cent, was granted during the year in most of the copper-mining districts. In the majority of cases the advance was to remain in effect so long as copper should sell at or above 18 cents per pound.

SMELTER AND MINE PRODUCTION.

GENERAL STATEMENT.

The production of copper in the United States in 1906 was 917,805,682 pounds.[a] This represents the year's smelter production—that is, the quantity of fine copper in the blister copper produced during the year and the production of refined Lake copper. The production of 1905, as given in the Mineral Resources for that year, was exceeded by 15,897,839 pounds and the apparent rate of increase in 1906 was accordingly 1.76 per cent.[b] This is an abnormally low increase, the gain in 1905 over 1904 having been 11 per cent, and in 1904 over 1903 nearly 16.40 per cent. The reasons for this decline in 1906 from the previous great increment in production will be presented in the discussion by States.

The mine production for 1906 was 916,971,387 pounds. Statistics from the mines were not collected for all the districts in 1905, and in consequence complete figures for comparison of the outputs of the two years can not be given. It may be stated, however, that the 1906 mine production exceeded that of 1905 by a somewhat larger amount

[a] The writer regrets to state that the figures for total production given in a preliminary statement issued July 12, 1907, were too low, owing to an error in the figures for Montana. The correction of this error does not in any way divulge the 1906 production of any single company or plant.

[b] A difference in the methods of computing the fine contents of blister copper makes the apparent increase in 1906 over 1905 less than it actually was. Had the same methods been employed in both years, the production in 1906 would have shown an increase of about 29,000,000 pounds, or 3.1 per cent.

than the gain in smelter production. In other words, the smelters did not wholly keep up with the output from the mines.

In the following table the production of mines and smelters is shown, apportioned to the States from which the copper was originally derived. The figures of smelter production—917,805,682 pounds, valued at $177,595,888—are those that most nearly represent the actual contribution of each State to the total available copper for the year.

Smelter and mine production of copper in 1906, by States, in pounds.

State.	Smelter production (Lake copper and fine copper content of blister).	Mine production.
Alaska	8,685,646	5,871,811
Arizona	262,566,103	266,831,864
California	28,153,202	28,726,448
Colorado	7,427,253	5,720,929
Georgia	17,182	26,198
Idaho	8,578,046	9,558,913
Massachusetts	9,744	9,744
Michigan	229,695,730	224,572,310
Missouri	54,347	54,347
Montana	[a] 294,701,252	290,700,975
Nevada	1,090,635	1,625,985
New Mexico	7,099,842	7,028,670
North Carolina	582,209	703,775
Oregon	545,859	415,803
Tennessee	17,809,442	17,979,317
Texas	51,377	51,377
Utah	50,329,119	56,593,576
Vermont	11,694	240,315
Washington	290,823	235,030
Wyoming	106,177	24,000
Total	917,805,682	916,971,387

[a] See footnote on page 10.

Of this total, 2,801,647 pounds[a] in blister were produced in Canadian smelters from ore and matte exported from the United States. In addition to this total, 54,543,116 pounds were produced as blister in domestic smelters from foreign ores, concentrates, and matte. This foreign material came principally from Mexico and Canada, but Cuba, Germany, and Bolivia and other South American countries were contributors, and a noteworthy quantity was recovered from Spanish pyrite cinders.

The figures of mine production collected by the field agents of the Geological Survey are based on reports from all known mining companies which produced copper in 1906, with the exception of companies in Massachusetts, Missouri, and Texas, where systematic inquiry of mine production has not yet been inaugurated. Careful estimates have been made to cover the production of the few companies in the Western States from which no report could be obtained, and for the three other States mentioned the smelter production has been taken as the mine production. Details of county and district production of the Western and Southern States are given in the chapter on the production of gold and silver. Details regarding Michigan are found in the report on Michigan mines.

The figures of smelter production are based on returns made confidentially to the Geological Survey by every known smelting com-

[a] Revision of figures previously published. This change does not affect the figures of production.

pany which handled United States ores, concentrates, or mattes in 1906. To all companies which have aided in furnishing information sincere thanks are extended.

These smelter figures represent actual recovery in blister and Lake copper, as previously explained. The fine copper content instead of the actual weight is given for blister copper. The Lake production is stated in terms of the furnace-refined product. The ultimate accuracy of these figures rests with the reporting companies.

Two large companies under the same general control, which operate several smelters and a refining plant each, reported their entire production in terms of electrolytic instead of blister copper. A third company, producing Lake copper, likewise reported a portion of its output as electrolytic instead of as ordinary Lake copper. Altogether, nearly 50,000,000 pounds of the total production of the country was so reported. The loss which attended the transformation of this quantity from anodes into electrolytic copper is practically equivalent to the copper content of bluestone recovered as a by-product in this refining process, and approximates 900,000 pounds. To bring the returns of these three companies as nearly as possible to the basis on which other companies reported, this 900,000 pounds has been allotted pro rata to the State production figures reported by these companies. In addition to the small error likely to arise from such estimates, there is another one, probably larger, for which no allowance can be made. It is due to the facts that usually about two months' time is required for the transfer of blister from smelter to refinery and for its conversion into electrolytic copper, and also that the quantity in transit during the last two months of 1905 may have been different from that during the corresponding months of 1906. Any such difference will closely represent the difference between smelter and refinery output for the year.

With the exception of these probable small errors, the figure for the total production is believed to be exact. The State figures are further affected by the failure of two large companies to make with the desired precision the apportionment of their total output to the State of origin. The errors from this cause would have been smaller if the production had been stated in terms of blister copper.

TONNAGE AND YIELD OF ORE SMELTED.

TONNAGE.

The bulk of the copper of domestic origin turned out by the smelters in 1906 was derived from approximately 19,743,000 tons of ore. This tonnage represents the quantity of ore which reached the copper smelters during the year either directly in smelting ore, or indirectly—for example, in the form of concentrates. It includes a considerable quantity of ore which was not mined expressly for its copper content. This class of ores, in which copper is of subordinate importance, comprises dry or siliceous gold and silver ores, which were handled mainly in pyrite smelting and for converter linings; lead ores carrying sufficient copper to make its recovery profitable; cupriferous zinc and pyritic sulphur ores the "cinders" of which are subsequently smelted for copper; and ores mechanically concentrated for values other than copper. Ores of this class can not be separated sharply from distinctly copper ores, and 1,700,000 tons, the figure representing their quantity, is only approximate. The common fluxing materials devoid of the precious and semiprecious metals are of course not included.

Of the total ore tonnage approximately 5,021,000 tons, or about 26 per cent, were of sufficient richness or of such favorable metallurgical character as to be smelted without concentration. The remaining 14,722,000 tons were concentrating ores, from which were produced about 2,985,000 tons of concentrates, the average concentration being slightly under 5 into 1. If the immense tonnage of milling ores of Michigan is excluded, the concentrating ores of the rest of the country exceeded the smelting ores by only a small tonnage. Included with the concentrating ores is a small tonnage from which the copper was extracted by leaching processes. A small quantity of copper was procured without the mining of any ore, by the treatment of mine waters. In both cases the copper was recovered from solution by replacement of iron scrap, and the resulting "precipitate," or cement copper, which may be regarded as a high-grade concentrate, went into the smelters.

The total tonnage of metalliferous materials of domestic origin from primary sources charged into copper-smelting furnaces in 1906 amounted to approximately 8,006,000 tons, 37.5 per cent being concentrates and the remaining 62.5 per cent, or 5,021,000 tons, being smelting ore. The copper content of about 60,400 tons of this ore reached Canadian smelters either as ore (32,000 tons) or in the form of matte. The contents of about 4,000 tons were returned to the United States in the form of matte. On the other hand, reduction plants in this country smelted a considerable import tonnage of foreign origin, the approximate figures being ore 280,700 tons, concentrates 20,500 tons, and matte 19,600 tons.

The total metal-bearing charge treated by copper smelters in the United States[a] in 1906 was about 8,294,000 tons, exclusive of material from secondary sources. The secondary material includes the following: (1) The conversion into blister of approximately 141,250 tons of custom matte, all of domestic origin, but a portion of which had been smelted in Canada. Part of this matte was of so low a tenor that it had to be resmelted to a higher grade before conversion; (2) the treatment of over 240,000 tons of flue dust, drippings, etc.—the materials resulting from details of internal operation; (3) the treatment of 404,496 tons of old slags, tailings, smelter cleanings, etc.—material discarded or lost in former operations.

Among the principal copper-ore producing States[b] Michigan is far in the lead, having extracted her copper in 1906 from 8,904,127 tons of ore; Montana is second in total copper-ore tonnage, with little more than half as much; Arizona is third, closely followed by Utah; Tennessee is fifth, and California sixth. Arizona leads in tonnage of smelting ore. Montana ranks next, having smelted half as much. Utah, Tennessee, and California follow in order. Michi-

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[a] The plant of the Northport Smelting and Refining Company, at Northport, Wash., is not included for the reason that, although situated just within the United States, it is essentially a Canadian smelter and treated no material from the United States in 1906.

[b] It had been planned to publish figures showing the tonnage of ores and concentrates from each State smelted in 1906. The blanks sent out to smelting companies by the Geological Survey called for statistics of the tonnage of smelting ore, concentrates, and custom matte from each State treated in each plant. The precise and complete replies made to these inquiries were very gratifying. However, three large companies refused information, and in the absence of complete data the plan has been abandoned for the present year. The effort to obtain full and fair statistics of all smelter operations with reference to tonnage of ores and concentrates will be continued, and it is hoped that complete data will be available for 1907.

gan produces no smelting ore, the comparatively small tonnage of mass and barrel copper smelted without concentration scarcely falling within this category. Montana is far in the lead as to tonnage of cupriferous concentrates smelted during the year; Arizona and Michigan are much lower, with Utah far behind. California produced practically no copper concentrates (except a small tonnage of "cement" copper) and Tennessee none whatever.

YIELD.

Of the 917,805,682 pounds of copper produced in 1906 by the smelters, 15,132,562 pounds were derived from the re-treatment of materials which had been subjected to reduction in previous years—namely, old slags, tailings, furnace linings, and the cleanings from old smelter sites. Of the 404,496 tons of this material, a great part was slags and tailings; consequently of low grade and capable of treatment only because of metallurgical advances. The average yield from this old material was about 1.8 per cent.

The remainder of the smelter output, 902,673,130 pounds of copper, was the yield from about 19,743,000 tons of ore, the average yield per ton being about 43 pounds, or 2.15 per cent. The 1,700,000 tons of ore mined and treated primarily for values other than copper furnished a very inconsiderable portion of the total copper production. If these ores are left out of consideration, the yield of the 18,000,000 tons of ore mined expressly for copper was close to 50 pounds per ton, or 2.5 per cent. The native copper ores of Michigan, which in 1906 yielded only 1.26 per cent, being excluded, the remaining copper ores of the country yielded an average of about 73 pounds per ton, or 3.65 per cent.

The blister of domestic origin produced in Canada—2,801,647 pounds—was derived from about 56,000 tons of ore (or its equivalent in matte); the yield was about 2.5 per cent, the low figure being due to the fact that much of the ore was low-grade material purchased by the Canadian smelters for flux and converter lining.

The foreign ores imported for smelting in this country were, considering the more costly transportation, necessarily of higher grade than the average of domestic ores. Actual figures can not be given, as only the figures for the combined yield of ore, concentrates, and matte are available.

Copper ores yielded 271,197 ounces of gold and 15,880,870 ounces of silver, according to mine reports for 1906.[a] This is an average yield for the 18,000,000 tons of copper ores of about 0.015 ounce of gold and 0.882 ounce of silver per ton. If the Michigan ores that do not carry silver, amounting to about 8,000,000 tons, are excluded from this calculation, the copper ores which actually contained precious metals yielded an average of about 0.027 ounce of gold and 1.588 ounces of silver per ton.

Pyrite smelting, which has grown rapidly in recent years, owing not only to metallurgical advances but to the marked increase in mining of pyritic copper ores, offers, because of its high requirement of silica flux, an advantageous method of treatment for those siliceous gold and silver ores which require or permit smelting. Copper is thus fast replacing lead as a collector of the precious metals in the

[a] See report on gold and silver.

smelting of dry ores. In consequence, the gold and silver product of all domestic ores treated in copper smelters was considerably in excess of the yield from the copper ores alone. This product in 1906, according to data partially incomplete, was, gold, 484,000 ounces; silver, 21,110,000 ounces.

The 1,700,000 tons of ores other than copper ores which were smelted in copper furnaces furnished, by difference, about 213,000 ounces of gold and 5,226,000 ounces of silver, an average of 0.125 ounce of gold and 3.07 ounces of silver per ton—a decidedly higher average than that of the copper ores.

The foreign ores, concentrates, and matte smelted in this country also yielded gold and silver in addition to copper.[a] The blister copper of domestic origin produced in Canada carried, on the other hand, very low precious-metal values. The total gold and silver product of copper smelters in the United States for 1906 was therefore somewhat higher than the figures given above for the product of domestic ores.

All this gold and silver was recovered as such only on electrolytic refining of the pig copper.[b] A part of the output of the Morenci-Metcalf and Bisbee districts in Arizona and of the Ducktown district of Tennessee, and small quantities from California, New Mexico, and Missouri are too low in precious metals to make the electrolytic refining of this copper profitable. With these exceptions, practically all the blister copper of the country, as well as a noteworthy portion (over 10 per cent) of Lake copper, is subjected to this separation by electrolysis. In all, about 669,000,000 pounds of domestic copper carrying gold and silver and requiring electrolytic refining were produced in 1906.

Ores containing sufficient quantities of both copper and lead to be classed as copper-lead ores[c] supplied 59,371 ounces of gold and 6,815,678 ounces of silver, according to reports from the mines. Practically all these ores were smelted in lead furnaces and the greater part of the precious metals was recovered in lead bullion, copper being collected as matte and further treated in copper furnaces.

ANALYSIS OF PRODUCTION.

GENERAL CONDITIONS.

Copper mines in general do not fall in the class of "poor man's mines." Ordinarily the ore is not amenable to any simple method of reduction and is of so low a grade as to preclude very extended hauls to existing reduction plants. Much money must first be spent in extensive development of the ore bodies. The company must usually expect to build its own smelter or mill and to operate on a large scale to achieve low cost of extraction. In consequence of these conditions, most of the important copper mines of the United States are in the hands of strong companies able to advance the capital required at the start.

In few other industries is the tendency toward centralization and combination better illustrated than among the copper-producing

[a] Complete figures are not available, owing to the lack of information from some of the large companies.
[b] An exception is the small quantity of silver obtained in Michigan as "pickings"—the sorting out of the "nuggets" and "half-breeds" which accompany the native copper.
[c] See report on gold and silver.

companies. Fully 720,000,000 pounds of the 1906 output was produced by four operators—the Amalgamated Copper Company, with its many allies and associates; the Calumet and Hecla Mining Company; W. A. Clark; and Phelps, Dodge & Co. With the entrance into the producing ranks of the Utah Copper and Boston Consolidated companies, the Ely mines, and the Dairy Farm mines, and with the expected increase in production of the Cactus and Mammoth mines, this list of four companies will be augmented by the United States Smelting, Refining and Mining Company, the Guggenheim interests, and the Newhouse interests. Four of these seven concerns either maintain or are closely associated with selling agencies.

Production at the principal mines is on a truly enormous scale, with ore tonnage and copper output of individual mining units ranging up to more than 2,000,000 tons and 100,000,000 pounds, respectively, with single milling plants of a daily capacity up to 8,000 tons, and with smelting plants turning out annually 90,000,000 to 175,000,000 pounds of copper each. To the magnitude of these operations almost as much as to the abundance of her natural resources does this country owe her preeminence as a copper producer, with a record of over half the world's production.

The general trade conditions under which copper was produced in 1906 have been outlined on a foregoing page. The following paragraphs present the principal features affecting production in each State:

ALASKA.

The blister copper production of Alaska in 1906 was 8,685,646 pounds, an increase of more than 3,500,000 pounds over the output for the preceding year. The mine production during the year, while exhibiting a good advance over 1905, was decidedly lower than the smelter production. This difference is explained by the fact that a considerable part of the 1906 smelter production was derived from ores mined in 1905.

The principal production came from Prince of Wales Island, in the Ketchikan district of southeastern Alaska. The only two smelters in Alaska are situated on this island—the plant of the Alaska Smelting and Refining Company at Hadley and the Alaska Copper Company's smelter at Coppermount. Both were blown in near the end of 1905, and the Hadley plant has since been in fairly steady operation, but the Coppermount smelter was out of blast for a considerable part of 1906. Both plants do some custom smelting and thus procure siliceous material to flux their own basic ores. Part of this siliceous ore was derived from British Columbia, but developments of siliceous copper ore at Maple Bay, on Portland Canal, furnished much of it and may make future importations unnecessary. Some ore from this region was shipped to the Tyee smelter on Vancouver Island, the resulting matte being forwarded to the United States for conversion. Both ore and matte from Prince of Wales Island were shipped to the smelter at Tacoma, Wash., and to the Britannia smelter on Vancouver Island, where they were transformed into blister copper.

The ores of this district are mostly heavy sulphide ores, probably of contact-metamorphic origin. Pyrrhotite and plentiful magnetite and pyrite accompany the chalcopyrite, the ore running high in iron. The grade of the ore is not high, the yield of copper being as a rule not much over 3 per cent. Precious-metal values are low. Supplies are costly, wages are high, and under these conditions successful operation is a noteworthy accomplishment. These deposits have been described by C. W. Wright.[a]

A second copper district embraces the country around Prince William Sound. The principal shippers from this district in 1906 were the Gladhaugh mine, at Ellamar, southwest of Valdez, and the Bonanza mine, on Latouche Island. The Tacoma smelter treated the mine output. The ore, which is chalcopyrite more or less disseminated through metamorphosed sedimentary rocks, has to carry a fairly good percentage of copper to stand the cost of this shipment, and most of that sent out in 1906 ranged from 7 to 8 per cent. It carries a little silver, moderate silica, and rather low iron and alumina. A number of other prospects in this region will probably prove of value. The deposits of this district have been described by U. S. Grant.[b]

The Copper River region, in the vicinity of Mount Wrangell, especially near Chitina River, is the third important copper region of the Territory. Rich bornite and chalcocite ores occur in greenstone near the contact with limestone.[c] These received considerable attention in 1906, the most important work being done by the Guggenheim Exploration Company. It is expected that railways connecting these deposits with the coast at Seward and at Valdez will be completed in the near future. If the deposits of this district develop as favorably as is at present expected, the production of Alaska will be greatly increased and will become an important part of the total output of the United States.

ARIZONA.

In 1906 Arizona produced 262,566,103 pounds of blister copper, an increase of about 35,000,000 pounds over the production of the Territory in 1905 and a larger increase by far than that of any other Territory or State. The mines yielded a slightly larger output, which reached the smelter, but was not wholly worked up during the year. The Territory now stands second in production, the output of Michigan, which just exceeded it in 1905, having fallen off slightly in 1906. Many districts contributed to the output, but the great bulk of the production was derived, as in former years, from four important camps. Arizona is thus distinguished from the two great producing States—Montana and Michigan—which have but one important district each.

Bisbee district.—The Bisbee or Warren district in Cochise County, the third largest district in the country and the largest in Arizona, made a record blister-copper production of about 131,000,000 pounds in 1906, as compared with about 100,000,000 pounds in 1905. The output, which would have been larger but for the failure of the fuel supply in December, was derived almost entirely from the Copper Queen, Calumet and Arizona, Superior and Pittsburg, and Shattuck-Arizona mines.

A detailed description of the geology and ore deposits of the Bisbee region has been given by F. L. Ransome.[d] The primary ore, which

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[a] Bull. U. S. Geol. Survey No. 284, 1906, pp. 50-53, and Bull. No. 314, 1907, pp. 65-72.
[b] Bull. U. S. Geol. Survey No. 284, 1906, pp. 78-87.
[c] See report by F. C. Schrader and A. C. Spencer, Geological Survey special publication, 1901; also Mendenhall, W. C., Prof. Paper U. S. Geol. Survey No. 41, 1906.
[d] Prof. Paper U. S. Geol. Survey No. 21, 1904.

consists of pyrite with chalcopyrite, replaces limestone near an intrusive body of granite porphyry, and is believed by Ransome to be the result of a modified sort of contact metamorphism. The copper of these primary ores has been in part concentrated by the process known as "secondary enrichment" into workable ore bodies of varying size and of irregular shape.

The tops of most of the Bisbee ore bodies lie at some distance below the surface, and the ores are in many places underlain by practically barren limestone instead of by primary ore. In other words, secondary enrichment has in some places extended to the very bottom of the ore bodies. Oxidation, also, has extended to unusual depth. The ores consist mainly of carbonates, oxides, chalcocite, chalcopyrite, and pyrite, all being in places more or less intimately mixed. Native copper is present also in many localities and in some stopes has been very abundant. As nearly as can be learned, about 50 per cent of the copper mined in 1906 was contained in the sulphides, chiefly chalcocite, and practically the whole of the remainder was carried by the oxidized minerals.

If the total production since the discovery of the district is taken into account, Bisbee is undoubtedly the richest of the great copper camps of the country. The ore mined to date is estimated to have yielded 8 per cent copper. The yield in recent years has been somewhat below that average, but it was higher than 6 per cent in 1906. The Calumet and Arizona ore, as stated in the annual report of the company, yielded 7.95 per cent, based on the tonnage as mined. All the ore mined in the district is rich enough to smelt, and no concentration is practiced. The ores contain but low values in gold and silver—on the average considerably too low to pay the cost of electrolytic refining. In consequence, some of the purer copper is sold without being thus refined.

The locus of the principal known ore bodies has been shown to be a great, flat-lying shoot, of variable width and thickness and as yet undetermined length, pitching gently toward the southeast, approximately with the bedding of the limestones. The proven productive area was extended to the west and to the southeast in 1906 by the entrance into the producing ranks of the Shattuck-Arizona Copper Company and of additional shafts of the Superior and Pittsburg Copper Company.

A mass of solid pyritic ore encountered on one of the lower levels of the Calumet and Arizona mine was apparently brought up by faulting from below the zone of secondary deposition. This ore was of low grade but, owing to its favorable character for smelting, was extracted at a profit. The possibility, pointed out by Ransome of the existence of other ore horizons underlying the one already developed and at such depth as to be mainly or wholly below the zone of secondary enrichment, is strengthened by this occurrence.

The ore bodies worked at present lie mostly between depths of 400 and 1,400 feet, the ore being deeper toward the southeast. The known ore bodies near the surface are practically exhausted. All development is carried on by means of vertical shafts, none of which has as yet been sunk far below the horizon of known ore bodies. Water has given considerable trouble in the sinking of the deep shafts in the southern part of the camp, but when a block of ground is once drained, only light pumping is required. The square set and filling system is mainly employed, and the high price of timber constitutes an important part of the cost of mining. Wages are also high, but transportation charges are not excessive, owing to service by the El Paso and Southwestern Railroad, a line controlled by Phelps, Dodge & Co. Spurs extend to the principal producing shafts. Power is furnished jointly by coal and oil fuel, and is reasonably cheap for that part of the country. It is commonly reported that the total cost of production of copper by the Calumet and Arizona Company in 1906 was considerably less than 7 cents per pound.

The older mines are developed well ahead of production and the new producers are to be put on the same foundation. The production of the district is therefore measured by available smelting capacity. The Copper Queen and Calumet and Arizona smelters at Douglas, which treated over 1,000,000 tons of ore from the camp, were enlarged during 1906 by the erection of one new blast furnace each. The Copper Queen smelter, the second largest in the country, handled in 1906 more crude smelting ore than any other copper smelter. This plant does a custom business, drawing ores from Mexico, New Mexico, and other Arizona camps, as well as custom ore from Bisbee. The smelters were seriously handicapped in the latter part of the year by lack of fuel, especially oil.

The Bisbee ores are of wide range in composition, but when mixed and bedded on the immense scale possible they are virtually self-fluxing and are smelted economically, the only objectionable feature of importance being the production of much flue dust, a portion of which is not recovered. Siliceous ore for converter linings was drawn chiefly from the Globe district.

During the year a large tonnage of slag from the site of the old Copper Queen black-copper smelter at Bisbee was shipped to the Douglas plant and re-treated. Copper Queen ores highest in sulphur were treated by the Old Dominion smelter at Globe.

An important transaction of the year was the consolidation of the old Bonanza Circle properties, the Calumet and Pittsburg, Lake Superior and Pittsburg, Pittsburg and Duluth, and Junction companies into a single company known as the Superior and Pittsburg Copper Company. This is under the same management as the Calumet and Arizona Company.

Active development in the southeastern part of the district was carried on by companies not in the producing list. Some of these bid fair to become productive.

Morenci district.—The copper district at Morenci and Metcalf, in Graham County, produced blister containing over 56,000,000 pounds of copper in 1906, an increase of nearly 4,000,000 pounds over the preceding year. Practically the entire production came from the mines and smelters of the Arizona, Detroit, and Shannon companies. The output would probably have been 2,000,000 pounds larger had not a flood early in December caused the closing of the Arizona Copper Company's smelter for the remainder of the year and stopped the receipt of ore at the Shannon plant for nearly twenty days.

A description of the ore deposits has been presented by Waldemar Lindgren.[a] With the exception of some of the ores of Shannon

[a] Prof. Paper U. S. Geol. Survey, No. 43, 1905.

Mountain, the old shallow bodies of high-grade oxidized ore derived from contact-metamorphic replacements of limestone have been exhausted. Of the 1906 production, over 92 per cent came from large disseminated bodies and stockworks of chalcocite along shattered zones in altered porphyry. The profitable ores change in depth to lean pyritic ores of similar distribution, which affirm the secondary character of the chalcocite. From geologic considerations it appears unlikely that a second zone of enrichment will be encountered under the known ore bodies.

The bulk of the ores are of low tenor in copper, nearly 90 per cent of them being of concentrating grade—under 4½ or 5 per cent and averaging 3 to 3½ per cent. These ores are milled with a concentration of about 6 into 1. The average yield of blister copper from the concentrating ores was slightly over 2 per cent in 1906. The smelting ores, which include the richer chalcocite ores and the oxidized ores mined by the Shannon Company, gave a much higher yield. The content in gold and silver is very low, the blister copper produced carrying on the average not over $3 per ton. Such blister as is sufficiently pure, therefore, is transformed into casting copper without electrolytic refining.

Few profitable ore bodies occur at a greater depth than 400 feet. A notable exception is furnished by the Coronado mine, where the ore occupies a fault fissure and has been developed to a depth of about 1,000 feet. The rugged topography allows the extraction of a great part of the ores by tunnels, shafts being used somewhat at Morenci and open cuts on Shannon Mountain. Square setting and filling is the chief method employed in the stopes, but the amount of timber per ton of ore is lower than is commonly required by that system. The filling of stopes by flushing in of mill tailings is an innovation to be adopted by the Arizona Copper Company. The mines are practically dry. Most of the power has been derived from producer gas, but coal and oil are now being used to a greater extent. The district is connected with outside transportation by the Arizona and New Mexico Railroad, owned by the Arizona Copper Company. Local transportation is effected by narrow-gage lines and inclined tramways. Water supply is an important item of expense, as it is necessary to pump from San Francisco River, 1,500 feet below Morenci. Mexican labor is employed to a large extent and commands half the wages paid to Americans.

The reserves of concentrating ore in the district are very large. As distinguished from Bisbee and Jerome, where all the ores are of smelting grade, the output of the Morenci district is dependent on the capacity of its concentrating mills. The new No. 6 mill of the Arizona Copper Company and the enlargement of the Detroit concentrator were completed during the year. The three smelters handled over 294,000 tons of copper-bearing material, representing over 1,000,000 tons of ore mined. Of this amount, about 134,000 tons were smelting ore and 160,000 tons concentrates. In addition, one of the smelters at Clifton treated some custom concentrates from New Mexico. The Arizona Copper Company produced no bluestone from its leaching plant during the year. The Shannon Company installed converters at its smelter early in the year and turned out its product as blister copper. The converting plant of the Detroit Copper Company was closed in November, to be rebuilt. For the remainder of the year the matte produced, which was of high grade, like all the matte in the district, was shipped to the Copper Queen smelter for conversion.

The oil-fired reverberatory furnace at the Detroit plant, designed to dispose of the large quantity of flue dust formed and to reduce the copper content of the slag flowing from the settler, has been operated very satisfactorily and marks the beginning of a method of much promise for the treatment of fines and concentrates. Considerable slag from old dumps of the Detroit smelter was reworked.

Jerome district.—The production of blister copper in the Jerome district of Yavapai County in 1906 was about 38,500,000 pounds,[a] a notable increase over 1905. This came wholly from the United Verde mine, the Equator, a small producer in the preceding year, having been idle in 1906.

The United Verde ore body occupies a zone of shearing so intense that the containing rock, a rather basic porphyry, has here been converted into a schist. Pyrite, chalcopyrite, and some zinc blende, with varying amounts of quartz, have in places partially or completely replaced this schist, and in other places the schist is injected by veinlets and stringers of sulphides and others of quartz. As a rule the more massive sulphide ore contains more iron and zinc, while that consisting of alternating bands of sulphide and schist—the so-called "slaty" ore—carries a much higher proportion of chalcopyrite. The ores are undoubtedly of pre-Cambrian age, like the inclosing rocks, and closely resemble certain pre-Cambrian copper ores from the Rocky Mountain region of northern New Mexico.[b] Almost the entire output in 1906 came from sulphide ores, but a little oxidized ore, rather high in gold, added to the production. The ores mined are all of smelting grade and carry a high percentage of copper, the average yield in 1906 having been considerably above that of the Bisbee camp and much higher than that of the other large pyritic deposits of Bingham, Utah, Shasta County, Cal., and Ducktown, Tenn. The content of the ores in gold and silver is decidedly higher than in any other of the large Arizona copper camps and far above the precious-metal yield of the pyrrhotite ores of Ducktown, although not very different from that of the Bingham and Shasta County ores.

So far as present developments have shown, the ore body is an irregular, rudely lenticular mass of large dimensions. The surface outcrop of the lens was about 800 feet long. The shoot pitches northward and undoubtedly extends along the pitch beyond the region explored to date. There is some reason to believe that a fault, which brings the schist up even with the Paleozoic sediments close by, passes just west of the ore body, and it may be that the deposit now known is but the eastern section of a body whose remaining portion lies at an indefinite depth below the sediments.

Extraction is effected through shafts, although there is a tunnel reaching the 500-foot level, and a new tunnel is being driven in 1907 to strike the lowest level of the new 1,000-foot shaft. Motor haulage is used on the principal levels. Square setting is employed only where absolutely necessary, and the use of timber is avoided as much

[a] The figures have already been published by the Arizona press.

[b] Lindgren, W., and Graton, L. C., A reconnaissance of the mineral deposits of New Mexico: Bull. U. S. Geol. Survey, No. 285, 1906, p. 81. The idea that the Jerome deposit might be pre-Cambrian was first suggested to the writer by Mr. Lindgren while these New Mexico occurrences were being studied.

as possible, owing to danger from fires. Native round timber is the kind most used. The system now prevailing is overhead stoping with horizontal back, and filling kept up within working distance. Work is carried on in certain portions of the "fire country" by the employment of the plenum air-pressure system originated at Iron Mountain, Cal. The developed workings are not very wet, but considerable surface water finds its way into the mine through the caved ground, and, passing through the burning stokes, takes up copper and sulphuric acid. An extensive system of flumes allows the precipitation of most of this copper. The district is served by a narrow-gage line owned by the company, which connects with the Santa Fe, Prescott and Phoenix. Oil is the principal fuel. European labor is extensively employed, but the wages are high, the daily pay for work in the fire country being $4.

All the higher sulphur ores are roasted before smelting, the claim being made that the ores carry too high alumina to make pyrite smelting successful. The highest-grade ores are lower in sulphur and are smelted direct. It is an interesting fact that ore extracted from stopes which had been on fire for several years is oxidized only slightly, and not at all except along fractures. Limestone flux is quarried along the railroad near the mine. Siliceous material is encountered in the workings in sufficient quantity to supply converter lining. The coke, which averages 10 per cent of the charge, is from Colorado. The settling of ground under and around the smelter appears to have ceased, and a new 20-foot furnace is being added in 1907.

The ground considered as ore reserves in 1902 was lost to immediate availability by the fire and attendant caving. These stopes are now gradually being reclaimed, but most of the ore now being mined comes from stopes that were unknown three years ago.

A number of other companies in the Jerome district were more or less actively engaged in exploration in 1906, but no important deposit has yet been developed.

Globe district.—The old silver camp of Globe, in Gila County, produced approximately 27,000,000 pounds of blister copper in 1906, an increase of about 2,000,000 pounds over the yield of 1905. This output was derived chiefly from the Old Dominion and United Globe mines, but the outlying mines, including the Gibson, Warrior, Eureka, Live Oak, and Inspiration, produced more in the aggregate than ever before, and the Arizona Commercial, nearer the larger mines, was also a producer. The output was somewhat reduced by a fire and consequent flooding in the Old Dominion mine in the early part of the year.

The geology and ore deposits of the district have been studied and described by F. L. Ransome.[a] The main productive area contains blocks of sedimentary rocks floated up and partly surrounded by an intrusive mass of diabase. The ore bodies are of two great classes—irregular replacements in the sediments and fault lodes or fissure zones in the diabase. The present writer believes that the former are of contact-metamorphic origin. Practically all the ores have been secondarily enriched. The workable ore in the limestone occurs, somewhat as at Bisbee, in irregular bodies at the base of great

[a] Prof. Paper U.S.Geol.Survey No. 12, 1903.

masses of mixed limonite and specularite. In the quartzite native copper and cuprite predominate. The chalcocite ores are for the most part enrichments of pyritic veins and disseminations in the crushed and altered diabase. The richest body of this ore has been developed to the fourteenth level, or 1,000 feet from the surface. In the United Globe mines bodies of primary pyritic ore rich enough to be worked are sometimes found.

The Globe ores have long been known to be of high grade, and the outlying mines are still shipping ores of an average content considerably over 5 per cent. But the increase in quantity of lower-grade concentrating ores in the United Globe and Old Dominion mines, and the extraction from old stopes of the Old Dominion of material too poor to be worked in former years and at a lower copper market, have lowered the tenor for the district, so that the average yield from all the ores in 1906 was about 3.4 per cent. A little more than one-third of the approximately 390,000 tons of ore treated in 1906 was concentrated, on an average about 5:1. Some of the iron-rich material surrounding old stopes in the limestone, and even old gob filling, was in 1906 extracted down to a minimum grade of 2 per cent. About 30 per cent of the 1906 output was derived from sulphur-bearing ores, chiefly chalcocite. Ore of this class will undoubtedly soon become the principal ore of the district. The greater part of the ore from the outlying mines is oxidized and much of it consists chiefly of chrysocolla. The gold and silver contents of the ore are very low, and the average yield per pound of copper is only about 0.5 cent.

Most of the workings are not deep; the deepest shaft in the camp goes down 1,000 feet. Tunnels are of service only in the upper workings. Square-set stoping predominates, but stulls have been employed in the flat stopes in quartzite. The bottom of the Old Dominion mine is exceedingly wet, and the pumping plant has been enlarged to a capacity of 6,000,000 gallons per day. Owing in part to the wetness of the ground, the kaolinized sulphide ore in the lower levels is difficult ground to hold. Transportation to the Old Dominion smelter is furnished by a branch line of the Southern Pacific. The Arizona Commercial Company in 1906 built a line connecting its mines with this smelter. Oil is the principal fuel. Mexican labor is employed in part.

The Old Dominion concentrator has been increased in capacity and a blast furnace and reverberatory have been added to the smelting plant. Globe ores have been at a disadvantage because of their high silica and lack of sulphur. It has been necessary to bring in outside sulphides, and favorable smelting charges have been impossible on much of the oxidized siliceous ore from mines in the district. Bisbee, Ariz., and Nacozari and Cananea, Mexico, supplied sulphide ores in 1906, while considerable siliceous ore from the district went to the Douglas and El Paso smelters, chiefly for converter lining. At the middle of 1907 it was estimated that 60 per cent of the copper of the Old Dominion and United Globe mines was coming from sulphide ores, and importations will probably cease before the end of the year. Some old slag was resmelted at the Old Dominion plant.

Other districts.—The chief producer in Arizona outside of the principal districts was the Imperial Copper Company's mine, in the Silver Bell district of Pima County. This company is building a smelter. Other Pima County producers of some importance were the Twin

Buttes, Mineral Hill, and Helvetia companies. The Helvetia operated a matting furnace. The Saddle Mountain Company, in Gila County, turned out considerable copper matte from self-fluxing garnetized limestone. The Commercial Mining Company was, next to the United Verde, the largest producer in Yavapai County. The Black Diamond Company, in Cochise County, made a small amount of matte. Many other mines contributed small amounts of copper to the output of the Territory. Some developments in the Chiricahua and Huachuca mountains and in Pinal County are of much promise. One of the important features of the year in the Territory was the blowing in of the custom smelter at Humboldt, Yavapai County.

Considerable Arizona ore was treated at El Paso, some went to Denver, and a little to California. A small quantity of matte was converted in the East.

CALIFORNIA.

General statement.—The production of blister copper in California in 1906 was 28,153,202 pounds, an increase of about 11,500,000 pounds over that of 1905. The bulk of the production and nearly the whole increase was from the Shasta County region. Several other counties contributed to the output, Calaveras County leading. The mine production for the year corresponds closely with that of the smelters. The agreement is largely due to the fact that all the principal producers operated their own smelters. The disaster at San Francisco, which temporarily demoralized certain industries, had little direct effect on copper production. The prices of many staples, including lumber, were increased considerably, however, and wages, especially for the ordinary trades, advanced to a marked extent.

Considerable old copper was recovered during the year from the San Francisco ruins, but this has been excluded from the statistics of production.

Shasta County region.—The Shasta County copper region, which lies near Sacramento and Pitt rivers, north of Redding, produced in 1906 slightly less than 21,000,000 pounds of blister copper, as against an even 10,000,000 pounds in the year preceding. This production came from four companies—the Mammoth, Mountain, Bully Hill, and Great Western.

This region, which next to the Lake Superior copper range is the most extensive of the important copper districts of the country, is one of considerable geologic complexity,[a] but is a unit as regards the general character and occurrence of its ores. It is commonly divided into four districts, viz, the Iron Mountain, Little Backbone, Bully Hill, and Afterthought. The ore bodies are invariably associated with intrusive stocks of quartz monzonite porphyry, although the ore in some places extends out into adjoining rocks. The ores are more or less complete replacements of country rock at localities of intense crushing, and the completeness of replacement appears to have been dependent on the degree of comminution of the rock. Most of the ore bodies are large, tabular, flat-lying masses whose original form has been modified by faulting. A few deposits, notably that of the Bully Hill mine, are steeply inclined and partake more of the form of veins. The typical ore is a massive sulphide made

[a] The geology of the region has been described by J. S. Diller in Geologic Atlas U. S., folio 138. The copper deposits are now being made the subject of special investigation by the Geological Survey.

up of varying proportions of pyrite and zinc blende, with chalcopyrite in comparatively small amount. It carries from 27 to over 45 per cent of sulphur, high iron, and 3 to 30 per cent of silica. In the Bully Hill district a barite gangue lowers the proportion of sulphides, but elsewhere the ores that do not appear to be almost solid sulphides are commonly of too low grade to be profitable. The secondary zone, which was wonderfully productive of copper and silver at the Iron Mountain and Bully Hill mines, has been exhausted, and at the other mines is either of little importance or practically absent.

The ores smelted in 1906 yielded approximately 3.6 per cent of copper. The yield per ton in gold was about $1.60, and in silver 2.25 ounces, or $1.50, which combined are equivalent to 2.9 cents per pound of copper. The percentage of copper can be expected to decrease to some extent, and that of silver to increase slightly when all the developed deposits become actively productive.

Through developments prosecuted during the year great reserves in mines of the Mammoth, Balaklala, Mountain, and Bully Hill companies were added to those already known in these mines, and in the Trinity company's Shasta King mine. Valuable discoveries were also made in the Afterthought mine of the Great Western Gold Company, and there were encouraging developments in some other mines. This district is undoubtedly next to the Lake Country, Bingham, and Ely districts in the amount of ore blocked out, and under reasonable conditions should be producing annually 100,000,000 pounds of copper before 1910.

Most of the ore bodies thus far discovered are developed by workings not more than 500 feet deep, but in the Bully Hill district the lowest level is about 900 feet below the outcrop. Owing to the rugged topography tunnels afford easy access to the ore bodies, but in a few places winzes from these tunnels are required. Open cutting is employed in part at the Balaklala and Afterthought mines. Water is not troublesome. Up to the present time square setting has been chiefly employed. At the Mammoth mine the horizontal slicing system with subsequent caving is employed, but none of the timber of the complete sets used is recovered. Methods requiring less timber will probably be employed in the mines that are now in the development stage. Native timber was used, but brought a high price in 1906. Electric power is employed almost exclusively, and is derived from the lines of the Northern California Power Company. Much of the coke comes from Australia. The Southern Pacific Railroad crosses the district. The Iron Mountain and Hornet mines are connected by a private railway, and the Mammoth by an aerial tramway, which is to be replaced by a combination steam and electric road begun in 1906. An aerial tram to connect the Balaklala and Trinity mines with the Southern Pacific line was begun in 1906, and construction was started on a private railroad to the Bully Hill district. The Afterthought district profits by a near-by branch of the Southern Pacific, which it is planned to extend to the camp. Wages are somewhat below the Butte standard, and it is difficult to procure the best class of labor. At the Iron Mountain mine, where some of the stopes are on fire, European labor is employed chiefly.

Pyrite smelting is now applied almost exclusively to the ores and is very successful. The average charge contains about 2 per cent of coke. Even the zincky ores of the Afterthought region are successfully handled by the aid of a hot blast. Some experiments are under way to save the zinc now lost at this plant, and if these are successful a similar method may be applied at Bully Hill also. The great demand for siliceous flux has stimulated the decadent quartz-mining industry of the country. The Mammoth Company took a lease on the great low-grade deposit at Quartz Hill and began the construction of a railroad to it during 1906. This company was the largest producer of the year, but turned out only matte, which was converted at the United States smelter, in the Salt Lake valley. The construction of converters, as well as of two additional blast furnaces, however, was begun in 1906. During that year the fine ore was shipped mostly to sulphuric-acid works near San Francisco, where the resulting cinders were smelted for their copper. The Mountain Copper Company, owing to the injunction against its Keswick plant, treated its entire output at its new plant near Oakland, where it has, in addition to a small electrolytic refinery, a sulphuric-acid and fertilizer plant that utilizes phosphate from Utah and Idaho. The Afterthought smelter shipped its matte to Utah for conversion. The Bully Hill smelter, which turned out blister copper, was closed early in the year pending the completion of its railroad, and remodeling and enlargement of the plant was begun. Work was actively carried on by the Balaklala company in the construction of its smelter, which had been planned to supply matte to the San Bruno smelter when that should be completed, but the abandonment of that project will necessitate the shipment of Balaklala matte elsewhere.

The smelters that were operated in 1906 treated approximately 289,000 tons of pyritic and siliceous ore from Shasta County. Custom ore to the extent of 42,000 tons was also handled, and consisted mostly of dry gold-silver ore from Nevada, with some siliceous copper ore from Idaho; also copper ores from Oregon, from Utah, and from other districts in California.

A matter of much importance both to this and other districts, especially in view of recent troubles over smelter smoke at Anaconda and Ducktown and in the Salt Lake valley, was the reversal by the United States circuit court of appeals of a decision which enjoined the Mountain Copper Company from operating its smelter at Keswich. The decision had been brought about by claims of injury, both to private agricultural property and to Government land, neither of which, as a matter of fact, was of much value. The change of local public sentiment which followed the closing of the Keswick plant and the desertion of the town has made other smelters in the district as safe from attack as if their stacks did not turn out a pound of sulphurous smoke. The Keswick plant resumed operations in 1907.

Other districts.—Among other productive districts in California are the Campo Seco and Copperopolis districts of Calaveras County. The ores consist of heavy pyrite with chalcopyrite and occur as lenticular bodies in schist. The average yield in 1906 was somewhat over 5 per cent. Some of the ores carry practically no gold and silver, and the copper, being free from impurities, is made into casting copper. Smelters were operated by the Penn Chemical Company at Campo Seco and by the Union Copper Mining Company at Copperopolis. The matte from both and some cement copper from the leaching plant of the latter were shipped East for further treatment.

The Copper King mine, in Fresno County, continued to produce a low-grade ore. A small production from San Bernardino and Inyo counties was treated in part at the Needles smelter, which handled also a little copper ore from Arizona. Other miscellaneous shipments from California, as well as ore from Nevada, reached the works of the Mountain Copper Company, the American Smelters and Securities Company, and the Peyton Chemical Company. The matte produced by the Peyton plant is converted in Washington and in Utah. At the Dairy Farm mine, in Placer County, active development of the large pyritic ore body was maintained throughout the year in order that the mine might be ready to supply a large tonnage to the new smelter at San Bruno, on San Francisco Bay. Cessation of work in 1907 on the construction of that plant, due to opposition and the prospect of complications over the smelter smoke, has caused closing of the Dairy Farm mine.

During the latter half of 1906 much attention was given in the daily press to copper deposits in the old Furnace Creek or Greenwater district of Inyo County. Many stock companies were formed, some of them with capitalization reaching over $10,000,000, and in the stock markets of western cities great excitement prevailed. According to such information as is available from competent and reliable men who have visited the district, the existence of copper deposits of particular importance has yet to be shown. The excitement has subsided, and it may be that legitimate development will eventually open up some profitable bodies of ore.

COLORADO.

The production of blister copper in Colorado in 1906 from materials originating within the State was 7,427,253 pounds. Returns from matte smelters receiving ores from outside the State has this year allowed a more accurate distribution of the output of Colorado smelters than was possible in previous years. The marked difference between reported mine production and actual smelter yield was noted and explained for last year's figures.[a] The same explanation undoubtedly applies this year, viz, that considerable copper was recovered by the smelters from ores in which copper was present in small amounts and was not paid for,[b] hence the mining companies in their reports to the Geological Survey assumed that no copper was recovered.

The production for 1906 was derived almost wholly from the smelting of ores (and concentrates) which were mined primarily for other metals than copper. As in 1905, the Leadville district ranked first in copper production, followed by the San Juan country. Gilpin, Chaffee, Clear Creek, and Dolores counties contributed smaller amounts and nearly every other mining county in the State produced a little copper.

The few districts in which copper is the chief metal were inactive or produced very little in 1906. Principal among these are the deposits at Pearl,[c] in Larimer County, at Cashin,[d] in Montrose County, and in the Plateau region[e] of southwestern Colorado, of

[a] Lindgren, W., Mineral Resources U. S. for 1905, report on gold and silver, p. 192.
[b] Compare pp. 5-6.
[c] Spencer, A. C., Bull. U. S. Geol. Survey No. 213, 1903, pp. 158-162.
[d] Emmons, W. H., Bull. U. S. Geol. Survey No. 285, 1906, pp. 125-128.
[e] Emmons, S. F., Bull. U. S. Geol. Survey, No. 260, 1905, pp. 221-232.

which short descriptions have been given by members of the United States Geological Survey.

A great part of the copper produced in Colorado was recovered in matte in lead furnaces at the large plants of the American Smelting and Refining Company, and ultimately appeared as electrolytic copper at the refinery at Perth Amboy. Much of it was first converted at Omaha, Nebr., where considerable cupriferous material from other States, especially that rich in gold and silver, was treated. The Ohio and Colorado Company also turned out a little copper matte from its lead smelter at Salida. Some copper was recovered from the smelting of zinc-ore cinders by the United States Smelting Company at Canyon. Some Colorado ore and matte went to the Salt Lake valley for smelting and converting. A little Colorado ore, as well as some Montana ore and matte, was made into matte in South Dakota. A small production of copper was turned out from Colorado ores at works in British Columbia. The Boston and Colorado smelter near Denver turned out refined copper of the casting grade until the refining plant was burned in the latter part of the year, after which matte was shipped for conversion. The Continental smelter at Ironton, the Grand Junction smelter, and the Ross Mining and Milling Company's smelter at Silverton were in operation for the whole or a part of the year, producing matte which was shipped outside of the State for conversion. Other smelters, including those at Pearl and Golden, were not operated during 1906. Besides handling material originating within the State, the Colorado smelters treated ores, concentrates, or matte from Arizona, Idaho, Nevada, New Mexico, Utah, and Wyoming.

IDAHO.

In 1906 the production of blister copper from Idaho was 8,578,046 pounds, a gain of about 1,250,000 pounds over the output in 1905. The difference between mine and smelter production in 1906 is due to the fact that a large quantity of Idaho ore was in storage at Canadian and Pacific coast reduction works at the end of the year. Much of the production came from the Snowstorm mine, in the Couer d'Alene district, and from the White Knob mine, at Mackay, Custer County.

The Snowstorm deposit[a] consists of a zone in pre-Cambrian quartzite that contains disseminated particles of chalcopyrite, bornite, and chalcocite, which in places are oxidized. The ore averages about 4 per cent copper, 6 ounces of silver, and 0.1 ounce of gold. It carries very high silica, in consequence of which it is given a favorable reduction charge by many smelting companies for use as converter lining. Such of the oxidized ore as is of too low grade or contains too little silica to be shipped for this purpose is treated by leaching at the mine.

At Mackay the White Knob mine and smelter were operated under lease. The deposit is of contact-metamorphic origin and lies mostly in limestone. The ore is oxidized down to a depth of 600 feet, and is of moderate grade in copper, gold, and silver. Sulphide ore from Bingham was brought in and smelted with the oxidized ore. The matte produced was returned to the Salt Lake valley for conversion.

The Seven Devils district, in Washington County; the Copper Queen mine, in Lemhi County; and the Weimer Company, in Fremont

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[a] Ransome, F. L., Bull. U. S. Geol. Survey No. 260, 1905, p. 301.

County, were among the other producers of the State. A small amount of copper was recovered as matte in lead furnaces and was turned into blister in the East. In 1906 Idaho copper was turned out at 17 smelters located in Alaska, British Columbia, Washington, Oregon, California, Montana, Idaho, Utah, Colorado, and Pennsylvania.

MICHIGAN.

General statement.—The smelter production of copper in Michigan in 1906 was 229,695,730 pounds,[a] as compared with a little over 230,000,000 pounds in 1905. The difference between the mine and the smelter production, as shown on page 11 is due to the fact that a quantity of mineral from ore mined and milled in former years had been stored and was not smelted till 1906, when the high price of copper brought it out. The same condition of affairs existed in 1905. The entire production of the State comes from the single district on the Keweenaw Peninsula.

Lake Superior region.—The slight falling off in production of copper in the Lake Superior district is due to the fact that although the mines as a whole made a substantial increase in their output, the amount of old mineral smelted by the Calumet and Hecla Company in 1906 was decidedly smaller than in 1905. Had it not been for numerous accidents, however, the mine production and, consequently, the smelter production would have been considerably larger. Among these reverses the fire at the Tamarack and the caving at the Atlantic and Quincy mines were most serious.

This region, as is well known, is the one great native-copper district of the world, although native copper in apparently similar occurrence is found in western and in south-central Virginia and in some other places. The copper occurs as masses of various size, from minute particles up to huge masses hundreds of tons in weight, contained in certain beds of a thick series of basic lavas and in some of the intercalated sandstone and conglomerate beds, all of pre-Cambrian age. The origin of these copper deposits is a problem as yet unsolved. The unchanged character of the ores at the great depth to which mining has been carried—deeper than anywhere else in the world—makes it appear certain that the native copper was deposited as such and is not an intermediate product of the oxidation of sulphides.

The ores are of extremely low grade, the average yield in refined copper of all the ores milled in 1906 having been 25.2 pounds per ton, or 1.26 per cent. A little silver occurs with the copper in some lodes. Averaged on the total tonnage in 1906, the silver yield was 0.025 ounce per ton.

The general similarity of geologic conditions, the uniform value of the ores, and the extent and regularity of the lodes necessarily cause any account of a year's progress in the Lake Superior copper district

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[a] Some statistics of smelter production for 1905 and 1906 which have been published are much too low in the figures for Michigan. The error appears to have arisen from the fact that the statisticians have really compiled mine production, which is reported to the State mineral commissioner as a basis of taxation. In the case of all Lake mines except the Calumet and Hecla, the mine production is measured by the actual year's yield of the smelters. The Calumet and Hecla Company, however, does not smelt all its mineral as soon as produced. The figures that this company reports to the mineral commissioner represent the amount of ingot copper that the mineral produced within the year is estimated to yield, and do not reflect in any way the actual smelter output for the year. These facts may be clearly gained from a perusal of the last two annual reports of the company, although the figures therein given are for the year ending April 30. The figures given above are based on direct returns from the Calumet and Hecla as well as the other companies, giving actual output of ingot copper.

to be little more than a chronicle of mechanical achievement. Number of feet of new development, increase in hoisting capacity, enlargement and improvement of mills and smelters—these, more than any other factors, measure the advances for the year. The result of this permanency and regularity of the lodes is seen in the wonderful equipments, the immense capacities, and the permanent character of all important undertakings.

The smelter production of the Lake district for 1905 and 1906 is shown in the following table. The figures of production of individual companies have already appeared in their annual reports.

Smelter production of copper in Michigan in 1905 and 1906.

Company.	1905.	1906.
	Pounds.	*Pounds.*
Adventure	1,606,208	1,552,628
Ahmeek	1,552,957	3,077,507
Allouez	1,167,957	3,486,900
Atlantic	4,049,731	1,439,082
Baltic	14,384,684	14,397,557
Centennial	1,446,584	2,253,015
Champion	15,707,426	16,954,986
Franklin	4,206,085	4,571,570
Isle Royale	2,973,761	2,937,098
Mass	2,007,950	2,106,739
Michigan	2,891,796	2,875,341
Mohawk	9,387,614	9,352,252
Osceola	18,938,965	18,588,451
Quincy	18,827,557	16,194,838
Tamarack	15,824,008	9,832,644
Trimountain	10,476,462	9,507,933
Victoria	....	546,334
Wolverine	9,464,418	9,548,123
Calumet and Hecla Copper Concentrating Co., Phoenix,[a] Rhode Island, Tecumseh, and Winona	95,373,829	100,472,732
Total	230,287,992	229,695,730

[a] Did not produce in 1906.

Prospecting in new territory and exploitation of old properties were carried on in 1906 more extensively than ever before, unless, perhaps, in 1898 and 1899, when the Kearsarge and Baltic lodes came into prominence. The activity in northern Keweenaw County, including the beginning of the Keweenaw Central Railroad, was of first importance, followed by the developments on and for the Kearsarge lode, south of the Calumet and Hecla property; the increasing importance of the Baltic lode and the explorations in Ontonagon County also demand especial notice. Much of this exploratory work brought forth results which within the next few years will materially augment the production of the district. Most of the well-established producers extended their reserves in greater proportion than ever.

The mines are worked to great depths, mostly through inclined shafts, but a few vertical shafts reach the deepest workings. Pillars are left to support the hanging wall, even in many places where the grade of ore is good, but are planned to be ultimately extracted. Underground sorting of the ore, leaving the worthless rock as filling, and keeping drifts and shoots open by dry walling, is a system coming to be very favorably regarded. Much heavy timber is required, however, in some of the mines. Water gives little trouble and is kept at the desired level by comparatively light pumping, although the sumps of most of the mines are far below the level of Lake Superior. Lake Superior affords the tremendous volume of water required by the mills. In addition to local transportation by the Mineral Range and Copper Range railroads and numerous private lines between mines, mills, and smelters, the region is joined with the main lines of traffic by the Duluth, South Shore and Atlantic Railway. Most important of all, the deep-water transportation of the Great Lakes is brought through the heart of the district by Portage Lake and the Houghton Ship Canal. Pennsylvania coal is therefore cheap, and the outgoing copper has to stand only a trifling freight rate as far as Buffalo. Electric power generated at central plants seems destined to replace steam for most purposes at the larger mines. Pumping and underground haulage are at present done in part by electricity. European labor is employed very largely, and the wages are low as compared with those paid in western camps.

With the exception of the comparatively small amount of coarse copper—"mass" and "barrel work"—sorted out at the mines, all the ores are subjected to crushing by steam stamps, followed by concentration. The failure of experiments at the Champion mill to apply graded crushing by rolls and regrinding mills in order to prevent excessive loss in the slimes caused by heavy impact of the stamps was a surprise to many western millmen. Regrinding of the coarse tailings from the stamp mills, however, is becoming general. The mineral from the mills is treated by a combined melting and refining process, which is very cheap as compared with the transformation of sulphide ores into electrolytic copper. A small proportion of the total output is either sufficiently argentiferous or so high in arsenic as to be refined electrolytically. During 1906 the Michigan, Quincy, and Dollar Bay smelters and the two smelters of the Calumet and Hecla Company, one at Hubbel and the other at Black Rock, N. Y., treated about 333,750,000 pounds of mineral, the product of about 9,018,000 tons of ore. Of this, over 8,904,000 tons were mined and milled in 1906.

MONTANA.

In 1906, Montana produced 294,701,252 pounds of blister copper, which, although a decrease of about 20,000,000 pounds from 1905, maintains Montana's rank as the greatest copper-producing State in the country. The output from the mines was a little lower than that of the smelters, mainly because severe weather and congestion of traffic prevented regular shipments to the smelters so near the end of the year that the decrease was not felt in the smelter production till in 1907.

Butte district.—Nearly the entire production of the State came as in former years from the Butte district in Silver Bow County, which is the greatest copper camp in the world. The mines of the Amalgamated, the North Butte, the Butte Coalition, and the Clark companies were the chief producers; but the United Copper, the East Butte, and the Pittsburg and Montana companies contributed considerably to the output, and a few other companies produced a little. The output was unquestionably affected by shortage of labor, but the tonnage of ore treated was a little larger than in 1905. The decided falling off in production must, therefore, be attributed mainly to a decrease in grade of the ores, but this was in part the outcome of a deliberate plan to conserve the higher grade ores while copper remained high.

A geological study of the Butte district has been made by Walter Harvey Weed, and the report to be published by the Geological Survey is expected to appear shortly. The veins are contained in a granitic rock, greatly shattered, and much altered in the vicinity of the ores. The original mineralization resulted in the formation of cupriferous pyrite, especially along fractures and fault zones. Concentration by descending waters has gone on to a remarkable extent and makes Butte deposits the best known example of secondary sulphide enrichment.

Rich secondary ore was encountered in 1906 at a depth of 2,400 feet in the Anaconda mine, and is the deepest secondary copper ore known. This occurrence, however, does not guarantee the general presence in the camp of similar ore bodies at that depth. Where oxidizing waters have not been able to penetrate freely, the pyritic ore is encountered little enriched from its original state, as, for example, at the 1,600-foot level of the Anaconda lode, and at about the same depth in a number of other places. The principal copper mineral is chalcocite, and about 90 per cent of the output in 1906 came from this mineral. Enargite contributed the bulk of the remainder, although secondary bornite and chalcopyrite furnished a little, and a comparatively small quantity came from oxidized ores from the eastern part of the camp.

Owing to the great quantity of low grade concentrating ores, comprising over 80 per cent of the total ore treated during the year, the average copper yield is low, approximately 3.15 per cent in 1906. The high loss attending a close separation of ore and gangue and the considerable percentage of chalcocite-coated pyrite in the ore permit only a low concentration, the average being close to 1.5 into 1. The yield in silver is rather high, the average in 1906 being about 2 ounces per ton of ore, or 0.032 ounce per pound of copper. Gold is comparatively lower, the yield per ton of ore being 0.01 ounce, or 0.00016 ounce per pound of copper. The precious metals, therefore, reduced the cost of copper production by about 2.24 cents per pound in 1906. The recovery of arsenic from the enargite ores, as practiced at the Washoe smelter, is also a source of revenue.

The productive area is remarkably small for so great an output. Great activity was manifested in exploration for an extension of the profitable ground to the north, south, and east of this area. On the east, Pittsburg and Montana showed some improvement for the year, and some oxidized ore was struck in the Bullwhacker and adjoining claims; but in general the outlying exploration has not as yet been successful. The most important developments of the year were in depth, several of the principal shafts having been sunk from 100 to 400 feet and new ore bodies or continuations of known bodies cut by the crosscuts driven at the attained depths. The North Butte maintained its splendid record. The cutting of a lode of good ore on the 2,400-foot level of the Anaconda is the most noteworthy feature of the year.

Most of the Butte ore bodies are large, although more tabular than in many copper camps, and hence not always especially wide. Square-set mining is the prevailing system; the cost of timber to the Amalgamated mines is reduced through control by that company of extensive timber lands. On the whole the mines are dry, the Lexington being one of the very few in which water is troublesome. Three trunk lines bring supplies into the district and afford communication with the smelters at Helena and Great Falls. A private standard-gage line connects the mines with the Washoe plant at Anaconda, where nearly three-fourths of the ore is treated. Coal comes largely from the mines of the Amalgamated Company in Montana, but considerable power is being derived from hydro-electric installations near Helena. American labor is extensively employed and receives high wages.

Owing partly to lack of a sufficient water supply for concentration and partly to the low cost of treatment at Anaconda and Great Falls, Butte has ceased to be a great smelting center, the Butte Reduction Works, which concentrate and smelt the Clark ores, being the only survivor. The Pittsmont smelter was closed early in 1906, owing to the failure to apply successfully the Baggaley process, and the old Montana Ore Purchasing Company smelter suspended operations and was dismantled a few months after its acquirement by the Butte Coalition Company. The Great Falls plant handles the output of the Boston and Montana mines, both smelting and concentrating ores, as well as some of the rich ores from other companies. The great plant at Anaconda, which has the largest copper smelter and in 1906 concentrated more ores than any other plant in the world, treated all the rest of the Butte output with the exception of a trifling amount of leady material which went to the Helena plant of the American Smelting and Refining Company. These various smelters handled in 1906 about 3,310,000 tons of ore and concentrates from the Butte district, representing over 4,500,000 tons of crude ore. Of this, about 856,000 tons was smelted without concentration. There was also treated a large tonnage of cleanings, etc., from the sites of dismantled smelters. A small amount of custom ore from other Montana districts and a little matte from the Amador and Cook City smelters were converted into blister. Considerable siliceous copper ore for converter lining came from the Coeur d'Alene district in Idaho. Both the Washoe and the Great Falls plants were enlarged during the year.

An occurrence of far-reaching effect on both amount and cost of production was the acquisition early in the year by the Butte Coalition Mining Company, under Cole-Ryan management, of all the Heinze property, over which controversy had arisen. The Red Metal Mining Company, which is the operating division of the Butte Coalition, at once entered into an agreement with the Amalgamated companies whereby vertical side lines were adopted. The result was reflected in increased production of these mines for even the first year.

NEVADA.

The output of blister copper from Nevada in 1906 was 1,090,635 pounds, as compared with a little over 400,000 pounds in 1905. The principal production came, as in 1905, from the mines of the Mason district, in Lyon County, including the Douglas, the Ludwig, and the Yerington properties. The ores shipped in 1906 were of high grade, mostly oxidized, and went to California, Utah, and Illinois for smelting. Production from this district is expected to be larger in 1907. Miscellaneous producers in several other counties added to the output.

No production was made in 1906 from the great disseminated chalcocite deposits of the Ely district, in White Pine County. The Nevada Northern Railway was built, connecting the camp with the Southern Pacific, and construction was begun on mills and smelters by the Giroux Consolidated Company, and by the Steptoe Valley Company, a subsidiary of the Nevada Consolidated and Cumberland-Ely companies. Development continued on a large scale, and enormous reserves of the low-grade ores were blocked out. Production should begin before the close of 1907.

NEW MEXICO.

The production of blister copper in New Mexico in 1906 was 7,099,842 pounds, an increase of about 1,700,000 pounds over the output of 1905. This production came principally from the Burro Mountain and the Santa Rita-Hanover districts, in Grant County,[a] and the increase for the year is attributable mainly to the Burro Mountain camp.

Burro Mountain district.—The Burro Mountain district, southwest of Silver City, produced in 1906 about half the output of the Territory. The principal producer was the Burro Mountain Copper Company, which operated a concentrating mill at its mine at Leopold. Other properties, however, produced more than in former years. The most important ores are stockworks carrying chalcocite-coated pyrite in crushed and altered porphyry. The ore of workable grade has been produced by secondary enrichment from above. The greater part of these ores are of concentrating grade. Some richer oxide ores carrying carbonates and chaysocolla occur in the district and were mined to a small extent in 1906.

The mines are less than 400 feet deep, and are not very wet. Square-setting is employed in the stopes. Transportation to a branch line of the Santa Fe Railroad at Silver City is effected by wagon, but the construction of a narrow-gage railway was begun in 1906. Mexican labor is employed largely.

The concentrates are shipped to Arizona and Colorado smelters, and some ore goes to the Comanche smelter at Silver City, whence matte is shipped to Arizona for conversion.

Santa Rita-Hanover district.—The deposits of the Santa Rita district, east of Silver City, were worked by the Indians before the coming of the Spanish explorers. The district maintained its output in 1906 mainly through the operations of leases from the Santa Rita Mining Company. In certain characters of its ore deposits the district somewhat resembles Globe, Ariz. The surface quartzite, which ranges up to 200 feet in thickness and is underlain by porphyry, carries cuprite and native copper in its countless fractures and joints. The near-by occurrence of contact metamorphic garnet rock, mostly oxidized into limonite, suggests that the copper in the quartzite descended from bodies in the overlying limestone before the latter was eroded away. Underlying the quartzite, the porphyry carries chalcocite ores along certain zones of crushing and alteration. These ores, which were plainly concentrations of lean pyritic impregnations, were in places very rich. They have now been almost exhausted, and the bulk of production in 1906 came from the quartzite ores. The deepest workings are slightly over 400 feet, and are reached by shafts, while shallow pits with windlasses or whimes serve the Mexicans in their leasing operations. The ore bodies in quartzite are commonly small and require little or no timbering. The chalcocite ore bodies are larger and in spite of square setting and filling, the ground is extremely difficult to hold. The native copper and cuprite are recovered mainly by the use of hand jigs, producing rich concentrates, which are shipped to El Paso for smelting.

In the Hanover district, lying just east of Santa Rita, the ores occur chiefly as contact-metamorphic deposits in limestone. At the Han-

[a] Lindgren, W., and Graton, L. C., Mineral Deposits of New Mexico: Bull. U. S. Geol. Survey No. 285, 1906, p. 83.

over mine, another old prehistoric working, the ores have been greatly oxidized and secondarily enriched. The Hermosa Copper Company produced heavy pyrite-chalcopyrite ores from limestone replacement bodies. The ores of this district go to Silver City and to Arizona smelters for treatment. Branch lines of the Sante Fe railroad enter both this and the Santa Rita district.

Other districts.—A small quantity of copper was produced from the Magdalena district, in Socorro County, where the ores are of contact-metamorphic origin and are associated with valuable deposits of zinc and lead. The well-known contact-metamorphic deposit at San Pedro, in Santa Fe County, was not worked in 1906, but operations were resumed early in 1907.

TENNESSEE.

In 1906 Tennessee produced 17,809,442 pounds of blister copper as compared with about 14,500,000 pounds produced in 1905. This output came almost exclusively from the Ducktown district.

Ducktown district.—The Ducktown district, in Polk County, in the southeastern part of the State, was in 1906 the ninth copper camp in the United States in point of production, and the principal copper-producing region in the eastern United States. Practically the entire output of Tennessee came from the Tennessee Copper Company and the Ducktown Sulphur, Copper, and Iron Company. The large increase over the production in 1905 was due mainly to the enlarged scale of operations of the former company.

The ores lie as great lenticular masses of sulphides parallel to the steeply inclined foliation of schists. Both the ores and the schists are probably of pre-Cambrian age. The ore minerals are predominant pyrrhotite with chalcopyrite and pyrite. Oxidation of the upper portion of these deposits produced heavy gossan, underlain by rich secondary chalcocite ores. These were exhausted long before their significance was known and at a time when the exploitation of the lean sulphides encountered below was out of the question. The entire output now comes from the primary ores.

The ores are low grade, the average recovery in 1906 having been just under 34 pounds blister copper per ton, or 1.7 per cent. Precious-metal values are also low, and part of the copper is sold as casting copper without electrolytic refining. The blister which in 1906 was refined in this country by electrolysis amounted to about half the total output for the year and yielded precious metals to the value of slightly over 0.4 cent per pound, one-tenth of this being gold. Some blister exported to Great Britain was refined there.

The ore bodies as yet developed lie within a few hundred feet of the surface, the deepest shaft being a little over 600 feet. The steeply inclined attitude of the deposits and the great strength of the schist walls permit the ores to be extracted by a system of underground quarrying without the use of timber. One slope in the Burra Burra mine of the Tennessee Company is 700 feet long, averages over 50 feet wide, and extends from the top of the 20-foot slice separating it from the level below to the bottom of the corresponding slice or floor pillar above, a height of 80 feet; in this slope there is but one pillar and not a stick of timber. Light pumping controls the water. Coal and coke come from Tennessee and West Virginia, and are cheap as compared with western prices. A branch line of the Louisville and Nashville Railroad serves the district and the mines and smelters are connected by private lines. Native white labor is employed largely, but some Europeans also are employed; the wages are very low.

Pyrite smelting is now practiced with much success at the smelters of both companies, and the first matte is further concentrated before conversion. Siliceous ore has been sought throughout the South, but has been secured with difficulty, and barren quartz is largely used. The matte of the Ducktown company was converted at the Tennessee plant, where the effect of the added capacity will not be fully felt till 1907. At the 2 smelters a little over 538,000 tons of Ducktown ore were treated, in addition to a small quantity of siliceous copper ore from North Carolina.

As a result of an injunction suit brought by the State of Georgia against the Tennessee Copper Company for alleged damage to agriculture and forests, this company began in 1906 the erection of a large sulphuric-acid plant, which is to utilize the sulphur from the blast-furnace flues.

UTAH.

In 1906 Utah produced 50,329,119 pounds of blister copper, as compared with about 54,000,000 pounds in 1905. The mine production for the year exceeded the smelter production by over 6,000,000 pounds, for the reason that a great amount of material received from the mines was not worked up by the smelters during the year, and at the end of the year there were stored at the smelters ores and concentrates containing more than 8,000,000 pounds of copper. The chief cause for the decrease in smelter production was the failure of the new Garfield smelter to handle as much material during the year as had been expected.

The production was derived chiefly from three important districts—Bingham, Tintic, and Frisco.

Bingham district.—The Bingham district, in Salt Lake County, is the sixth in importance in the country. The blister production fell somewhat below that of 1905, which was about 39,000,000 pounds, and the reasons are the same as already given for the State's decrease—lack of fuel and storage of ore at reduction works.

The geology and ore deposits of the district have been described by J. M. Boutwell.[a] Two main types of copper deposits occur in the camp. The deposits which up to the present have been most productive are large replacement bodies of heavy pyritic ore in limestone near the contact of a porphyry. Chalcopyrite is present in the pyrite, and gives the ore its value in copper. The ores are mostly massive and comparatively impervious, and oxidation with accompanying secondary enrichment has proceeded to comparatively shallow depths. At present practically all the copper from the deposits of this type is derived from the primary pyritic ore. The second type of ore deposit has only recently been actively exploited, and its contribution to the district's output in 1906 was not very large. These ores are mainly disseminations of pyrite and chalcopyrite in silicified porphyry. Descending waters carrying copper derived from the ore at higher levels have either coated or completely replaced the original sulphides by chalcocite. The immense deposit being worked jointly by the Utah Copper and the Boston Consolidated com-

[a] Prof. Paper U. S. Geol. Survey No. 38, 1905.

panies is a disseminated deposit, which appears independent of fissures and fractures. In the Ohio Copper Company's property the secondary ore is more confined to definite fractures and veinlets, and where these are in quartzite the copper occurs chiefly as cuprite and native, as at Globe, Ariz., and at Santa Rita, N. Mex. By tunnels and diamond drilling, these secondary deposits have been proved to extend several hundred feet below the surface. Of importance is the practical absence of gossan and the unusal shallowness of the oxidized zone, as represented by the practically barren cap-rock.

In copper content the ores of the pyritic replacements of limestone vary greatly. Many of these bodies are in places too low grade to be worked in entirety, and the average grade of ore mined in a year is therefore affected by the price of copper at that time. In the case of companies that do considerable custom smelting, like the Bingham Consolidated and the United States, heavy pyritic ore that would not be profitable for its copper content alone can be used to advantage because of its excess in sulphur and iron. The average recovery of copper in 1906 from all these replacement ores was undoubtedly lower than for previous years and was probably something under 3 per cent. The gold and silver values, which are considerable, help materially in reducing the cost of copper production. Lead ores encountered in some abundance in certain of the mines also aid in this respect. The great disseminated chalcocite deposits have been estimated by very extensive sampling to carry between 1.5 and 2 per cent copper. The yield from the comparatively small tonnage treated to date is higher than such a content would indicate and may mean that the upper portion of the deposits is somewhat richer in copper than the lower portion.

The producers of former years all contributed to the output in 1906. In addition to the broadened scale of operations on the disseminated ores inaugurated by the Utah Copper and the Boston Consolidated companies, the Ohio Copper and the Utah Apex companies opened up large quantities of ore. Reserves well in advance of production were maintained in the other important copper producers, of which the Utah Consolidated continues the largest and is commonly believed to have been in 1906 the cheapest producer of copper in the country. Some of the smaller companies experienced a successful year in development. The marked revival of lead mining in the district which characterized 1905 was continued in 1906 and was responsible for a part of the copper output. The passing of control of the Bingham Consolidated and the Ohio Copper companies to F. A. Heinze was an important feature of the year's transactions.

The limestone replacement ore bodies are commonly large, tabular, and moderately inclined. They are worked mainly by the square-set system, with or without filling, but the horizontal slicing system with complete square-setting and consequent shooting of the timbers and caving is employed in the United States mines in Bingham as in Shasta County, Cal. In the Bingham Consolidated mines some of the stopes are worked by a method of mill-holing and caving. This caving system is also used for the deeper portions of the disseminated deposit of the Utah Copper Company, while on both this and the Boston Consolidated Company's properties stripping and extraction of the upper portion of the deposit is done by steam shovels. A great part of the timber used in the district comes from Oregon and is expensive. Most of the ore bodies as yet explored lie within a few hundred feet of the surface. The deepest one known in the district is in the Yampa mine, where the Craig tunnel cuts the lode at an inclined depth of 1,800 feet. The prevalence of deep, steep-sided canyons allows tunnels to be particularly effective means of opening the mines. With increasing depth of development, however, some of the mines have been forced to sink winzes below the lowest tunnel practicable, and a great tonnage in the Utah Copper property lies below local drainage and will doubtless require some method of hoisting when it shall be extracted. Water is not troublesome at present depths. Coal comes mainly from the eastern part of the State and is reasonably cheap, but electric power is used to a considerable extent. A branch of the Rio Grande Western Railroad connects the district with the Salt Lake Valley, where most of the smelters are situated. The Copper Belt Railroad and several aerial trams furnish additional local transportation. A line connecting the district with the new Garfield smelter was begun in 1906. European labor is extensively employed and the average wage is lower than in most western camps.

The heavy pyritic ores are smelted, commonly after roasting, although pyrite smelting is practiced at the Bingham Consolidated smelter. The disseminated chalcocite ore is concentrated about 20:1 on the average, producing a concentrate carrying 30 per cent or more, which is smelted in reverberatory furnaces. At the Garfield smelter, which was built chiefly to smelt these concentrates, the reverberatories were completed and one was put in commission about the middle of the year; but some drawbacks were experienced and the plant produced only a small quantity of copper in 1906. The increased capacity of the United States smelter was largely demanded for the conversion of California matte. The Yampa smelter at Bingham was increased in capacity. Its matte was shipped to the valley for conversion. At the Murray works of the American Smelting and Refining Company considerable copper was recovered in matte from the lead furnaces. At the Utah Consolidated smelter experiments were continued in the hope of devising a method for dissolving the sulphurous flue gases, but the outcome does not appear to have been successful. Construction of a reverberatory furnace was begun at the Bingham Consolidated plant. The great mills of the Utah Copper and the Boston Consolidated companies situated near the Garfield smelter were well along in construction at the end of the year, and are expected to begin concentration in 1907.

Some Bingham ore was shipped to the White Knob smelter at Mackay, Idaho, where its sulphur contents were utilized in smelting the oxidized ores of that company. A small quantity of copper was recovered from cinders of Utah zinc ores smelted in Colorado. The Salt Lake valley smelters treated a large quantity of copper matte from California, and siliceous gold and silver ore from Nevada, also ore and matte from Idaho, Colorado, Wyoming, and Montana, in addition to the bulk of the copper output from other districts in Utah, including Tintic and Frisco.

The smelters south of Salt Lake City have long been subject to heavy claims for alleged injury to agriculture, and as a result much money has been spent by the operating companies in the effort to reduce the amount of sulphur in their smoke. Unfortunately for them, the land in the Great Basin region which is capable of being tilled is naturally rich and does not require the use of artificial fertilizers. The local market for sulphuric acid is therefore exceedingly limited, and the Salt Lake smelters are too far distant to ship to the east and the south.

Late in the year the Federal court gave a decision enjoining the four smelting plants near Murray and Bingham Junction from operating on an ore or combination of ores containing any arsenic or more than 10 per cent of sulphur. By the giving of a bond of $100,000 each to pay any damages they might commit in the meantime, the smelters were permitted to continue operations pending appeal and decision by the higher court. This decision, if sustained, will put an end to smelting on the present sites, and may force the companies to move elsewhere—a step contemplated by some of them. The threatened removal of the smelters, however, has aroused property owners and business men in the vicinity, and as in California the dependence of the community on the smelters has been realized.

Tintic district.—The Tintic district at Eureka, Juab County, is the second copper camp in the State and the tenth in the country. The camp is essentially a precious metal camp, with copper and lead as accompanying metals of importance but in varying quantities. The copper production for 1906 was derived in large part from the Centennial Eureka, Eureka Hill, and Mammoth companies, but nearly every producing mine in the camp added more or less copper to the output of the district.

The geology and ore deposits of the Tintic district have been described by Messrs. Tower and Smith.[a] The ore deposits occur along fissures in limestone and in the intruded monzonite, also as contact metamorphic deposits in the limestone near the igneous rock. The lodes in limestone are most persistent and are the greatest producers at present from three principal ore zones. The ore bodies are very irregular, but many are large. The chief primary ore minerals besides pyrite are chalcopyrite, enargite, galena, and specularite, with various silver minerals, all in a gangue of quartz and barite. Oxidation has extended with unusual completeness as far as the depth of present developments, but it would seem that secondary deposition has played little part in the distribution of values. Practically the only ores which have withstood oxidation are lead ores, in which some galena remains. The lead ores carry a little copper; it is probable that less than 5 per cent of the copper production is derived from sulphide ores. The presence of enargite and its oxidation products is a matter of economic significance in view of the recent decision enjoining the smelters in the Salt Lake valley, where practically all the Tintic ores are reduced, from treating ores containing any arsenic. The average yield of all the Tintic ores is in the neighborhood of 2 per cent of copper, but certain ores yield decidedly more. The Mammoth and Ajax are among the few mines in which copper is the most important metal.

Development is by means of shafts, the deepest of which is over 2,200 feet. Water is not troublesome in the mines, and a supply for the camp has to be piped in. The district is served by the Rio Grande Western and by the San Pedro, Los Angeles and Salt Lake railroads. Many of the mines are now worked on the leasing system.

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[a] Nineteenth Ann. Rept., U. S. Geol. Survey, pt. 3, 1899, pp. 601-767. The writer has not visited the Tintic district, and the notes here given are mostly from the report cited.

There is no smelter in the immediate vicinity of the Tintic camp, although it was reported near the close of 1906 that one was to be erected there in the near future. The old mills of the district which depended largely on amalgamation have been abandoned because of their failure to save the baser metals. The new mills make a concentrate for shipment, but the greater part of the ore is shipped direct to the smelters.

Frisco district.—The Frisco district in Beaver County made a decided gain in its copper output for 1906, but a considerable portion of the production did not reach the form of blister copper during the year. The bulk of the output was from the Cactus mine of the Newhouse Mines and Smelters Corporation.

From a brief description of the geology of the district by S. F. Emmons,[a] the following notes are extracted. The ore body of the Cactus mine lies in a wide zone of shattering which marks a fault that may be the continuation of the famous old Horn Silver fault. The ore consists of pyrite with some chalcopyrite disseminated through this shattered zone.

By shaft and tunnel the deposit has been opened to the 600-foot level, and diamond drilling has proved the continuation of the ore body some distance below this level. The quantity of ore exposed is very great. According to figures in a published report of the company, it appears that the Cactus mine yields a lower percentage of copper than any other large mine outside the Lake Superior region. Low gold and silver values, however, somewhat reduce the cost of production per pound, and high-grade ore has been encountered in places. The deposit is stripped and the upper portion extracted by steam shovel, which is said to reduce the cost of mining 40 per cent. The ore is concentrated about 10:1, and the product shipped to Salt Lake smelters over a branch and the main line of the San Pedro, Los Angeles and Salt Lake Railroad. The mill was enlarged in 1906 from 600 tons to 900 tons daily capacity.

Other districts.—The Little Cottonwood district in Salt Lake County, the Park City mines, the Ophir district in Tooele County, and the Tutsagubet district in Washington County were the principal contributors to the State's copper production outside of the three districts already described. In all but the last named of these smaller districts, copper is recovered incidentally to the production of other metals. In the Tutsagubet district, however, the Utah and Eastern Copper Company, operating the Dixie mine at Shem, has a small copper smelter. The operation of this smelter was resumed during the year, and the black copper which it turned out was shipped East for refining. Small quantities of copper were produced in numerous other districts of the State. An important deposit at Copper Mountain, in Box Elder County, was reopened in 1906 and began shipments the same year.

OTHER STATES.

Georgia.—The blister copper output of Georgia in 1906 was 17,182 pounds, almost double that of 1905. The production came chiefly from sulphide ore of the Seminole mine in Lincoln County and from cement copper recovered from mine waters by pumping out the Georgia and Tennessee Copper Company's mine in Haralson County.

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[a] Bull. U. S. Geol. Survey, No. 260, 1905, pp. 242–248.

At the former property a small smelter made a little matte. The entire output of the State was transformed into refined copper at plants in New Jersey.

Massachusetts.—In 1906 Massachusetts produced blister copper to the extent of 9,744 pounds as against about 1,700 pounds in 1905. The production came principally from Charlemont, Franklin County, from cupriferous pyrite mined by the Davis Sulphur Ore Company and smelted in New Jersey, and from matte produced at the New England Mining Company's smelter and further treated in New York works.

Missouri.—Missouri entered the list of producers in 1906 with a blister-copper production of 54,347 pounds. Among the contributors to this total are the Missouri Copper Mountain Company, which operated a small matting furnace at Sullivan, Crawford County, and shipped its product to Illinois for further treatment. The North American Lead Company at Fredericktown blew in a smelter late in the year and turned out some blister copper which went to the Atlantic coast refineries. An electrolytic refinery was completed by this company. It went into commission early in 1907 and is turning out electrolytic copper nickel and cobalt.

North Carolina.—The production of blister copper in 1906 from ores originating in North Carolina was 582,209 pounds as against about 470,000 pounds in 1905. A large part of the production came from low-grade siliceous copper ore of the Union Copper Company at Gold Hill, Rowan County, which was shipped as converter lining to smelters in Tennessee and New Jersey. The North Carolina portion of the Virgilina district in Person County was also productive. Chalcocite-bornite ore in quartz gangue was shipped both in the crude state and as concentrates. Much of this went to the West Norfolk smelter where it was transformed into matte and then converted into blister and refined copper at some of the electrolytic refineries.

Oregon.—In 1906 the production of blister copper from Oregon was 545,859 pounds, a decrease of about 300,000 pounds from the production of 1905. As was the case in 1905, the principal production was from Josephine County and from the Queen of Bronze mine at Waldo, where the Takilma Smelting Company has a matte smelter. On account of the long wagon haul to Grants Pass, the coke supply was limited, and the smelter was operated only during the month of September. The matte was shipped away for converting. At the Oregon Smelting and Refining Company's smelter at Sumpter, Baker County, some copper was produced from Oregon ores as well as from those from Idaho and California. This plant is being enlarged in 1907 and is to treat ores from the Seven Devils district in Idaho. It produces matte which is shipped for further treatment. Some Oregon ores were treated in 1906 at the Tacoma smelter in Washington.

Texas.—Miscellaneous ore shipments from Texas received by reduction works yielded 51,377 pounds blister copper in 1906.

Vermont.—The 1906 blister-copper output from ores of Vermont was 11,694 pounds as against about 85,000 pounds in 1905. The falling off in smelter production from that of 1905 and the difference between mine and smelter production in 1906 is due chiefly to the fact that a large part of the cupriferous material mined in 1906 and shipped to Atlantic coast works was stored and not smelted during the year. A large part of the production was from the old Pike Hill mine in Orange County, where, as at the Elizabeth mine, magnetic concentration of the heavy pyrrhotite ore was practiced.

Washington.—The blister-copper production of Washington in 1906 was 290,823 pounds and in 1905 about 223,000 pounds. This came from several mines, mainly in Skamania, Snohomish, and Stevens counties, and was smelted in Washington, Alaska, and British Columbia.

Wyoming.—The production of blister copper from materials originating in Wyoming was 106,177 pounds in 1906. In 1905, the production was over 2,500,000 pounds. The difference between the smelter production and the mine production in 1906 may be explained by the fact that a considerable quantity of matte yielded by ore mined in 1905 was not converted till 1906. The great falling off in production was due to the closing down of the principal producer, the Penn Wyoming Copper Company. A little copper was produced by other mines. The smelter of the Rambler Mining and Smelting Company in Albany County was not operated during the year. The 1906 output was turned out by smelters in Colorado and Utah.

The principal copper camp in Wyoming is the Encampment district, in Carbon County. The geology and mines of this district have been described by A. C. Spencer.[a] The most important deposits occur in fractured and jointed areas of quartzite. The rocks and probably the ores are of pre-Cambrian age. The primary ore minerals appear to have been pyrite and chalcopyrite, but secondary enrichment has caused the development of chalcocite and some bornite and covellite. These secondary minerals are becoming less abundant with depth. The ores previously worked have carried good values in copper and precious metals. Development has not extended below a depth of 600 feet.

The concentrating mill of the Penn-Wyoming Company was burned in March, 1906, and no output was made for that year. A new mill, larger than the previous one, was built; it was put in commission and the smelter started up again in the spring of 1907.

GEOLOGICAL CLASSIFICATION OF COPPER ORES.

An interesting question to both the geologist and the metallurgist is the character of the ores from which comes the copper production of the country. The collection of exact statistics bearing on this subject appears to be impracticable, but a division into certain groups can be made with a reasonable approximation to the truth. In the case of important camps in which mixed ores are mined efforts have been made to learn from mine and smelter superintendents and from company geologists—to whom thanks for information furnished are due—the proportionate yield from each kind of ore. Average analyses of the bedded ore have been of considerable service in this respect.

In contradistinction to primary ores, secondary sulphide ores and oxidized ores have been worked over and generally concentrated by surface waters. The estimate leads to the result that oxidized ores furnished 12 per cent, sulphide ores 62 per cent, and Michigan native

[a] Prof. Paper, U. S. Geol. Survey, No. 25, 1904.

copper ores 26 per cent of the total production of the country in 1906. About 16 per cent of the total came from primary sulphide ores and was derived mostly from the mineral chalcopyrite. Over 57 per cent of the entire production came from secondary ores, and four-fifths of this, or nearly 47 per cent of the total production, was from sulphide ores and was yielded chiefly by the mineral chalcocite. Of the total yield from sulphide ores, 25 per cent was furnished by primary sulphide ores. Excluding the unique native copper ores, 16 per cent of the yield from all other ores was from oxidized ores, 21 per cent was from primary sulphide ores, and 63 per cent was from secondary sulphide ores.

A brief summary showing the basis of this classification may serve to emphasize the relative importance of the various districts as producers of certain ores.

The principal yield from oxidized ores was from portions of the output of the Bisbee, Globe, and Metcalf districts, in Arizona; Santa Rita-Hanover district, New Mexico; Mason district, Nevada, and Tintic district, Utah. Small amounts from oxidized ores came from numerous less important districts.

Copper from primary sulphide ores comprised part or all of the production of Jerome, Ariz.; Bingham, Utah; Shasta County, Cal.; Ducktown, Tenn.; the Alaska districts, combined; Frisco, Utah; Calaveras County, Cal.; Silverbell (Imperial), Ariz.; Saddle Mountain, Arizona; North Carolina districts, combined; and Tintic, Utah. A great many of the smaller producers derive their output from primary sulphide ores.

Secondary sulphide ores yielded almost half of the total production, and the bulk of this came from a few great districts. The important contributors were Butte, Mont.; Bisbee, Morenci-Metcalf, and Globe, Arizona; Bingham, Utah; and Burro Mountains, New Mexico.

The primary native copper ores came solely from the Lake Superior district and, with the exception of a very little from sulphide and arsenic ores, comprised the entire output of that district. Probably 2,000,000 pounds of native copper was yielded by the quartzite ores of Santa Rita, N. Mex., and Globe, Ariz., but these are undoubtedly secondary ores.

REFINERY PRODUCTION.

The production of refined copper in the United States in 1906 was made by 16 refineries,[a] of which 10 employ the electrolytic process. Eight of these electrolytic refineries are situated on tide water, 6 on the Atlantic coast and 2 on the Pacific. Five plants are located on the Great Lakes and refine Lake copper, 4 (in Michigan) being furnace refineries and 1 (at Buffalo) employing the electrolytic process in part. Three plants located respectively at Blue Island, Ill., Denver, Colo., and Great Falls, Mont., are dependent on railroad transportation. The last named is an electrolytic refinery. The Boston and Colorado refinery at Denver was destroyed by fire in the latter part of 1906. Eleven of these plants do a custom refining business, and the individual production of 5 of them is very large, ranging in 1906 from 90,000,000 to 270,000,000 pounds.

[a] The statistics given in this section of the report are based on figures furnished the Geological Survey by each of these refineries.

The combined annual capacity of the electrolytic refineries at present in operation, which is about 1,170,000,000 pounds, appears ample to meet any immediate growth in smelter production of this country and of those countries which depend on American refineries. A refinery of considerable size at the old Anaconda smelter site can be put in commission if occasion arises. The recent increase in electrolytic refining capacity has made competition for business rather keen and has resulted in a lowering of charges for electrolytic refining.

LAKE COPPER.

The native copper of the Lake Superior district occurs commonly in the crystalline state and is unusually pure, even as it comes from the mine. The so-called refining of Lake copper, therefore, is essentially only a separation, by fusion, of materials too heavy to be discarded in concentration. A little arsenic is generally present, however, and some of this clings to the copper through the refining process. Although this constituent causes a lowering of electrical conductivity, its presence is believed to give added tenacity and strength to the product. An additional explanation of the superior tensile properties of Lake copper is that its perfect molecular arrangement, denoted by its natural crystalline character, gives it greater cohesion and that this internal structure is in part retained through the single melting to which the copper is subjected. It is claimed that each additional melting decreases the strength of the copper. Electrolytic refining of course destroys any previous internal structure besides removing the arsenic, and electrolytic copper from the Lake district must therefore rank with ordinary electrolytic copper.

Of the 229,695,730 pounds produced by the smelter from Lake Superior concentrates, 205,608,382 pounds were refined by the old furnace process, and, after having been brought to pitch by poling, were cast mostly into ingots but also into cakes and wire-bars. This quantity represents the output of true Lake copper in 1906. Some of this copper from the south range mines, including the Baltic, Trimountain, and Champion, contains somewhat more arsenic than the average Lake copper, but does not on that account appear to be avoided by consumers, and commands the current price.

The remaining 24,087,348 pounds of the year's smelter production from Michigan, principally from the Calumet and Hecla and Quincy mines and a small portion from the Isle Royale, was cast into anodes and shipped to refineries. The greater portion was handled at the Buffalo plant of the Calumet and Hecla company, but some was treated in New Jersey. Electrolytic copper to the extent of 24,017,833 pounds was produced from Michigan material in 1906. The small difference of 69,515 pounds in these two amounts represents loss attendant upon refining and the difference in stocks and material in transit at beginning and at end of the year. A part of this copper was subjected to electrolysis for the sake of recovering the silver which it contained, and in this way 227,822 ounces of silver was produced. The average silver content per pound of copper treated was, however, only 0.009 ounce, or, at the average price of silver for the year, only 0.6 cent. Inasmuch as some of the copper contained decidedly more than this average of silver, the remaining copper can not have contained enough silver to pay for recovery by electrolysis in view of the attendant lowering in grade of the copper from Lake to electrolytic. The reason for electrolytic refining of this silver-poor copper was to free it from excessive arsenic.

The total production of refined or marketable copper from the Lake district in 1906 was 229,626,215 pounds.

CASTING COPPER.

Blister copper too low in precious metals to make their recovery profitable and carrying impurities in too small quantities to be especially objectionable is refined by the furnace process and cast mostly into ingots. This copper is generally of too low conductivity for use in electrical transmission and rather too impure to be desirable for brass making or rolling. Possessing certain desirable physical properties, however, it makes good copper castings, and is put mainly to this use.

Owing to the decreasing cost of electrolytic refining and the growing demand for copper of high conductivity, the relative importance of casting copper is gradually diminishing. If the excess in cost of electrolytic refining over the old furnace process averages $11 per ton, or 0.55 cent per pound, and if the price of casting copper ranges 0.25 cent lower than that of electrolytic, then about 0.3 cent per pound, or $6 per ton, in precious metals will practically pay the cost of electrolytic refining. The production of casting copper in 1906 amounted to 33,459,413 pounds. This was all from domestic sources. So far as known, no casting copper from foreign sources was produced in the refineries of this country during 1906.

The chalcocite ores of the Morenci-Metcalf district and the mixed chalcocite and oxidized ores of Bisbee, in Arizona, furnished most of the casting copper produced in 1906. Similar ores in the Burro Mountains, Grant County, N. Mex., also too low in precious metals to pay for recovery, yielded some of the casting copper. Some of the chalcopyrite ore mined in Calaveras County, Cal., is practically free from gold and silver and yields very pure copper without electrolytic refining. Certain lots of blister from the pyrrhotite ores of Ducktown, Tenn., are of such low tenor in gold and silver that these metals are not separated. Some of the pig copper goes to Europe without further treatment in this country. A portion of the product from Missouri was also sold as casting copper in 1906. The bulk of the casting copper was refined in the melting furnaces of some of the electrolytic refining plants, and a part of it was derived from accumulations at these plants of material poor in gold and silver.

The production of casting copper was probably higher in 1906 than it would have been with a stationary or descending price for the metal. During a considerable portion of the year, when most of the supply was sold months ahead, a substantial premium could sometimes be secured on copper for immediate or early delivery. Blister containing barely enough precious metals to warrant electrolytic separation could, if of requisite freedom from impurities, be made, under such conditions, to yield a better profit by simple furnace refining, with sacrifice of the precious metals, but with delivery forty-five to sixty days earlier than would have been possible had it entered the electrolytic tanks.

It may be added that throughout the country, but especially in the manufacturing centers of the East, there is a large number of plants which rework the refuse copper from various industries. The refining process employed at these plants, which is commonly a melting and oxidation, followed by reduction to pitch and casting, yields a copper which is often of somewhat inferior grade, but suitable for certain uses, such as the making of ordinary castings. The quantity of copper refined in this way in 1906 is estimated from returns of several of the larger companies at 30,000,000 to 40,000,000 pounds, and it may have been even more.

ELECTROLYTIC COPPER.

The quantity of electrolytically refined copper produced in the United States in 1906 from domestic materials of primary origin was 648,614,592 pounds.[a] This was produced mainly by the refining of blister or converter copper,[b] but 24,017,833 pounds were derived from anodes of Lake copper refined for purification or for silver content. The records of the refiners did not permit the absolutely complete discrimination and deduction of the entire output of copper from secondary sources, such as scrap, drosses, etc., and in consequence a wholly insignificant quantity of such copper is included in the total. The year's production of the electrolytic refineries from domestic material of distinctly secondary sources was 15,382,129 pounds. Materials of foreign origin electrolytically refined in 1906 in the plants of this country yielded 191,370,022 pounds. The total output of electrolytic copper by American refineries during the year was therefore 855,366,743 pounds, of which 839,984,614 pounds was from primary sources.[c] The cathodes resulting from electrolysis are commonly melted and cast, according to specifications of the buyer, into wire bars, ingots, cakes, or other forms.

In addition to the 855,366,743 pounds of electrolytic copper, the refineries turned out approximately 10,689,880[d] pounds in the form of bluestone. This quantity of copper, which is about 1.23 per cent of the total copper subjected to electrolytic refining during the year, virtually represents the loss attendant upon this process, and indicates an average recovery of about 98.8 per cent of the copper received. An average recovery higher than this certainly could be made, and probably would be if the bluestone were not a product which commands a good price and if it did not afford by its formation certain advantages of internal operation, as, for example, the neutralization of excess of sulphuric acid in the electrolyte.

The 191,370,022 pounds of refined copper from materials of foreign origin were derived in part from blister made in domestic smelters and in part from blister (and old copper) imported as such. If it be assumed that the materials treated lost 1.2 per cent of their contents in the refining process, then the copper content of these materials before

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[a] A small additional amount of domestic pig, principally from Tennessee, was electrolytically refined in Europe.

[b] Among other materials which were refined were a small quantity of "cement" copper and black copper bullion containing 321,977 pounds of copper.

[c] A small part of the foreign product was derived from old and scrap copper. The weight of this material was 6,626,919 pounds (see table page —) and the estimated yield of refined copper was 6,487,226 pounds. This is new material, so far as consumption in this country is concerned, and hence is classed with copper of primary origin.

[d] See under heading "Copper Sulphate," page 49.

refining was 193,623,694 pounds. Of this, 54,543,116 pounds were held in blister turned out in domestic smelters from imported ores, concentrates, and matte. The remaining 139,080,578 pounds must represent approximately the copper content of foreign blister (and old copper), which was imported as such and required only refining. This imported blister was derived principally from Mexico and Canada, but some came from Australia, Japan, Peru, and several other countries.

The recovery of gold and silver by the electrolytic refineries in 1906 was very large. With the exception of the small quantity of native silver mechanically separated from the Lake ores and "mineral," this recovery represents the year's yield of those metals from the ores which were reduced by copper smelting. In the absence of complete figures on this yield by the refineries, at least an approximate idea of the precious metal content of the blister copper treated can be gained from the smelter statistics. It has been previously shown [a] that the precious metal yield of the year's smelter production from domestic materials was approximately 484,000 ounces of gold and 21,110,000 ounces of silver. It was also stated [a] that, with the exception of a small quantity of silver from Michigan, this yield of gold and silver was contained in about 669,000,000 [b] pounds of domestic copper, which consequently required electrolytic separation. The electrolyzed Lake copper, 24,087,348 pounds, with its low yield of silver can be excluded from further consideration. The remaining 645,000,000 pounds, all blister or converter copper, held the remainder of the precious metals, viz, about 484,000 ounces of gold and 20,870,000 ounces of silver. If it be assumed that the 54,543,116 pounds of foreign blister—which was produced in domestic smelters, and was turned out mingled indiscriminately with the domestic blister—contributed the same proportions of precious metals, then the average content per pound of blister copper was 0.00075 ounce gold and 0.0324 ounce silver. This amounted to 1.55 cents in gold and 2.17 [c] cents in silver per pound, or a total value of nearly $75 per ton.

As a matter of fact, the foreign ores smelted in this country, being principally straight copper ores, doubtless carried a somewhat lower ratio of precious metals to copper than the ratio in domestic ores, which were in part gold and silver ores. It is probable, therefore, that the actual precious metal yield of all blister, both domestic and foreign, turned out by domestic furnaces was a little lower than the figures given—3.5 cents per pound, or $70 per ton, is presumably about correct. The strictly copper ores of domestic origin, exclusive of Lake ores, contributed about 0.87 cent in gold and 1.63 cents in silver for every pound of copper which they yielded,[d] a total of 2.5 cents per pound, or $50 per ton of copper. Even on the assumption that electrolytic refining was required only for the separation of the precious metals, and assuming that the average charge for this service is $15 per ton, or 0.75 cent per pound, the cost of production of over 625,000,000 pounds of copper in 1906 was reduced an average of 1.75 cents per pound by recovery of the gold and silver present

[a] See page 15.
[b] The minute quantities of gold and silver contained in the blister which was refined to casting copper were lost, and accordingly are not included in any of the statistics.
[c] Computed at 67 cents per ounce, the average price for 1906.
[d] Compare page 14.

with the copper in the ores. In reality, a great part of the copper which was subjected to the electrolytic process required this refining for its purification, and in such cases the whole of the 2.5 cents per pound was profit. That copper which did not require purification but was electrolytically refined for its precious metal content gained about 0.2 cent per pound by sale as electrolytic instead of casting copper, in addition to the precious metals recovered.

The cost of electrolytic refining is unfortunately increased in many cases by the inability of the refiners to secure from their many patrons the converter copper already cast into anodes of such uniform properties as to give good results in the electrolyzing process. It is necessary, as a consequence, to melt the converter copper and cast it into anodes at the refinery. At a comparatively few smelters, among which are those that do their own refining, anodes are cast from the converters. It is almost needless to say that change in the price of silver affects the profit to be derived from electrolytic refining and may even determine whether or not certain copper shall be electrolytically refined.

TOTAL REFINED COPPER.

The total production for the year 1906 of refined new copper from materials originating in the United States was 887,682,387 pounds, comprising electrolytic, Lake, and casting copper, as shown in the following table:

Production of domestic refined copper in 1906.

	Pounds.	Percentage of total.
Electrolytic (total domestic)	648,614,592	73.2
Lake (exclusive of Lake electrolytic)	205,608,382	23.1
Casting	33,459,413	3.7
Total refined	887,682,387	100.0

These figures do not include a small quantity of domestic pig copper, about 9,700,000 pounds, or slightly over 1 per cent of the total, which was exported before refining. Including the 191,370,022 pounds of electrolytic copper from foreign sources, the total output of refined new copper by American refineries in 1906 was 1,079,052,409 pounds. There was an additional quantity of copper, 50,000,000 pounds or perhaps more, which was recovered by refining processes from materials that had already entered consumption once before. These secondary sources include old copper, scrap, trimmings, skimmings, drosses, and all the various residues and waste metal from the copper-consuming industries. The quantity of this reworked copper produced in 1906 was undoubtedly somewhat larger than in previous years. The increase was due in part to the larger copper consumption and proportionately greater quantity of refuse copper. The high price of the metal aided in bringing out unusual amounts of second-hand and scrap copper, and several million pounds of old copper were recovered from the ruins of the San Francisco fire and put again into marketable form.

COPPER SULPHATE.

The quantity of hydrous copper sulphate, or bluestone produced as a by-product, in the electrolytic copper refineries in 1906 was in the neighborhood of 42,252,500[a] pounds, having a fine copper content of 25.3 per cent, or about 10,689,880 pounds. The bluestone plant of the Arizona Copper Company did not produce in 1906. So far as known no other bluestone was recovered during the year in the copper producing industry, the copper sulphate in mine waters and from leaching processes having been converted into metallic copper by precipitation with iron scrap.

COPPER OXIDE.

Copper oxide to the extent of 725,260 pounds and containing 77 per cent, or 558,450 pounds, of copper was produced as a by-product at refining works in 1906. Its chief use is for the refining of oil.

STOCKS.

Complete returns show that the following stocks were on hand at the Lake and electrolytic refineries at the beginning and at the end of the year:

Stocks of copper at refineries.

January 1, 1906	pounds..	118, 244, 028
January 1, 1907	do....	92, 470, 792
Stock reduction during 1906	do....	25, 773, 236

These figures for stocks do not represent refined copper entirely. They include material in course of treatment and finished product unsold. They do not include undelivered sales. No attempt has been made to ascertain nor to estimate the stocks carried by consumers. The reduction of stocks during the year represents refined copper.

In addition to these stocks at refineries, there was at smelters or in transit to refineries copper in blister to the amount of 110,000,144 pounds on January 1, 1906, and of 100,630,245 pounds on January 1, 1907. If, therefore, all smelters had closed down on January 1, 1906, about 226,000,000 pounds of copper, allowing for loss on refining, could have been made available for sale to consumers. If, likewise, on January 1, 1907, smelting had ceased, about 191,000,000 pounds could have been made available. The difference at the beginning and end of the year, about 35,000,000 pounds, is due in part to depletion of stocks under the combined influence of high price and heavy demand for consumption and in part to a falling off in production during the last month of the year as a result of congestion of traffic.

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[a] About 5 per cent of this quantity is estimated.

IMPORTS AND EXPORTS.

IMPORTS.

The total quantity of copper in unmanufactured form imported into the United States in 1906 was 225,843,281 pounds[a] as compared with 210,724,685 pounds in 1905. The source of these imports is shown in the following table compiled from records of the Bureau of Statistics of the Department of Commerce and Labor:

Imports of copper into the United States in 1905 and 1906, by countries, in pounds.

Country.	Ore, matte, and regulus (copper content).		Pigs, bars, ingots, plates, old, etc.	
	1905.	1906.	1905.	1906.
United Kingdom			26,284,302	22,549,321
France			1,549,138	3,202,168
Germany			2,945,441	5,303,712
Other Europe			1,955,358	5,649,689
British North America	15,403,429	10,329,955	23,636,843	30,398,369
Mexico	28,890,239	31,690,058	102,646,343	85,595,359
Cuba			433,440	513,240
South America	1,503,427	4,390,589		
Other West Indies and Bermuda			278,502	399,569
Japan				6,752,486
Other countries	4,308,205	2,874,289	890,018	16,194,477
Total	50,105,300	49,284,891	160,619,385	176,558,390
Grand total			210,724,685	225,843,281

It should be noted that the British North American imports include the approximate equivalent of 306,700 pounds as matte, and of 2,801,647 pounds as blister, both of which were produced in Canadian plants from materials originating in the United States. The figures for 1905 doubtless include comparable but somewhat smaller quantities of domestic material.

Since all unmanufactured copper is free of duty, movements of the material are not so strictly accounted for as of dutiable products like lead and zinc. The copper contents of ore, matte, and regulus, for example, is not determined by the customs officials; instead, the figures supplied by the importers are accepted and hence are liable to inaccuracy. It appears probable that the figures for 1906, viz., 49,284,891 pounds are considerably too low, since, even though they do not allow for loss on smelting, they are nearly 5,000,000 pounds below the year's actual recovery in domestic smelters from these foreign materials.[b]

Several noteworthy facts are reflected by the table. The stationary position of the materials imported for smelting and converting contrasts markedly with the 16,000,000-pound increase in importation of smelter products requiring only refining. The great falling off in Mexican imports was more than made up by marked increase from Japan and other countries which had not exported much in 1905. The decrease in ore and matte from British North America is more than balanced by the gain in blister importation and marks the

[a] Including 142,226 pounds in rods and rolled sheets and plates—really manufactured products.
[b] See page 11.

growth of converting at Canadian smelters during the year. Increase in imports from Continental Europe was in part offset by decline in materials received from the United Kingdom. The increase in imports of smelting materials from South America is worthy of note.

The Bureau of Statistics of the Department of Commerce and Labor also keeps a record of "Imports for consumption," which is based on the quantities of imported material withdrawn for consumption from the customs warehouses during the year. This set of figures, which in the case of copper differs only slightly from those given above, is the one which indicates the addition from foreign sources to the available supply of copper in the country.

In the following table are given the figures of imports for consumption, divided according to classes of materials. In the case of the metallic products, the actual weight of the material is given, whereas of the ores, mattes, and other lower grade materials the copper content is recorded and is open to the inaccuracy already mentioned. The second column of figures shows the estimated yield of refined copper from these imports. In these calculations it is estimated that ore loses 7 per cent and matte and regulus 1 per cent of its copper content in the transformation to blister, and that the old copper and blister contain 99 per cent copper. All these materials are assumed to lose 1.2 per cent in refining. The quantities of imported matte and blister from domestic sources have been deducted from the items "matte" and "pigs, bars, etc.," respectively.

Imports of copper for consumption in 1906.

Materials.	Copper and copper contents of ore, etc., in pounds.[a]	Estimated yield in refined copper, in pounds.
Ore	27,169,220	24,988,524
Matte	[b] 11,411,878	11,173,062
Regulus, and black and coarse copper	1,775,685	1,738,527
Old copper, clippings, etc	6,626,919	6,487,226
Pigs, bars, plates, ingots, etc.:		
Unrefined	[c] 140,798,489	138,100,922
Refined		28,191,053
Total foreign imports in terms of refined copper		210,679,314

[a] The figures in this column were taken from the books of the Bureau of Statistics for this report.
[b] This figure excludes 306,700 pounds of copper in matte imported from Canada, but derived from domestic ores.
[c] This figure excludes the weight of blister, containing 2,801,647 pounds of copper, imported from Canada, but derived from domestic ores and matte.

EXPORTS.

The exports of metallic domestic copper from the United States in 1906 amounted to 454,752,018 pounds, as compared with 534,907,619 pounds exported in 1905. This is a decrease of over 80,000,000 pounds, and is nearly 100,000,000 pounds below the record export figures of 1904. In addition to these exports in metallic form the copper contents of 47,619 long tons of ore, matte, and regulus were exported in 1906 as against 37,688 long tons in 1905. A small quantity of foreign material was reexported. The accompanying table shows the movements of copper from the United States to the various countries in 1905 and 1906.

Exports of domestic copper from the United States in 1905 and 1906, by countries in pounds.

Country.	Ore, matte, and regulus.		Ingots, bars, plates, and old.	
	1905.	1906.	1905.	1906.
United Kingdom	112,000	461,440	60,945,794	55,097,670
Belgium			4,997,206	6,475,054
France			74,604,044	80,703,723
Germany		132,160	104,575,864	96,629,040
Italy			15,800,967	19,777,296
Netherlands			130,675,386	151,650,293
Russia			18,418,982	9,523,992
Other Europe			25,279,162	25,260,807
British North America	55,305,600	82,208,000	3,019,450	4,176,135
Mexico	29,003,520	23,744,000	290,763	263,319
Chinese Empire			79,940,250	4,932,128
Other countries		120,960	16,359,751	262,561
Total	84,421,120	106,666,560	534,907,619	454,752,018

In addition foreign copper was reexported to the extent of 1,718,584 pounds in 1905, and of 1,726,822 pounds in 1906, including in 1906 159,040 pounds of ore, matte, and regulus.

The decrease in metallic exports is almost wholly due to the practical cessation of purchases by China, where the demand for coining purposes was supplied by the large importations of 1905. Dutch importations from this country in 1906 were greatly in excess of those for the previous year, and France, Italy, and Belgium also took more of American copper than in 1905. The copper exports to Germany, the United Kingdom, and Russia, and miscellaneous exports to other countries were considerably lower than for 1905. In the exportation of ores and matte the only noteworthy change was the increase to Canada, principally from Alaska.

To determine the extent to which the year's exports lowered the supply of copper in the country available for consumption, it is necessary to measure the exports in terms of refined copper. Since domestic materials in a stage of treatment lower than the metallic state do not affect the supply of marketable copper, exports of domestic ore, matte, and regulus need not be considered in this connection. With the exception of about 9,700,000 pounds domestic pig, copper exported before refining, the domestic metallic exports were in the form of refined copper. The foreign material reexported did not change its condition from that in which it was imported.[a] Probably therefore, none of it was in the refined state. The assumption is made that the loss on converting the reexported foreign ore and matte into blister would have been 4 per cent of the copper contents, and that all of the exported foreign material would have lost 1.2 per cent on refining. The approximate equivalent of copper exports, including foreign material, may therefore be estimated at about 446,700,000 pounds.

CONSUMPTION.

The consumption of refined copper in the United States in 1906, was about 682,000,000 pounds, according to the most reliable data obtainable, as at least 5,000,000 pounds should be added to the total of the table because of the smelter discrepancy in copper content of imported material already mentioned. This is about 77 per cent or within about 200,000,000 pounds of the year's domestic production of

[a] Otherwise, according to the rules of the customs office, it would have been credited as domestic

refined copper, and 43 per cent of the entire production of the world in 1906. Compared with the record consumption in 1905, this is an increase of about 82,000,000 pounds, or 14 per cent.

There appears to be no practicable way of ascertaining directly the consumption of copper in the United States. Any method that would produce reasonably accurate results would entail too great an expenditure of time to be feasible. We are forced, therefore, to rely either on bold estimates of the consumption or on indirect methods of computing it. The estimates are expressed in figures of assumed monthly consumption, usually in multiples of 5,000,000 pounds, sometimes with an arbitrary addition or deduction, supposed to compensate for unusual conditions. The indirect method of deducting from total available supply the quantity withdrawn from supply and letting the difference represent consumption, is undoubtedly more accurate, providing the component data are reliable. Previous computations by this method have never been made, so far as known, on the basis of refined copper—the real basis of consumption—and it is believed that on this account errors of greater or less magnitude have entered such figures. In the following table all the items are in terms of refined copper, except the stocks at refineries; these represent refined copper only in part, but the difference can be only refined copper.

Consumption of refined copper in the United States in 1906.

	Pounds.	
Domestic refined new copper produced in 1906	887, 682, 387	
Foreign imports for consumption	210, 679, 314	
Stocks at refineries, January 1, 1906	118, 244, 028	
Total available supply		1, 216, 605, 729
Exports	446, 700, 000	
Stocks at refineries, January 1, 1907	92, 470, 792	
Total withdrawn from supply		539, 170, 792
Apparent consumption		677, 434, 937

These figures are based on the reasonable assumption that the entire quantity of material imported (less reexports), or its equivalent, is transformed into refined copper during the year.

USES.

To the principal uses of copper, the consumption of refined new copper may be apportioned as shown in the following table. This distribution is based on partial returns from refiners and copper-selling agencies and on estimates furnished by some of the principal consumers.

Uses of copper in 1906.

Electrical purposes, including wire	pounds	340, 000, 000
Brass manufacture	do	210, 000, 000
Rolling mills, sheet copper	do	35, 000, 000
Miscellaneous uses, principally castings	do	100, 000, 000
Total consumption	do	685, 000, 000

It is of course impossible to make an exact separation, even with complete data. Some sheet copper and copper castings, for example, are used in electrical industries, while not all the copper wire manufactured is used for the transmission of electricity.

The greater part of the copper used in the electrical industry was electrolytic copper, although some Lake copper was used, especially for wire of the smaller gages. The marked increase in consumption for the year is attributable in large part to the enormous expansion in the use of electricity. The growing importance of cheap power and the perfecting of long-distance transmission have led to the widened application of water power and to electrification of many power-consuming plants. The actual or projected electrification of railroads is a notable factor of the increase in consumption.

The three other important uses of the metal, combined, consumed in 1906 but little more new copper than was consumed for electrical purposes. The brass industry consumed both Lake and electrolytic copper, and required a greater quantity than ever before. Probably more than half of the copper consumed by the rolling mills was electrolytic, Lake copper being used for sheets of special strength requirements. Among the principal uses of sheet copper are roofing, the manufacture of receptacles for liquids, and the growing employment in modern buildings for fire-proofing and decorative purposes. For castings and miscellaneous uses, nearly 27,000,000 pounds of casting copper were used in 1906, since, according to the best information available, less than 7,000,000 pounds of copper of this grade were exported during the year. Lake copper was used in certain castings for structural purposes, and electrolytic copper was employed largely in the manufacture of the bronzes and other alloys aside from brass. The railroads are undoubtedly the largest consumers of copper castings, some doing their own casting from raw copper and others purchasing the finished castings. The copper used for miscellaneous structural and ornamental purposes amounts in the aggregate to a considerable proportion of the annual consumption.

The 50,000,000 pounds or more of re-worked copper also went into consumption. About 15,000,000 pounds of this was electrolytic and was put to the same uses as new electrolytic copper. The remainder was casting copper and was consumed for the purposes designated above as miscellaneous.

A good idea of the relative quantities of electrolytic copper consumed by various industries is afforded by statistics showing the quantity of copper in each of the several forms in which copper is sold. Figures from several electrolytic refineries show that the relative quantities cast in various forms were as follows: Wire bars, 68.8 per cent; ingots, 17.5 per cent; cakes, 8.2 per cent; cathodes and other forms, 5.5 per cent. These refineries produced 582,451,834 pounds, or 70 per cent of the total new electrolytic copper turned out by domestic plants in 1906. If it be assumed that the remaining 30 per cent of the total electrolytic copper production was cast in these forms in the same proportions, then the year's production of new electrolytic copper was turned out approximately as follows: Wire-bars, 578,000,000 pounds; ingots, 147,000,000 pounds; cakes, 69,000,000 pounds; cathodes and other forms, 46,000,000 pounds. Cathodes constitute the great bulk of the last item, and these, together with ingots, represent closely the quantity of copper purchased for brass making and casting. Wire-bars, of course, represent the consumption for wire, and cakes measure the output of the rolling mills. These proportions, however, do not exactly apply to domestic consumption, since exports of electrolytic copper were not in these proportions. Most of the cathodes, for example, were for export orders. In spite of the saving of $2 to $3 per ton, which can be made by dispensing with the final melting and casting, very little cathode copper is used in this country for either brass or castings; the founders apparently prefer ingots, emphasizing the old saying that a good-looking product sells best.

No successful substitutes for copper as a conductor of electricity have yet been discovered. Copper has the highest electrical conductivity of any of the metals which are sufficiently cheap to be used, and no alloy containing copper has a conductivity as high as that of the pure metal.

PRICES.

The average price of electrolytic copper at New York in 1906 was 19.30 cents per pound. The average price for Lake copper was 19.55 cents and for casting copper 19.10 cents. These prices represent the average of the daily prices of the metal for immediate delivery. They are therefore probably higher than the actual prices received by producers, especially in view of the fact that in 1906 an unusual quantity of copper was sold for future delivery. The figures are also mathematical rather than actual averages in that they assume equal quantities of copper to have been sold every day.

Compared with the price of electrolytic, the prices of Lake and casting copper were a little higher than in previous years, because they could be made more quickly available for the market and were able to secure the advance offered for spot or early delivery. These premiums were at times so substantial that, to take advantage of them, considerable copper, which would otherwise have been refined electrolytically, was furnace refined and sold as casting copper, the higher price and lower refining charge more than offsetting the loss of precious metals.

In spite of the high prices, domestic consumption increased decidedly over 1905, while exports remained about the same, if the unusual shipments to China in 1905 be excluded. The fluctuations in the price of electrolytic copper from month to month and the effect produced on export demands are shown in the following table. The monthly prices for 1906 have been compiled from the best sources obtainable.[a] Figures for exports are from reports of the Bureau of Statistics.

Monthly prices and exports of copper in 1905 and 1906.

	Prices of electrolytic copper, in cents.		Exports of ingots, bars, etc., in pounds.	
	1905.	1906.	1905.	1906.
January	15.01	18.38	43,246,994	31,985,053
February	15.01	17.88	44,856,032	36,092,275
March	15.13	18.30	41,597,725	38,462,661
April	14.92	18.38	58,234,827	33,830,067
May	14.63	18.48	46,744,959	42,321,749
June	14.67	18.50	58,018,828	39,662,582
July	14.89	18.25	37,901,361	40,520,290
August	15.66	18.38	48,942,284	46,789,702
September	15.97	19.13	46,954,409	34,964,157
October	16.28	21.20	35,156,328	39,245,144
November	16.60	21.88	31,565,859	36,738,984
December	18.33	22.83	41,688,013	34,139,354
Averages and totals	15.59	19.30	534,907,619	454,752,018

[a] The monthly prices given in the 1905 volume of Mineral Resources of the United States are for Lake copper and are not of service in this connection.

WORLD'S PRODUCTION.

The smelter production of copper in the world in 1906 was 1,596,973,700 pounds, while in 1905 the production was about 1,545,137,000 pounds. In 1906 the smelter output of the United States was 57.47 per cent of the world's total production, and in 1905 it was about 57.52 per cent.

The following table shows the output of the various copper-producing countries in 1906. The figures are those compiled by Messrs. Henry R. Merton & Co. (Limited), of London, reduced to pounds, except that the official figures of the United States production, in even hundreds, are inserted.

World's production (smelter output) of copper in 1906.

Algeria .... pounds..	985, 600	Mexico .... pounds..	135, 800, 000
Argentina .... do....	235, 200	Namaqualand ...... do....	5, 824, 000
Australasia .... do....	81, 200, 000	Newfoundland ..... do....	5, 140, 800
Austria .... do....	2, 744, 000	Norway .... do....	13, 708, 800
Bolivia .... do....	5, 600, 000	Peru .... do....	19, 051, 200
Canada .... do....	57, 030, 400	Portugal .... do....	5, 421, 600
Cape Colony .... do....	8, 825, 600	Russia .... do....	23, 497, 600
Chili .... do....	57, 668, 800	Spain .... do....	105, 055, 200
England .... do....	1, 120, 000	Sweden .... do....	1, 120, 000
Germany .... do....	45, 561, 600	Turkey .... do....	952, 000
Hungary .... do....	470, 400	United States ...... do....	917, 805, 700
Italy .... do....	6, 417, 600		
Japan .... do....	95, 737, 600	Total .... do....	1, 596, 973, 700

REPORT ON MICHIGAN MINES.

PRODUCTION.

The two principal metallic products of Michigan are iron and copper, but along with the latter a little silver is recovered. Copper and silver are found in only one district, which is commonly called the Lake Superior copper country. This district follows the axis of the Keweenaw Peninsula and, with a width of 3 to 6 miles, extends practically without break for 70 miles in a northeasterly direction. Although general geologic conditions vary somewhat from point to point along the copper range, the main features are practically identical from one end to the other. Perhaps no other district in the country possesses such uniform ores. Both copper and silver occur almost wholly in the native state, in lodes of great extent and, as a rule, of remarkable uniformity. The lodes worked at present strike northeastward, parallel to the trend of the range, and dip at variable angles to the northwest. The ores are divisible into two classes, dependent on the character of the copper-bearing material; these are amygdaloid lodes and conglomerate lodes. The former are the more numerous, but are, on the whole, of lower grade.

The value of the copper and silver product of the mines of Michigan amounted in 1906 to $43,940,489. To this total copper contributed $43,791,600, the value of 224,572,310 pounds produced by 23 companies; the 222,222 fine ounces of silver produced by 8 of these companies had a value of $148,889. The increase in total value in 1906 over 1905, amounting to nearly $10,000,000, is due largely to the higher prices for the metals, especially copper, as compared with the prices in 1905. There was, however, a notable increase in production of both metals. This production was obtained from 8,904,127 tons of ore mined and milled during 1906. This is a much larger tonnage than was mined in any other State. The ores had an average value of $4.94 per ton, of which $0.0167 was in silver and $4.92 in copper. This is equivalent to 0.025 ounce of silver and 25.2 pounds (1.26 per cent) of copper per ton. From these ores 325,205,470 pounds of concentrates were derived. Of the concentrates over 97 per cent was fine-grained mineral, the product of the stamp mills; the remainder was the coarser "mass" copper and "barrel work" sorted out at the mine. The concentrates yielded, on the average, 69.05 per cent of refined copper.

Of the total output 2,546,682,tons, or 28.6 per cent of the ore mined, was from conglomerate lodes. This ore yielded 30,199 fine ounces of silver, or 13.6 per cent of the State total, and 101,830,674 pounds of copper, or 45.3 per cent of the State total. The remainder of the product was from amygdaloid ores.

Only three counties in Michigan contribute to its output of copper and silver. In the table below the production of these metals as refined, the quantity of ore treated, and the yields of metal per ton are given for each county.

Production of copper and silver in Michigan for 1906, by counties.

County.	Silver.		Copper.			Concentrates.		Ore (tons).
	Fine ounces.	Ounce per ton.	Pounds.	Pounds per ton.	Per cent.	Pounds.	Yield of refined copper (per cent).	
Houghton	217,006	0.029	201,574,609	27.1	1.36	292,222,024	69.0	7,438,945
Keeweenaw	1,850	.0019	15,916,659	16.5	.83	22,300,075	71.4	963,903
Ontonagon	3,366	.0067	7,081,042	14.1	.705	10,683,371	69.1	501,279
Total and averages	222,222	.025	224,572,310	25.2	1.26	325,205,470	69.05	8,904,127

REVIEW BY COUNTIES.

The following paragraphs aim to present in outline the physical status of the various mines and the principal factors affecting their production in 1906.

HOUGHTON COUNTY.

Of the entire production of the State in 1906 over 95 per cent of the silver and about 90 per cent of the copper were turned out by the mines of Houghton County. This county occupies the middle and richest 40 miles of the 70-mile productive belt. It contains 15 of the 23 mines that were productive in 1906, and all but one of the larger producers. Five of the 8 mines that produced silver are within the county. The total production of the county is given in the following table, which also shows the proportion and the average yield[a] from conglomerate and amygdaloid ores.

Production and average yield of Houghton County, by kinds of ore.

	Amygdaloid rock.	Conglomerate rock.	Totals and averages.
Silver:			
Fine ounces	186,807	30,199	217,006
Per cent of county total	86.1	13.9	100.0
Average yield, ounces per ton	.038	.012	.029
Copper:			
Pounds	99,743,935	101,830,674	201,574,609
Per cent of county total	49.5	50.5	100.0
Average yield, pounds, per ton	20.4	40.0	27.1
Average yield, per cent	1.02	2.00	1.36
Concentrates:			
Pounds	143,034,914	149,187,110	292,222,024
Average yield, per cent	69.7	68.2	69.0
Ore:			
Tons	4,892,263	2,546,682	7,438,945
Per cent of county total	65.8	34.2	100.0

The production was obtained chiefly from five great lodes—the Baltic, Kearsarge, Pewabic, and Osceola amygdaloid beds and the Calumet conglomerate. Other lodes, including the Isle Royale, Atlantic, and Winona amygdaloids and the Allouez conglomerate, contributed to the output.

Calumet and Hecla.—The Calumet and Hecla mine is the largest in the district and probably the second largest copper mine in the world. As is well known, this mine is the greatest dividend payer in the world, having paid $99,350,000 up to December 31, 1906, and having passed the hundred-million mark early in 1907. It is located on three of the five great lodes, viz, the Calumet conglomerate and the Osceola and Kearsarge amygdaloids. The conglomerate is the richest lode in the entire copper country and has been the principal source of the mine's copper output. Between 90 and 95 per cent of the mine's record production for the year was derived from this lode. The Osceola amygdaloid, which lies parallel 730 feet to the east, furnished the bulk of the remainder. The Kearsarge lode, still farther east, is of recent development, and produced a little in the latter part of the year.

The conglomerate lode, which is 8 to 35 feet thick and averages over 12 feet of stoping ground, was worked during the year through one vertical shaft and ten inclined shafts on the vein. These shafts open the lode, practically without break, for 1¾ miles along the strike. One of the inclines, No. 4 Calumet, is 8,100 feet long, its sump being 4,750 feet below the surface and practically at the Tamarack boundary at that point. The vertical shaft, known as the Red Jacket, is 4,900 feet deep. It is situated about a mile from the outcrop on the hanging-wall side, and passes through the lode at a depth of 3,287 feet, the fifty-seventh level of the inclined shafts. Its depth allows practically all the ore west of it to the Tamarack line to be extracted by crosscuts from it.

[a] It may be well to point out that for the conduct of ordinary mining operations in this district wet assays are practically never made. They would, in fact, seldom be of much value. The Lake Superior fire assay is much more common, especially in experimental operations, and is supposed to give an indication as to how much refined copper the material tested will yield. But, as a rule, the richness of an ore is stated in terms of the mill or smelter recovery from it. An ore which runs 30 pounds "mineral" may run only 20 pounds "ingot," the former being the weight of concentrates produced from a ton of this ore, and the latter being the weight of refined copper recovered from these concentrates. Such an ore would "yield" 1 per cent of refined copper, although it may actually have contained 1.3 per cent or more.

The Calumet conglomerate has not been profitable to the southwest of the Calumet and Hecla property, where it was thoroughly explored by the Osceola Company, nor to the northeast, where the Centennial endeavored for years to locate a mine on it. The Tamarack Company, whose property lies to the west and contains the "deep" of the lode, has encountered leaner and less regular ore bodies, but has been successful. The main profitable shoot appears to pitch northward in the lode. As a consequence, good values are found at depth directly down the dip from the unprofitable ground explored by the Centennial. A matter of much importance, both to this company and to the district, is dependent on this pitch of the shoot. It is the development of the 200 acres comprising an L-shaped strip, known as the "Five Forties," which extends northward from the main territory held by the company and is bounded on the east, north, and west by other properties.

The highest ore in this tract is in the southeast corner, nearly 2,500 feet below the surface. The deepest ore is considerably below the level of the present workings. To open this tract, instead of sinking a vertical shaft, as the Tamarack Company has been forced to do in its property, a blind slope or inclined winze is being driven, starting from the fifty-seventh level. It pitches downward to the north parallel to the lode and extends close to the western boundary of the tract. It lies at an angle to both strike and dip of the lode, and as its inclination is only 22°, direct transfer of loaded cars can be made from the levels turned from the slope up to the fifty-seventh main level and thence to the Red Jacket shaft. At the end of 1906 this winze had already been carried into the second 40-acre tract and was opening up some very good ground.

Although the ore from the Calumet conglomerate has gradually decreased in tenor from a former average of about 4 per cent of copper, it is still rich, as Lake ores run, yielding 45 pounds of ingot per ton, or $2\frac{1}{4}$ per cent. The decrease in grade has, moreover, been brought about fully as much by improvements and lower costs, enabling lower-grade ores to be worked, as by an actual falling off in content of the lode. The copper carries a little silver.

The Osceola amygdaloid has only in the last two years been an important source of production to the Calumet and Hecla Company. Five inclined shafts open this lode in Calumet and Hecla ground at intervals extending over about 2 miles and to a maximum vertical depth of about 1,000 feet. All five were operated in 1906, with a combined daily output of approximately 1,000 tons, running about 20 pounds of refined copper per ton. This branch of the mine is becoming increasingly important.

In Calumet and Hecla ground the Osceola lode carries more silver than any other in the district, except perhaps the Pewabic lode of the Quincy.

On the Kearsarge lode three inclined shafts were in operation during 1906. The deepest of these attained a depth of about 1,000 feet measured along the dip. Small shipments of ore went to the mill in the latter half of the year. The lode is not especially encouraging so far as present developments have gone, and operations may possibly be suspended here when copper sells at a low price. Increased tonnage capacity was obtained in 1906 by a change from 5-ton to $7\frac{1}{2}$-ton skips at several of the incline shafts.

The mine as a whole is said to be blocked out for eight years' stoping at the rate of production of the year ending April 30, 1906, which was 87,304,689 pounds. Development will doubtless be maintained this far ahead of production.

The Calumet and Hecla stamp mill at Lake Linden, though of course wholly dependent on the mine, has nevertheless been the actual measure of the mine's production. During 1906, 23 single-expansion steam stamps were in commission. Most of these handled conglomerate rock, and all are designed for this service. They will handle 300 tons of conglomerate rock each. As operated during 1906, part of the stamps crushing about 1,000 tons of amygdaloid daily, the capacity of the mill was about 7,000 tons. Five old stamps of the Hecla section of the mill have been remodeled and put into operation in 1907. They are designed to crush the amygdaloid output of the mine and to handle about 600 tons each. The capacity of the mill with 28 stamps is now very nearly 10,000 tons, making this the largest concentrating mill in the world.

It is interesting to note that although most other mills of the district have been "compounding" their stamps, the heads at the Calumet and Hecla, which have been completely remodeled recently, have retained the single-expansion cylinders. Other companies report lower costs as a result of compounding; yet the Calumet and Hecla people claim that their method is the cheaper. It is certain that 600 tons of amygdaloid or 300 tons of conglomerate per stamp is a splendid record for simple heads. This, however, is behind the capacity of compound stamps at several mills.

The concentrating portion of the mill has been improved along with that devoted to crushing. Woodbury classifier jigs have been installed throughout, followed by Evans tables and Wilfley regrinding mills. The ratio of wash water to ore has been materially reduced and the saving of values is much greater than formerly. Considerable of the silver produced by the mine is recovered at the mill as "pickings." The remainder is obtained from the electrolytic vats.

The smelting plant at Hubbel and the smelter and electrolytic refinery at Black Rock, near Buffalo, N. Y., have been enlarged to handle the increased output of the mill.

Tamarack.—The Tamarack mine draws its ore from both the Calumet conglomerate and the Osceola amygdaloid. It contains the outcrop of neither lode and therefore reaches them by crosscuts from deep vertical shafts, four of which have recently been used for handling ore. They ranged in depth, at the end of 1906, from 3,409 feet (No. 1) to 5,229 feet (No. 3), the deepest in the world. The Osceola lode has been developed only in the south end of the company's property and to a much smaller depth than the conglomerate. The Calumet conglomerate is of lower grade, and its copper is less regularly distributed than in Calumet and Hecla ground, but in the territory tributary to No. 3 shaft, which is not far from the Five Forties tract of the Calumet and Hecla Company, very good ore has recently been opened up, and better rock is being opened in No. 5 than for some time previously. Owing to this improvement in grade and to the fact that the poorer Osceola lode was not worked in 1906, the copper content of the ore mined increased to 25.2 pounds of ingot per ton, as against 21.1 pounds in 1905.

The tonnage mined in 1906 was reduced almost one-half and the copper output cut down over a third by a fire that broke out January 11, 1906, in No. 2 shaft. The gases from combustion of the old timbers permeated the workings so that No. 1 shaft, as well as No. 2, produced no ore for the remainder of the year and therefore practically no work was done on the Osceola lode. No. 5 shaft, which is also connected with No. 2, was idle for four months. In view of the fact that only one shaft was operated steadily throughout the year and one other for only eight months, the output as compared with that of 1905 is most creditable and encouraging.

By January, 1907, No. 2 shaft had been reclaimed, Nos. 3 and 5 were working steadily, and the fire was gradually burning itself out through No. 1, which, as soon as possible, will be used to increase the amygdaloid production.

Underground electric haulage installed on several levels of the mine has demonstrated its ability to increase the ore output and will doubtless be extended. Possibility of developing the lower portions of the mine by inclines, thus hoisting in two cages and doing away with the long crosscuts, is being considered.

The two stamp mills on Torch Lake now contain two compound and five simple heads. Three of the latter are to be compounded at once. During the year 389,680 tons were stamped.

No extensive additions were made during the year to the Dollar Bay plant of the Lake Superior Smelting Company, where the Tamarack and Osceola copper is smelted.

Osceola.—The Osceola, North Kearsarge, and South Kearsarge branches of the Osceola Company were operated during 1906. The Tamarack Junior branch was idle. The Osceola branch, situated southwest of the Calumet and Hecla and producing from the Osceola amygdaloid, operated two inclined shafts on the lode. By the end of the year these inclines were more than 4,200 and 4,400 feet long. The ground opened in the bottom was as good as that mined heretofore, but the average grade yields under 1 per cent in refined copper. Increased output has been obtained by underground sorting and storage of much of the waste rock. A ten-day strike in December lowered the production a little.

The Calumet conglomerate has never been profitable in Osceola ground, and up to the present time developments on the Kearsarge lode have not been particularly encouraging.

The South Kearsarge and the North Kearsarge branches, separated by the Wolverine mine, derive their copper from the Kearsarge lode. At the end of 1906 two shafts on the South Kearsarge had reached inclined depths of about 1,800 and 2,200 feet, and at the North Kearsarge the two inclines were about 3,100 and 3,850 feet long. The ore is poorer than that mined in the Wolverine, but it yields more than the Osceola amygdaloid and brought up the average of all the Osceola ore to 18.3 pounds of refined copper per ton in 1906. The production of the North Kearsarge was materially decreased by a fire that started in No. 1 shaft September 22, 1906, and by the caving of the shaft that followed. No ore was extracted from this shaft until well into 1907.

The encouraging ground encountered in the lower part of the North Kearsarge workings has led to the sinking of a new shaft farther north.

At the two stamp mills on Torch Lake the last of the seven heads was compounded during the year, and 1,016,240 tons of ore were milled. The Lake Superior Smelting Company smelts the mill product.

Centennial.—The Centennial mine, which lies northeast of the Calumet and Hecla, is now working the Kearsarge lode after having fruitlessly explored the Calumet conglomerate. A small tongue of land projecting from the main tract of the company covers the outcrop of the Kearsarge lode and has allowed the sinking of two downward-diverging inclines parallel to the lode. The deepest is 3,100 feet, measured along the dip. During 1906 development was sacrificed for the sake of production, and a substantial increase in output resulted. With the additional equipment now possessed, both exploration and stoping can hereafter be carried on properly. The value of the ore mined fell off in 1906, especially in the lower part of No. 1 shaft, so that the average yield of refined copper was only 13.58 pounds per ton, as against 17.4 pounds in 1905. This is by several pounds per ton the lowest grade of ore mined from the Kearsarge lode.

The mill at Grosse Point operated only one single-expansion head on Centennial ore, crushing 166,000 tons. A second head, held in reserve during 1906, will be operated in 1907. The third stamp head of the mill is compound and is operated under lease by the Allouez Company. Centennial mineral is smelted at the Quincy plant.

Wolverine.—The Wolverine is a Kearsarge lode mine and has made a splendid record for low costs and large dividends. Of the three inclined shafts in operation only two handle ore; the deepest (No. 3) has a sump over 3,000 feet from the outcrop. The lode is remarkably uniform in copper content and the stopes are extensive. The yield of refined copper per ton of rock stamped in 1906 was 27.06 pounds. Production was maintained at the normal rate in spite of the burning of the No. 3 shaft house and the consequent burden of double duty on No. 4 shaft. Developments for the year continue to show good ground. Prospecting on the West lode did not disclose anything of value.

The stamp mill of two simple heads, situated at Traverse Bay, treated 352,890 tons during 1906, producing a very high grade of mineral, which was smelted at the Michigan smelter.

Tecumseh.—The Tecumseh property, situated south of the Osceola, covers portions of the outcrops of the Calumet conglomerate and the Osceola and Kearsarge amygdaloids. The two former lodes had proved barren in this tract, but recent work on the Kearsarge lode is encouraging. Two incline shafts were being sunk in 1906 and in the course of development a little copper was extracted. In the latter part of the year the Tecumseh was taken over as a part of the new La Salle Copper Company, controlled by Calumet and Hecla interests. With more ground thus available this ought to develop into a good mine.

Rhode Island.—A little south of the Tecumseh and just north of the Franklin lies the Rhode Island mine. Several lodes pass through the property, including the Pewabic, East, Old Pewabic, Mesnard, Epidote, and the Albany and Boston, or Allouez, conglomerate. These have been more or less developed with but little success, and only a few thousand pounds of copper were produced in 1906 from this development. Underground work was stopped in June, 1906. The Kearsarge lode has recently been located on the property and diamond-drill cores have indicated that it may be valuable. On the outcome of this indication the future of the mine depends.

Franklin.—The Franklin mine lies north of the main Quincy mine. It consists of two sections, known as the "Old Franklin," on the Pewabic amygdaloid, and the "Franklin Junior," on the Albany and Boston, or Allouez, conglomerate. The amygdaloid mine has been nearly worked out to the boundaries of the property, and in 1906 nearly 75 per cent of the production was derived from conglomerate ores of the Franklin Junior. The Old Franklin workings are entered by two shafts 2,800 and 3,200 feet deep on the incline. The West lode, parallel with the Pewabic, is being prospected and is producing a little. The conglomerate lode in the Franklin Junior is much lower in grade than the material being mined from the Pewabic amygdaloid, and brings the average yield of refined copper per ton of ore milled down to just about 12 pounds per ton; but the bottom of the mine contains ore of better grade. The Kearsarge amygdaloid, which has been located on the property, may prove productive when it is opened.

Four stamp heads were operated during 1906 at the stamp mill at Grosse Point, and treated 372,378 tons of ore, producing a low-grade mineral which was smelted at the Quincy plant.

Quincy.—The Quincy mine is situated just north of Portage Lake, and is the southernmost of the mines of the north range. The principal product of the mine comes from the Pewabic lode, but the West lode has of recent years become important. The Hancock amygdaloid also runs through the company's property. The acquisition of 800 acres from the Arcadian company in 1906 gives the company an additional 1½ miles along the Pewabic lode to the north. This lode is now controlled by the Quincy company for about 3 miles along its strike, with the exception of a section of the upper portion of the lode owned by the Franklin Company. Four deep inclined shafts are in operation, the length of the deepest, at the end of 1906, being about 5,400 feet, measured along the slope.

The Pewabic lode averages between 15 and 20 feet wide, ranging from 10 to 40 feet. It is stoped almost entirely, except the pillars, and in 1906 yielded slightly over 16 pounds of refined copper per ton. Mass copper is becoming less and less important. Portions of the lode carry noteworthy quantities of silver. Part of the smelter product is accordingly cast into anodes and electrolytically refined at the Black Rock plant of the Calumet and Hecla Company.

The two stamp mills on Torch Lake contain 8 stamp heads, of which 1 is of the steeple compound type. Experiments are being made on recrushing. During 1906 over 1,000,000 tons of rock were crushed, producing a mineral yielding an average of about 60 per cent in refined copper. This concentrate was treated by the Quincy smelter, at Hancock, where considerable custom work is also done. At the smelter briquetting of the low-grade mineral is expected to result in higher recovery.

The production in 1906 was over 2,500,000 pounds below that of 1905. This was due partially to a slight decrease in the quality of ore; but it was mainly the result of serious caves early in the year, caused by the giving way of the insufficient pillars in the upper, nearly or quite exhausted workings. The crushing in of the walls produced terrific air blasts. Operations were continued under greatest difficulties and the almost steady maintenance of production was a creditable achievement. A strike that closed the mine for four weeks at the middle of the year and did much toward the reduction of output was caused largely by the fright which the men experienced during the caves and air blasts. The mine is at present in good shape, and the method now adopted of filling or of blasting in the walls of the exhausted stopes, and of leaving much stronger pillars, promises to prevent the recurrence of such serious accidents.

Isle Royale.—The Isle Royale mine, situated close to Houghton, south of Portage Lake, derives its copper at present from the Isle Royale amygdaloid. Several other lodes are known on the property and the Portage and the Mabbs were formerly productive. The principal operating shaft is No. 2, more than 2,200 feet on the incline. Three exploratory shafts are being sunk. One of these aims to develop the Baltic lode, but up to the end of the year no copper-bearing ground had been encountered at a depth of 475 feet. The Isle Royale lode is of good width, but carries copper unequally distributed; the average yield of ingot copper in 1906 was 15.3 pounds per ton.

At the stamp mill on Portage Lake only one of the three heads was operated on Isle Royale rock. It is a compound head, and crushed during the year 192,210 tons, producing a 72-per cent mineral, which was smelted by the Lake Superior Smelting Company. A little silver is encountered in the lode, part of which is recovered by picking, the remainder being separated electrolytically in the East.

Atlantic.—The Atlantic mine, southwest of Houghton, is situated on an amygdaloid lode known as the Atlantic ash bed. Two main operating shafts, 2,250 and 3,100 feet in inclined depth, open this lode to the thirty-seventh level. The copper-bearing ground is very uniform, and the Atlantic stopes are among the most continuous in the Lake district. For years the Atlantic mined the lowest-grade copper ore in the world. The lowest yield for any year was in 1902, when the ore returned only 11.09 pounds per ton, or slightly over 0.5 per cent. Recently the rock broken has been sorted underground, so that the yield rose to 14.69 pounds per ton for 1906.

Early in 1906 the hanging wall began again to settle, after having given little trouble for more than a year. The disturbance continued and increased, producing air blasts, ruining the shafts, and finally in May causing the suspension of all underground work. The plentiful water which the mine made is gradually filling the workings.

The last half of the year was devoted to exploration of other lodes on the company's property. In section 16, just north of the Baltic mine, a shaft is being sunk to cut the Baltic lode, which is expected to carry pay values at a depth of about 1,000 feet.

The old mine may possibly be opened by new foot-wall shafts, which will allow the extraction of ore estimated at 5,000,000 tons.

The stamp mill at Redridge, on Lake Superior, operated four of its six stamps till the end of May and during that time crushed nearly 100,000 tons, producing a 74 per cent mineral, which was smelted at the Michigan smelter, the largest and most modern smelter in the district.

Baltic, Trimountain, and Champion.—These three adjoining mines, which are under the same management, form really a single mining unit. They are situated on the Baltic lode, the Baltic mine being the northernmost and adjoining the Atlantic on the south; the Trimountain and Champion are to the southwest.

The Baltic lode is notably wide. With a dip of 70° to 73°, it ranges from 15 to 80 feet or over in stoping width, the wider stopes apparently extending beyond the limits of the Baltic amygdaloid bed. Owing to the great width of the stopes, they are filled with the waste rock which is sorted out underground. This greatly reduces the cost as compared with timbering and unquestionably produces a more effective and stable support for the hanging wall. Considerable heavy copper of both mass and barrel sizes is present in the lode, and much of the copper in the stamp rock is coarser than in most other lodes. Narrow calcite veinlets and seams, carrying copper minerals, are encountered in the workings. They commonly cut across the lode, are broken down in stoping, and their copper saved with the mill concentrate. Chalcocite and bornite occur in these veins, but commonly they contain copper arsenides, and, as a result, the copper of these mines contains appreciable quantities of arsenic.

The Baltic mine is developed by means of 4 shafts, which range from 850 to 1,400 feet deep on the incline. The mill is situated at Redridge, on Lake Superior, and contains 4 heads. During the year 649,932 tons of rock were stamped, producing a 71 per cent mineral, and yielding 22.15 pounds ingot copper per ton.

The Trimountain mine has 4 shafts, of which the deepest was 1,466 feet at the end of 1906. The stamp mill at Beacon Hill, on Lake Superior, crushed 506,924 tons of ore with 4 compound heads. The concentration produced a 66 per cent mineral, and the yield per ton of ore was 18.76 pounds refined copper.

At the Champion mine the 4 shafts range from 1,100 to 1,300 feet on the incline. The stamp mill is located at Freda, on Lake Superior. It handled 671,785 tons of ore during 1906, producing a 68 per cent mineral. The average yield in refined copper per ton of ore was 25.2 pounds. The experimental plant, in which crushing by rolls was tried, did not prove successful, and was dismantled to make room for additional stamps.

The mineral from the Copper Range mines is smelted at the Michigan Smelting Company's plant, on Portage Lake, near Houghton.

Winona.—The Winona is the southernmost of the producing mines in Houghton County, and is situated near the southwestern corner of the county, about 20 miles southwest of Houghton. The Winona lode, which has long been known, is an amygdaloid and may perhaps be the same as the Baltic lode. The lode, which dips at about 70°, is worked through an inclined shaft 880 feet deep at the end of 1906. Work at the deepest shaft of the mine, about 1,000 feet in inclined depth, was abandoned early in 1906 because of the poor ground tributary to it. A new shaft is being sunk at the south end of the property, where the best values are being found. The large proportion of mass copper found in the early days of the mine has diminished, so that at present most of the copper is obtained by milling. Much of the copper is very fine and requires particular care in concentration to prevent excessive loss.

Regular shipments of ore to the Adventure mill began in October, 1906, and up to the end of the year 19,399 tons were shipped, though a small part of this had been previously mined and stored. From this ore were produced 457,775 pounds of about 60 per cent concentrates, which were smelted by the Michigan Smelting Company. The yield of refined copper per ton of ore was 14.34 pounds, but this is expected to improve with the doubling of the tonnage planned for 1907.

Copper Concentrating Company.—This company, which planned to rework the tailings discharged from the Quincy mill, operated only a short time and produced only a trifling quantity of copper. The rather elaborate plant, with a capacity of about 2,000 tons per day, is said to have been satisfactory in its results and the suspension of operations is attributed to lack of funds to put the plant on a paying basis.

Exploratory and development work.—In addition to the rather unusual amount of development work carried on in 1906 by the producing mines already mentioned several new properties and former producers in Houghton County were actively explored during the year. Among these are the Caldwell, situated east of the Rhode Island and controlled by Calumet and Hecla. It holds the Kearsarge lode and is expected to develop into a valuable mine. The old Hancock mine adjoining the Quincy and under the town of Hancock has been revived and with its increased territory should soon become an important producer. The Superior, between the Baltic and Isle Royale, is making an encouraging showing on the Baltic lode. The Challenge, probably on the Baltic lode, 5 miles southwest of the Champion, and the King Philip, southof the Winona, both controlled by the St. Mary's Mineral Land Company, are developing well. The Globe, just south of the Champion, is a promising property, being explored by the Copper Range Consolidated Company. Few other prospects have encountered what seems as yet the making of a mine.

KEWEENAW COUNTY.

The mines of Keweenaw County furnished in 1906 about 6.1 per cent of the total State production and about 0.8 per cent of all the silver. The county occupies the northern part of the Keweenaw Peninsula and comprises the north end of the Copper Range. Although the seat of many of the earliest mines in the district, there were in 1906 but three producing mines in the county. The entire production was from amygdaloid ore, derived wholly from the Kearsarge lode. The following table shows the metal and ore product and the average yield:

Production and average yield of Keweenaw County in 1906.

Silver:	
Fine ounces	1,850
Yield, ounces per ton	.0019
Copper:	
Pounds	15,916,659
Yield, pounds per ton	16.5
Yield, per cent	.83
Concentrates:	
Pounds	22,300,075
Yield, per cent	71.4
Ore:	
Tons	963,903

Allouez.—The Allouez mine, just north of the North Kearsarge mine and near the Houghton County line, has had a long and checkered career. It was opened in the early days on the Allouez conglomerate, the lode now worked in the Franklin, but on the whole the results were not successful. A later attempt was made to develop a mine on the Osceola lode, but this likewise failed. Recently the Kearsarge lode, which outcrops to the east of the company's holdings, has been explored, found rich, and a valuable mine opened upon it. Operations are carried on through a shaft nearly vertical in its upper portion, which cuts the lode at a depth of 1,480 feet, and which at the end of 1906 was about 2,000 feet deep. A new shaft farther northeast is being sunk as rapidly as possible. The lode is of good width, averaging 16 feet or more, and in 1906 yielded 19.5 pounds ingot copper per ton of ore stamped. A small quantity of silver is obtained as pickings. During the year, 178,400 tons of ore were sent to Centennial mill, where 1 head was operated under lease. From this a 63 per cent mineral was produced and shipped to the Quincy smelter.

On January 1, 1907, the Allouez Company took over a half interest in the Centennial mill, which will hereafter be run as a unit on the ores from the two mines, with an expected lowering of costs. It is thought that a joint smelting plant may later be erected. The output of the mine will undoubtedly show a marked increase in the near future when stopes are started from the drifts now driven.

Ahmeek.—The Ahmeek mine lies east and northeast of the Allouez. Following unsuccessful work years ago on the Kearsarge conglomerate, the Kearsarge amygdaloid was located in 1903, and has since been actively developed. Only a small section of the outcrop of the lode is owned by the company, but their acreage on the underlay is of good size. From two inclined shafts about 900 feet deep the development of the lode has been carried on to date. As soon as the two shafts are connected at the lower levels systematic stoping can be started and will result in decidedly increased output. Most of the 166,960 tons of ore stamped during the year was handled by the 1 head leased at the Isle Royale mill, but as the tonnage increased some of the ore was stamped at the Tamarack mill, while the fire was curtailing the output of the Tamarack mine. Altogether, 4,044,900 pounds of 76 per cent concentrates were smelted at the Dollar Bay works of the Lake Superior Smelting Company. The average yield of ingot copper per ton of ore was 18.4 pounds.

Mohawk.—The Mohawk mine is next east of the Ahmeek and covers much of the outcrop of the Kearsarge lode. It is the most northerly mine in the district among present producers, has the largest output in Keweenaw County, and bids fair soon to pass the Wolverine, and thus become the largest mine on the Kearsarge lode. Five inclined shafts, ranging in depth from 500 to 1,500 feet, open the lode, the oldest and deepest workings being to the north. The lode averages about 16 feet in width and is reasonably uniform in copper content. The yield per ton in 1906 was 15.1 pounds ingot copper. The lowest openings of the mine are at present the most satisfactory. Cross veins carrying several compounds of copper and arsenic were important in the upper levels, but furnish very little copper at present, and the Mohawk copper is not regarded as arsenical. The stamp mill at Traverse Bay contains 4 heads, of which 2 are of the steeple compound type. The remaining 2 are to be compounded during 1907. During 1906 the 2 compound heads and a single expansion head were operated, treating 618,543 tons and producing 12,723,515 pounds of 74 per cent mineral, which was refined at the Michigan smelter. With 4 compound heads and plentiful stoping ground, the production of this company should soon show an advance.

Exploratory and development work.—The northern end of the Keweenaw Peninsula is expected to become a very important continuation of the present producing belt. The Keweenaw Copper Company, with extensive holdings that were formerly held by several companies, is opening up the Medora amygdaloid with encouraging results. The Calumet, Osceola, and Kearsarge lodes, among others, are also believed to have been encountered by the extensive diamond drilling done in 1906. Three subsidiary companies of the Calumet and Hecla—the Gratiot, the Manitou, and the Frontenac—give promise of adding to the company's resources as soon as their help shall be required. The Gratiot, next north of the Mohawk, holds the continuation of the Kearsarge lode close to the proved workings of that company. The Manitou, formerly the old Delaware, between Lac La Belle and Lake Superior, has some development on the Montreal River lode, and holds the Kearsarge amygdaloid. The Frontenac, also in the northern part of the county, has not yet been actively developed. Other properties, including the Old Cliff mine, now owned by the Tamarack, are of prospective value.

ONTONAGON COUNTY.

Ontonagon County holds the southwestern end of the Copper Range as at present developed, although copper is known to occur beyond and into Wisconsin. The Ontonagon County mines in 1906 produced about 3.2 per cent of the State's copper output and 1.5 per cent of all the silver. This production came from 4 mines, of which 2 produced silver in addition to copper. Mass copper is especially common in these southern mines, although not nearly so important as in the early days of mining in the district. Of the 1906 production of "mass" and "mineral" of the county, 2,554,496 pounds, or nearly 25 per cent, consisted of mass or barrel copper, which was sent direct to the smelter. The geology of the southern end of the range is not so well understood as it is in Houghton County. There are a large number of more or less cupriferous lodes, but they are generally not well individualized, and few have been correlated with the productive lodes to the northeast. The copper produced in 1906 came wholly from amygdaloids, and chiefly from the Evergreen, Calico, Branch, Knowlton, and Forest lodes. The county's record in 1906 is shown in the table below:

Production and average yield of Ontonagon County in 1906.

Silver:	
Fine ounces	3,666
Yield, ounces per ton	.0067
Copper:	
Pounds	7,081,042
Yield, pounds per ton	14.1
Yield, per cent	.705
Concentrates (and mass):	
Pounds	10,683,371
Yield, per cent	69.1
Ore:	
Tons	501,279

Adventure.—The Adventure mine lies fully 10 miles southwest of the Winona, the nearest producer in Houghton County. At the end of the year the operating shafts were 694 and 1,215 feet deep on the incline, respectively. Although 7 lodes are known in the property, including the Evergreen and Mass, the Knowlton was the only lode on which stoping was done in 1906. The distribution of the copper in the lode is very erratic, and owing to a marked deterioration in the grade of ore mined during the last half of the year, the average yield of the ore was only 11.4 pounds ingot. A little silver was recovered. The 3-stamp mill at Edgemere handled 136,080 tons of ore, producing a 60 per cent mineral which was smelted at the Quincy plant.

Mass.—The Mass mine, lying west and southwest of the Adventure, is opened by 4 inclined shafts, of which 2 are over 1,750 feet deep. The Evergreen lode is the principal source of copper at present. Like the other lodes of this part of the Copper Range, the values are bunchy. The yield per ton for 1906 was 11.3 pounds per ton. A small silver production was made. As special emphasis during the year was put upon development work, the production should soon show some increase. The mill on Keweenaw Bay has 2 heads, only 1 of which handles Mass ore during the year, the other having peen operated by the Michigan Company for most of the year. Hereafter both heads will be available for stamping Mass ore. During the year 185,789 tons of ore were treated, giving a total concentrate, including mass copper, of 3,055,175 pounds, of 69 per cent yield.

Michigan.—The Michigan mine lies a few miles southwest of the Mass. Three inclined shafts, of which 1 is about 800 and 2 nearly 1,800 feet in depth, allow the development of the mine. Several lodes have been worked in this property, but the Calico and Branch are the only ones at present productive. This mine, which has always been notable for its mass copper still produces a larger proportion of mass than any other mine. Of the 4,270,100 pounds of cupriferous material smelted, 1,669,055 pounds were mass copper, the remainder being stamp-mill concentrates. The average yield of the ore stamped was 20.4 pounds per ton, and considerable new ground of equal richness was opened up during the year. One stamp at the Mass mill was employed till September, after which the ore was shipped to the Atlantic mill which was idle. In all 140,225 tons were stamped. The product treated at the Michigan smelter yielded 67 per cent refined copper. A 2-stamp mill is in course of erection on Keweenaw Bay. The mine is certain to show increased production in the near future.

Victoria.—The Victoria mine lies about 4 miles southwest of the Michigan, and is the last of the producing mines in that direction. Although the oldest mine opened in the district in historic times, recent production began only in the middle of 1906. The mine is opened on the Forest amygdaloid, and the old No. 2 shaft, recently unwatered, is about 2,100 feet in inclined depth. The average yield of the ore stamped during 1906 was 13.94 pounds ingot. The production was gained from 39,185 tons of rock handled in the 1-stamp mill, yielding 906,030 pounds of 60 per cent mineral, including mass. Very cheap power, furnished by a recently installed Taylor hydraulic air compressor, is used in practically all operations and is a boon to the mine.

Exploratory and development work.—Rich drill cores were taken in 1906 from the old Belt mine of the Lake Copper Company northeast of the Adventure. The Copper Crown, 7 miles west of the Victoria, has struck some encouraging ground and is contemplating the erection of a 1-stamp mill. The Nonesuch, in the Porcupine Mountain district, is under option to the Calumet and Hecla Company. The lode is unique in being a fine-grained, conglomeratic sandstone. It carries good copper values and is commonly expected to make a mine.

LEAD.

By J. M. Boutwell.

INTRODUCTION.

The aim of this report is to afford a concise, authentic statement of the lead industry in the United States in 1906. It includes statistics of production and consumption, descriptions of development of resources and of progress in reduction, and statistics showing trade conditions. The statistics of domestic production are compiled from direct confidential returns courteously furnished to the Survey by every known lead smelting and refining company operating in this country last year. Inasmuch as the totals are compiled from these statements of individual companies their correctness is necessarily dependent upon the correctness of these statements. The facts regarding development of resources and progress in reduction were gathered through personal observation in the field, through correspondence, and through the literature. The statistics on trade conditions are taken from the records of the Department of Commerce and Labor, and world statistics are from foreign sources as credited. Every reasonable effort has been made to secure correctness. The writer gratefully acknowledges the cordial and appreciative spirit with which producers have cooperated to make this permanent Government record correct. The writer gives most hearty thanks to Mr. Charles Kirchhoff for the valuable foundation laid during his preparation of these reports annually since the foundation of the Survey and for his kindly interest and advice, to the authors from whose works the writer has drawn freely, and to the numerous parties who have kindly supplied information.

GENERAL PROGRESS OF INDUSTRY.

In 1906 the lead industry experienced a year of highest prosperity. The increases in the United States production and consumption were the main factors in the increases in world production and consumption. Both imports and exports fell off. The demand held so strong that the average price for the year broke all records of recent years and the closing price was the highest for the entire year.

In the development of ore and reduction resources important progress was made. The largest mines in the Cœur d'Alene district greatly increased their known reserves by proving the extent of their main shoots to much greater depths. In southwestern and southeastern Missouri liberal drill prospecting revealed noteworthy extensions of reserves. Elsewhere certain camps began shipping, which promises important development, and in individual properties valuable strikes were made.

In reduction the most noteworthy improvements during the year were the adoption at its various plants by the American Smelting and Refining Company of the Huntington-Heberlein process for roasting, and the installation of the Betts electrolytic process at the two latest and most modern refineries—the United States Metals Refining Company and the Canadian Metals Company, Limited.

In the operating field the lead industry is widely different from the zinc industry. In the latter the production is by nearly twenty distinct smelting companies, the bulk of it by six large competing companies, while in the lead industry a single corporation, the American Smelting and Refining Company, dominates the entire field, with interests exceeding the combined interests of all others. Last year, however, a leading competitor, the United States Smelting, Refining, and Mining Company, so expanded its mining, smelting, refining, and metals departments as to become a significant factor in the industry. The Pennsylvania Smelting Company greatly increased its smelting and refining capacity.

No widespread labor troubles have arisen to interfere seriously with any branch of the industry. Shortage of labor has been felt, however, in several districts. Fuel shortage seriously retarded operations in the Northwest and car shortage served somewhat to limit the output.

PRODUCTION.

The gross annual production of lead in the United States since 1825 is shown in the following table. The figures for the years 1825–1882, inclusive, in the absence of official records, have been compiled from the best available sources. Totals for 1882 were compiled from statistics gathered by the Census Bureau. Figures for subsequent years are based on returns collected by the Survey. The totals for 1906 embrace the lead produced in the United States from domestic ores, as confidentially reported directly to the Survey by all known operating lead-smelting companies in the country.

Production of lead in the United States, 1825–1906, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1825	1,500	1849	23,500	1869	17,500	1889	156,397
1830	8,000	1850	22,000	1870	17,830	1890	143,630
1831	7,500	1851	18,500	1871	20,000	1891	178,554
1832	10,000	1852	15,700	1872	25,880	1892	173,305
1833	11,000	1853	16,800	1873	42,540	1893	163,982
1834	12,000	1854	16,500	1874	52,080	1894	162,686
1835	13,000	1855	15,800	1875	59,640	1895	170,000
1836	15,000	1856	16,000	1876	64,070	1896	188,000
1837	13,500	1857	15,800	1877	81,900	1897	212,000
1838	15,000	1858	15,300	1878	91,060	1898	222,000
1839	17,500	1859	16,400	1879	92,780	1899	210,500
1840	17,000	1860	15,600	1880	97,825	1900	270,824
1841	20,500	1861	14,100	1881	117,085	1901	270,700
1842	24,000	1862	14,200	1882	132,890	1902	270,000
1843	25,000	1863	14,800	1883	143,957	1903	282,000
1844	26,000	1864	15,300	1884	139,897	1904	307,000
1845	30,000	1865	14,700	1885	129,412	1905	302,000
1846	28,000	1866	16,100	1886	130,629	1906	350,153
1847	28,000	1867	15,200	1887	145,700		
1848	25,000	1868	16,400	1888	151,919		

PRODUCTION BY STATES IN 1900-1906.

The lead content of ores mined and smelted in this country from 1900 to 1905, inclusive, is given below by States from which the ores were derived. The figures were compiled from smelter reports and it should be noted that they represent the content of the ores and not the actual recovery, which is the quantity available for consumption. The latter quantity, termed merchant lead, has regularly been secured approximately from the figures for lead content by allowing 5 per cent loss therefrom for smelting, desilverizing, and refining.

Lead content of ores smelted by the works in the United States, 1900–1905, in short tons.

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	....

The statement of production in 1906 differs in certain significant features from the statements for previous years, and accordingly is not included in the preceding table for 1900–1905, but is given separately. The actual production of lead and the exact sources of the ores yielding it for 1906 are shown according to direct returns supplied to this office by each company known to have engaged in lead smelting in this country in 1906. These company returns were made, by special request, for "pig lead" from all known smelters running on the Mississippi Valley lead ore, and for "lead produced" by all others; both kinds of returns distributed the ore according to its source. The State totals compiled from them represent therefore the actual ore production of the several States. Although no method is entirely above criticism, owing to the nature of operations in the lead smelting industry, yet this method is believed to afford the most accurate basis practicable for figures on the production of lead. Through the appreciative cooperation of the smelting companies and special leave from those who were the sole producers of ores from certain States it has been possible to distribute this product definitely according to the sources of the ore with the exception of only nine one-hundredths of 1 per cent of the total products. Every reasonable effort was made to secure for publication also complete smelter statistics on the tonnage of smelting ore and concentrates received from each State; and, though it proved impossible to obtain complete data this year, the writer earnestly bespeaks the continued cooperation of the several companies toward this end in the future. Returns from all known Canadian smelters state that in 1906 they did not treat any lead ores from the United States. The total production of 350,000 tons of lead in 1906 in the United States from ores mined in this country includes the total derived from known domestic sources and the greater part of that derived from unassigned sources and of that recovered from zinc residues.

Lead produced in the United States in 1906, apportioned by States according to source of ore, in short tons.

Rank.	Source of ore.	Quantity.	Percentage of total.
	United States:		
17	Alaska	8	0.004
5	Arizona	2,884	.83
12	California	432	.12
4	Colorado	50,497	14.52
1	Idaho	117,117	33.68
11	Illinois	572	.17
13	Iowa	270	.08
7	Kansas	1,932	.56
15	Kentucky	44	.01
2	Missouri	111,075	31.95
6	Montana	2,485	.72
9	Nevada	1,669	.48
10	New Mexico	640	.18
16	Tennessee	11	.006
3	Utah	56,260	16.18
14	Washington	46	.01
8	Wisconsin	1,753	.50
	Total from domestic ores	347,695	100.00
	Unassigned sources:		
	Zinc residues	2,053	
	Undistributed	[a] 405	
	Total unassigned	2,458	
	Total domestic and unassigned	350,153	
	Foreign:		
	British Columbia	7,238	12.88
	Central America	112	.20
	China	18	.03
	Mexico	48,839	86.89
	Total from foreign ores	[b] 56,207	100.00
	Grand total from all sources	406,360	

[a] Including, according to special reports, 25 tons of lead from Texas.
[b] Exclusive of 12,339 tons of lead derived from Mexican bullion.

REFINED LEAD.

The following statement of the production of refined lead shows the total quantity refined in the United States from all sources, the production of desilverized lead and of soft lead, and the amount of lead obtained by refining foreign ores and base bullion. The grand total embraces all lead desilverized at works in this country and the pig lead recovered from the Mississippi Valley lead ores, and the desilverized lead includes that derived from foreign sources. In the totals for 1906 that for refined lead is exclusive of 10,546 tons of antimonial lead reported by refineries. About 25,000 tons of pig lead derived from Mississippi Valley lead ores which was desilverized is included under desilverized lead, but not under soft lead.

Production of refined lead in the United States, 1883–1906, in short tons.

Year.	Total production.[a]	Desilverized lead.[a]	Soft lead.[b]	From foreign ores and base bullion.
1883	143,957	122,157	21,800	....
1884	139,897	119,965	19,932	....
1885	129,412	107,437	21,975	....
1886	135,629	114,829	20,800	[c] 5,000
1887	160,700	135,552	25,148	[c] 15,000
1888	180,555	151,465	29,090	28,636
1889	182,967	153,709	29,258	26,570
1890	161,754	130,403	31,351	18,124
1891	202,406	171,009	31,397	23,852
1892	213,262	181,584	31,678	39,957
1893	229,333	196,820	32,513	65,351
1894	219,090	181,404	37,686	59,739
1895	241,882	201,992	39,890	76,173
1896	264,994	221,457	43,537	77,738
1897	291,036	247,483	43,553	83,671
1898	310,621	267,842	42,779	99,945
1899	304,392	263,826	40,566	95,926
1900	377,679	329,658	48,021	106,855
1901	381,688	323,790	57,898	112,422
1902	377,061	303,011	74,050	100,606
1903	378,518	295,074	83,444	88,324
1904	404,453	315,284	89,169	95,850
1905	399,302	296,186	103,116	80,793
1906	404,746	313,886	90,860	66,399

[a] Including foreign base bullion refined in bond.
[b] Including a small quantity of lead produced in the Southern States.
[c] Estimated.

SOFT LEAD.

The quantity of soft-lead ores and of soft lead actually recovered from them, apportioned according to the source of the ore as compiled from direct returns by smelters to this Bureau, is shown in the following table. In these totals the 25,000 tons of soft lead which was desilverized is included. The total production of 115,860 tons is an increase of 12.3 per cent over that of the preceding year.

Production of soft lead in the United States in 1906, in short tons.

Rank.	Source of ore.	Quantity.	Smelting ore and concentrates.[a]	Percentage of total soft lead made from domestic ores.
10	Colorado [a]	9	18	0.01
6	Idaho [a]	175	328	.15
4	Illinois	572	[b] 860	.49
5	Iowa	270	[b] 420	.23
2	Kansas	1,932	2,518	1.67
7	Kentucky [a]	44	64	.04
1	Missouri	111,075	222,610	95.87
9	Tennessee [a]	11	16	.01
8	Washington [a]	19	26	.02
3	Wisconsin	1,753	[b] 2,639	1.51
	Total	115,860	229,499	100.00

[a] All except one producer of soft lead kindly furnished the figures for their tonnage of ore treated, and all except one of them gave the smelting ore and concentrates separately; but the inability of one large producer to separate these necessitates the combination of the two items in this table.
[b] Contains an estimate necessitated by the failure of one small producer to supply figures for ore tonnages.

ANTIMONIAL LEAD.

The production of antimonial lead from ores derived from all sources, as reported direct to this office by all desilverizers known to be operating in this country, is shown in the following table:

Production of antimonial lead in the United States from 1896 to 1906, in short tons.

1896	7,507	1902	9,169
1897	8,867	1903	9,579
1898	8,473	1904	11,001
1899	6,345	1905	10,995
1900	9,906	1906	10,546
1901	10,656		

COMPARISON OF STATE TOTALS COMPILED FROM SMELTER AND MINE RETURNS.

The total production of lead as compiled from mine reports and from smelter reports reveals facts of unusual interest to mine producers, smelter operators, and the mining public. The table below shows the respective totals obtained by each method and the differences.

Comparison of State totals compiled from smelter and mine returns, in short tons.

State or Territory.	Totals based on smelter reports.	Totals based on mine reports.	Differences.	
			Smelter excess.	Mine excess.
Alaska	8	(a) 8		
Arizona	2,884	2,819	65	
California	432	169	263	
Colorado	50,497	52,051		1,554
Georgia		5		5
Idaho	117,117	127,502		10,385
Illinois	572	(a) 572		
Iowa	270	(a) 270		
Kansas	1,932	(a) 1,932		
Kentucky	44	(a) 44		
Missouri	111,075	(a) 111,075		
Montana	2,485	2,232	253	
Nevada	1,669	1,912		243
New Mexico	640	1,494		854
Tennessee	11	(a) 11		
Texas		25		25
Utah	56,260	62,671		6,411
Washington	46	463		417
Wisconsin	1,753	(a) 1,753		
Total	347,695	367,008		

a No statistics for mine production were collected. Smelter figures used for basis of comparison.

It will be noted that in certain States returns are shown by only one set of statistics, that in most of the remainder the totals reached by the two methods agree closely, but that in a few instances large discrepancies appear. Thus smelter returns but no mine returns were collected from Alaska, Illinois, Iowa, Kansas, Kentucky, Missouri, Tennessee, and Wisconsin, while mine returns but no smelter returns were collected from Georgia and Texas. Fairly close agreement between the totals based on the respective methods is found in the case of Arizona, Montana, and Nevada. The differences in Colorado and New Mexico are to be expected and probably are attributable to the fact that the mine reports include all ores regardless of form of final product and covers some lead which was made into pigment by the United States Smelting Company at Canyon, Colo., and by the Ozark Smelting and Mining Company at Joplin, Mo., and Coffeyville, Kans., while this lead does not appear in the smelter statement for lead ores. The small differences in California may be due to incomplete or incorrect returns and that for Washington is believed to arise from failure of a smelting company to properly separate and distribute its receipts from Washington.

These various factors are inadequate to explain the discrepancies occurring for Idaho and for Utah. The estimation of lead from mine reports is by dry assay of concentrates and crude ore shipped. Smelter losses may account for a small part of the differences, but the calculation is known to be very close and the mine totals correspondingly reliable. The smelter totals are compiled from reports of five companies for Idaho and three for Utah, far the larger part in each instance being handled by one and the same concern. Some inaccuracy is necessarily involved in the manner in which this company, owing to the complexity and magnitude of its operations, found it necessary to figure its State totals. In fact, the assay content of the ores received from each State was reduced to accord with the average recovery in all smelting operations of this company. It is open to serious inaccuracies in that, refined product being taken for a basis, large increases in mine shipments during the later part of year not being refined before close of year would not be credited; also in that such application of a general country average reduces the plants making high losses and those making low losses to a common level regardless of the differences in tonnages treated. Thus some of the large discrepancies in these two States, apparently attributable for most part to smelter reports, might be due to inaccuracies in this mode of computation.

RESOURCES.

The leading lead-producing States, as shown by the production table, are Idaho, Missouri, Utah, and Colorado, in the order given. They afford together 96.3 per cent of the lead made in this country from ores derived from the United States, and Idaho and Missouri together produce 65.6 per cent.

IDAHO.

The output from Idaho is almost entirely from the Coeur d'Alene district, which, with Wallace as its central distributing point, embraces the camps of Wardner, Mullan, Burke, Mace, Gem, and Murray. The lead bodies occur in fissures or fracture zones in Algonkian quartzite.[a] They are veins of great size and extraordinary persistence in both strike and depth and have a general northwest trend. They were formed in part by filling, but mostly by replacement of siliceous walls. The ores are composed of galena, with small amounts of silver in a gangue of quartz and siderite. Tetrahedrite, chalcopyrite, and barite are occasionally found. They are prevailingly of milling grade, though a few mines shipped some ore direct. In general the lead ores averaged per ton: Lead, about 7 to 8 per cent; silver, about 3½ ounces; zinc, about 4 per cent; and a trace of gold, averaging in concentrates 50 cents per ton. The concentrates are raised to an average lead content of about 50 per cent.

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[a] Ransome, F. L., Ore Deposits of the Coeur d'Alene district, in Contributions to Economic Geology in 1904: Bull. U. S. Geol. Survey No. 260, 1905, pp. 274-303.

The year 1906 was the most prosperous in the history of the district, the shipments, aside from the important developments in copper and zinc mining, having far exceeded those of any previous year. The bulk of the output is mined by two companies, the Bunker Hill and Sullivan Mining and Concentrating Company and the Federal Mining and Smelting Company. The former operates at Wardner and Kellogg, the largest single producing lead mine in the country, and the latter, with headquarters at Wallace, secures from its Morning, Mace, Tiger-Poorman, and Wardner properties in this district the largest lead production mined by a single company in a single district. The Hecla and the Hercules are also important lead producers. In addition to these great companies and the other large ones there are a number of other properties shipping lead.

The most important developments of the year in the lead industry in this district have been the great extension of known ore reserves. Thus, in the Bunker Hill and Sullivan mine, the continuance of its main shoot an additional depth of 400 feet was proved by sinking 400 feet below its lower tunnel and drifting at the 1,000 and 1,100 foot levels. On the 1,000-foot level the body proved to be of large size, and on the 1,100-foot level, though it had not at the time of the visit been thoroughly opened, the grade proved equal to that above. On the Sullivan side of the mine a new ore body was found. These developments will greatly extend the life of this mine. The Federal Company also added greatly to its known reserve, thus in the Morning mine the main vein was opened, running a No. 6 tunnel, and the continuance of the main shoot for an additional 300 feet in depth was thus demonstrated. In the Tiger-Poorman the main shoot was explored on the 2,000-foot level and was found somewhat contracted but carrying a notably higher content of lead. In the Hecla mine sinking from the 600 to the 900 foot level demonstrated the continuance of the ore shoot in depth for this additional 300 feet, with the same amount and grade of ore as exist above. Very important additions to ore reserves were made in various mines. General exploration was unusually active. Several promising mines began to ship, and a number of properties were incorporated.

In southwestern Idaho, in Owyhee County, 25 miles southwest of Silver City, the South Mountain group of lead-silver prospects has been optioned for an eastern syndicate. This ground afforded the bulk of the ores which attracted attention in 1873, and it is understood that it will now be thoroughly explored with a view to developing its lead-producing capacity.

In Lemhi County, north of Mackey, the Gilmore mines of the Silver Dollar group worked a promising body of lead-carbonate ore, and, though 80 miles from the railroad, shipped a considerable quantity of high-grade concentrates. The ore occurs in a fracture zone in metamorphosed limestone. Transportation was by a train drawn by a traction engine to Dubois on the Oregon Short Line, but the district is reported to be looking so well that the construction of a connecting railroad branch is being considered.

In the Coeur d'Alene district the ore is a very fine-grained massive galena, frequently sparsely distributed through siliceous and iron gangue, and accordingly necessitates fine crushing which leads to high slime losses. A very large percentage requires milling, the feed samples yielding 7 to 10 per cent lead and 15 per cent iron, and accordingly are concentrated about seven to ten times to secure a 45 to 55 per cent product. The lead recovery is very imperfect, as it is in certain mills as low as 65 per cent, and an average of 85 per cent saving is regarded as excellent.

The mills handling the output from the large mines are of large capacity, some of them treating 1,000 tons a day. They are equipped for fine crushing and regular wet concentration, Frue vanners being universally used, and in a number of mills Callow screens and settling tanks have recently been installed to save the values in fines. At the Bunker Hill and Sullivan properties it was estimated that the mill losses ran 10 to 12 per cent, and accordingly tailings have been collected until they now amount to approximately a million tons. A new tailings mill was erected last year and equipped with four 6-foot Anaconda type Huntington mills, fifteen vanners, thirteen Wilfley tables, two Callow screens, and fifteen Callow settling tanks, to treat 2,000 tons mixed tailings a day. In the Federal mills special attention was directed toward saving values in slimes by regrinding and treating again on Wilfley tables, vanners, and in settling tanks. At the Morning mill three sets of Callow screens with settling tanks were installed. The disposal of the tailings from these several great mills, which has given no little concern, will be accomplished by special means. It is stated that the large companies operating above Wallace have jointly purchased land on which a tailings conveyor and stacker will be located. It is planned to excavate the creek bed sufficiently to create a great sump and restore the natural flow of the stream. The smelting is done outside of the district entirely, the ores being shipped widely to Washington, Montana, Colorado, Missouri, New Jersey, and Pennsylvania.

MISSOURI.

In this State the lead output is furnished by the southeastern Missouri lead district and the southwestern Missouri zinc-lead district. The former, including Bonneterre, Flat River, Fredericktown, and Mine La Motte districts, is the second most important lead district in this country. In 1906 its output amounted to almost 80 per cent of the lead production of the entire State.

The ore occurs disseminated irregularly in Ordovician magnesian limestone. It is composed of grains of galena free from blende, but associated with small amounts of copper, cobalt, and nickel. Contrary to prevailing beliefs, the galena is not free from silver in commercial values, but carries from 1.25 to 1.50 ounces of silver to a ton of concentrates, and yields on treatment 1 to 1.25 ounces. Last year refining of southeastern Missouri ores yielded 31,300 fine ounces of silver. (See report on gold and silver.) The ores are very low grade, running from 3 to 7 per cent lead, and require concentration. Mills equipped for treating large tonnage by ordinary wet methods are located at each property, and the product is smelted at plants in Missouri and Illinois owned by the mining companies.

In 1906 the production showed an increase of about 5 per cent over that of the preceding year. The Central mine was unwatered, and after thorough drill prospecting considerable new ground was added to the property. New shafts were sunk by the Central, St. Joseph, Desloge, and National companies, and a modern 1,000-ton mill was erected at the Central mine. The Doe Run Company decided to erect a 1,200-ton mill and the capacity of the New Leadwood smelter of the St. Joseph Company was increased by the addition of ten roasting furnaces.

In the southwestern district, which contributes most of the remaining 20 per cent of the State's lead output, the lead production maintained the regular ratio to that of zinc, namely, 14 per cent, and increased over that of the preceding year about 10 per cent. The ore occurs in Carboniferous limestone, intimately associated with blende, either disseminated or in fractures (see description under "Production of zinc in 1906"). It is of low grade and is milled at the various plants located in the different districts in that section. It is smelted in the vicinity, and a considerable portion goes into white lead and zinc-lead white. Last year the known reserves of lead ore were considerably increased by the proving of considerable extensions of "sheet ground" in the vicinity of Webb City, Oronogo, and Carthage, while important bodies were developed in the Granby district.

The following table shows the quantity and value of lead ore produced in this district by camps, as compiled by Mr. Jesse Zook, of Joplin:

Lead ore shipments from the Missouri-Kansas district, 1905–6, in short tons.

<table>
<tr><th rowspan="2">Locality.</th><th colspan="2">1905.</th><th colspan="2">1906.</th></tr>
<tr><th>Quantity.</th><th>Value.</th><th>Quantity.</th><th>Value.</th></tr>
<tr><td>Webb-Carterville</td><td>16,699</td><td>$1,026,355</td><td>17,262</td><td>$1,344,049</td></tr>
<tr><td>Joplin</td><td>6,291</td><td>388,040</td><td>6,814</td><td>531,288</td></tr>
<tr><td>Galena-Empire [a]</td><td>2,547</td><td>160,760</td><td>4,190</td><td>324,985</td></tr>
<tr><td>Duenweg</td><td>3,258</td><td>202,515</td><td>3,963</td><td>314,388</td></tr>
<tr><td>Prosperity</td><td></td><td></td><td>2,754</td><td>217,185</td></tr>
<tr><td>Granby</td><td>874</td><td>53,565</td><td>985</td><td>76,643</td></tr>
<tr><td>Beef Branch</td><td>335</td><td>18,940</td><td rowspan="2">870</td><td rowspan="2">62,822</td></tr>
<tr><td>Spring City-Spurgeon</td><td>142</td><td>8,790</td></tr>
<tr><td>Baxter Springs [b]</td><td>566</td><td>34,450</td><td>669</td><td>51,299</td></tr>
<tr><td>Oronogo</td><td>319</td><td>19,850</td><td>354</td><td>27,403</td></tr>
<tr><td>Aurora</td><td>114</td><td>6,960</td><td>346</td><td>26,087</td></tr>
<tr><td>Mitchell</td><td rowspan="2">103</td><td rowspan="2">6,275</td><td rowspan="2">339</td><td rowspan="2">26,141</td></tr>
<tr><td>Sherwood</td></tr>
<tr><td>Alba</td><td rowspan="2">174</td><td rowspan="2">10,740</td><td>240</td><td>18,532</td></tr>
<tr><td>Neck City</td><td>125</td><td>9,707</td></tr>
<tr><td>Carthage</td><td>11</td><td>620</td><td>62</td><td>4,774</td></tr>
<tr><td>Springfield</td><td></td><td></td><td>44</td><td>3,608</td></tr>
<tr><td>Badger [a]</td><td>53</td><td>2,960</td><td>43</td><td>3,266</td></tr>
<tr><td>Zincite</td><td>62</td><td>3,855</td><td>43</td><td>3,380</td></tr>
<tr><td>Stotts City</td><td>88</td><td>660</td><td>20</td><td>1,524</td></tr>
<tr><td>Cave Springs</td><td></td><td></td><td rowspan="2">12</td><td rowspan="2">910</td></tr>
<tr><td>Central City</td><td>9</td><td>550</td></tr>
<tr><td>Playter</td><td></td><td></td><td>4</td><td>250</td></tr>
<tr><td>Miscellaneous [c]</td><td>14</td><td>800</td><td>4</td><td>317</td></tr>
<tr><td>Total</td><td>31,659</td><td>1,946,685</td><td>39,143</td><td>3,048,558</td></tr>
</table>

[a] Kansas.
[b] The ore credited to Baxter Springs, Kans., was derived from Quapaw Reservation, Ind. T.
[c] Includes output from Morgan County, Mo., Mansfield, Mo., and Harrison and Zinc, Ark.

COLORADO.

The production of lead in Colorado last year was a few thousand tons less than in 1905, amounting to 50,497 tons, or 14.52 per cent of that produced in the United States from domestic ores. This slight falling off was probably due not to any single factor but to a combination of several. Thus, a temporary car shortage reduced the output from several districts; working out old ore bodies may not have been balanced by discovery of their equivalent resources; extraordinary activity in zinc mining doubtless drew somewhat from lead mining; similarly, the success attending investments by Colorado operators in Nevada prospects led to placing in Nevada enterprises considerable capital which would usually have been directed to the development of Colorado resources. Nevertheless, the fourth largest output in this country was made.

The complex lead ores of this State carry in addition silver, gold, zinc, and some copper, of both milling and smelting grade. They occur in large replacement bodies in limestone, as at Leadville, and in veins in fractures, as at Aspen, Georgetown, and Silverton.

The developments of perhaps widest significance were the tunnel enterprises of Yak at Leadville and the Newhouse at Idaho Springs. The former has been most actively and successfully operated and is greatly stimulating mining in that district. The Newhouse tunnel, designed to drain and to open at a depth the properties of the Clear Creek country, had attained a length of nearly 15,000 feet in April, leaving about 6,000 more before reaching its destination above Silver City in Gilpin County. This State is a great smelting center for western ores, and all the lead ores mined in Colorado, except a relatively small percentage which went to another State, were smelted at local plants.

UTAH.

Last year this State increased its lead production more than 25 per cent, and passing Colorado assumed third place. This production was made by the Park City, Tintic, and Bingham districts, in which the largest shippers were the Daly-Judge, the Daly-West, and the Silver King. The Bullion Beck, the Dalton, the Lark, the Bingham, the New Haven companies, the Ophir Hill and New Stockton Company in the Ophir and Rush Valley districts, respectively, and the old Miller mine were also heavy shippers. The shipments from Park City are derived from rich replacement bodies in upper Carboniferous limestone, and from veins occupying strong northeast-southwest fracture zones. Those from the latter sources were much below the normal amount, owing to the fact that the stoppage of the Ontario drain tunnel and the consequent drowning of lower levels of connecting mines prevented mining in depth on the Daly-West. The drain tunnel was opened in November, however, after long and persistent effort, and with the continuation of the deep level in the Ontario the Daly-West is drained and opened at a depth of 2,100 feet. With the passage of the Ontario and Daly properties into the hands of the parties operating the Daly-West and adjoining properties, important developments and increased output may be expected. An important strike of high-grade lead-silver ore was made in the Little Bell mine, and the old Jupiter and Odin properties have been reopened and have made noteworthy shipments. The principal lead shipments from Bingham are from northeast-southwest fissures, and those from Tintic are afforded by both bedded and fissure deposits. The revival of the Cottonwood and the American Fork camps is already showing results in considerable shipments. The famous Old Emma and Flagstaff mines at Alta in Little Cottonwood Canyon have been taken up, and promising developments have been made in neighboring properties here and in the Big Cottonwood Canyon. Very important developments were made in the southern and western parts of the State. These facts tend to warrant the belief that in the immediate future, unless there is unexpected hindrance, Utah will continue its marked advance in lead production.

WISCONSIN.

In Wisconsin lead is now generally a by-product of zinc production, comprising only about 5 per cent of the metal output, and mining for lead alone is now restricted to a few properties in the extreme southern part of the mining district. Lead occurs as galena, associated with blende to a limited extent, but generally alone in crevices near the surface and sparsely disseminated in grains with zinc. The rapid development of zinc mining, leading to a corresponding increase in the production of lead, and the success attending operations of lead mining in the southern section are demanding increased smelter capacity. Accordingly, in addition to the Dubuque plant, which was running during the year, a plant is to be built by the operators of the old Dodgeville smelter, and it is announced that the Northern Smelting Company will start a lead smelter at Waukesha.

VIRGINIA AND KENTUCKY.

In Virginia and Kentucky considerable prospecting for lead has been carried on. Operations in mining have progressed well. Several good bodies have been opened, and success attended experiments in concentration.

NEW MEXICO.

In New Mexico, as in Missouri, most of the present lead output is incidental to zinc mining, being derived from mixed lead-zinc ores. Last year, however, lead production received an impetus from the unusual activity in mining in this State. Important lead ores were developed in the Organ Mountains in Donna Ana County, at Magdalena, Cooks Peak, Granite Gap, and elsewhere.

ARIZONA.

In Arizona mining of lead was successful in the old camps, and several new discoveries were reported.

NEVADA.

In Nevada, in the old camp of Eureka, the famous Eureka and Richmond properties taken up by the United States Smelting and Mining Company were reopened in September, 1905, and after unwatering and retimbering were put in condition, both underground and on the surface, for active operation. Last year extensive improvements were made and several thousand tons of low-grade ore were shipped. The lack of transportation prevented much larger shipments, but now, with adequate railway facilities, about 130 tons a day are shipped. The tonnage of milling ore, carrying lead, silver, and gold, now in sight should enable the old property to make good record this year. In the Robinson mining district, in several properties at Ely and camps tributary thereto, some promising bodies of lead are being opened.

WASHINGTON.

The principal lead production from this State was by the Jupiter Lead Company, at Northport, Stevens County. In the extreme northeast corner of Washington, in Stevens County, an area of about 50 square miles, known as the Metaline district, was actively developed and shipments were made. The region lies on both sides of Pend Oreille River, 18 miles south of the Canadian line and about 60 miles north of Newport on the Great Northern Railroad, from which it is reached by steamer down Pend Oreille River. The nearest city is Spokane, about 80 miles southwest. The camp had been previously opened, first thirty-seven years ago, and again twenty years ago. Last year the Spokane Lead Mining Company, the Larsen Lead Company, the Metaline Mining and Smelting Company, the Mammoth Silver-Lead Mining and Smelting Company, and a number of private interests were operating. A shipment of crude ore, running 73.1 per cent lead, 1.1 ounces silver, and 2 per cent zinc, was made to Illinois, and considerable ore was mined ready for milling. The ore is said to occur either in fissures or disseminated through metamorphic limestone, and to carry good lead values, usually about one-tenth as much silver, and occasionally, as in the Mammoth mine, some zinc. A concentrating mill is to be erected, and ore contracts are being taken. The Federal Government has just completed the removal of the greatest obstacle to the development of the district, lack of transportation, by rendering the river navigable through Box Canyon, a few miles above the camp. With the installation of regular steamboat service, permitting the introduction of milling machinery and supplies and the shipments of ore, the investigation and proving of the resources of the district will be greatly facilitated.[a]

MAINE.

In New England some of the more promising old mines were unwatered, reopened, and worked. At Cherryfield and Deer Isle, in Maine, prospects opened in 1879 were again opened last year, and zinc-lead ore was mined and shipped.

NEW HAMPSHIRE.

In New Hampshire lead mines were operated at three points, Woodstock, Gorham, and Madison. The Hunton Mining Company operated their lead-zinc property at Woodstock throughout the year, and experimented on treatment with a 100-ton mill equipped with card tables. The ore consists of galena and blende, and occurs in a vein filling a fissure cutting gneiss. Several miles to the east a promising lead-silver property, with several hundred feet of workings, is being reopened and thoroughly developed and improved. Ore from the main vein, which is regularly sorted and sacked for shipment, assays excellent lead and silver values, fair gold content, and, in certain portions, high copper values. For the present only crude ore will be shipped, but it is planned to erect a mill later for treating lower-grade ores. At the Silver Lake mine at Madison a complex ore carrying lead-silver and zinc is being mined, but it offers serious difficulties to successful concentration and separation.

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[a] The receipt of detailed information on this district, including photographs and ore samples from Mr. Lewis P. Larsen, of Spokane, and of information from Mr and Mrs. D. D. Birks, is gladly acknowledged.

MASSACHUSETTS.

In Massachusetts the old Merrimac silver-lead mine, near Newburyport, was taken up early during the current year and is now being unwatered. A sacked shipment of concentrates yielded, according to certified assay, lead 62.40 per cent, silver 32.70 ounces, and gold 0.31 ounce. The property has a record of affording some high-grade ores, and it is proposed to conduct active mining and milling operations during the present year.

ALASKA.

In Alaska some lead deposits were prospected in the Wrangell district, but distance from tidewater is a serious obstacle to development in this locality. On Prince Edward Island, along Cholmondeley Sound, on Grand Mountain, deposits of galena, with pyrite, chalcopyrite, and blende, occur in a vertical northeast shear zone in limestone. They have been opened by tunnels and shaft, and the showing has led to the decision to construct a 5,000-foot aerial tram and a wharf.

PHILIPPINE ISLANDS.

Promising deposits of galena were recently discovered in the island of Marinduque, and galena was located in central Cebu near Consolacion.

MEXICO.

The lead industry in Mexico last year was marked by extraordinary activity in smelter construction, but a slight decrease in production. American investors were very active in Mexican mining matters, a number of important properties were taken up, and exploration has been most vigorous. The American Smelting and Refining Company increased its already large holdings, and the United States Smelting and Refining Company made important additions to its possessions.

CANADA.

Last year Canada produced 27,100 tons of lead against 28,290 in 1905, a decrease in quantity of 4.68 per cent from that of the preceding year and an increase in value (at 5.657 cents per pound) of 14.54 per cent. Ores exported to the United States yielded 7,238 tons of lead. About 95 per cent of this was produced in British Columbia, chiefly the East Kootenai district, in which the St. Eugene and North Star mines were the chief producers. Returns from all active Canadian lead smelters state that last year no ores from the United States were treated in Canada. The bounty on lead paid by the Dominion government and the excellent condition of Canadian production works should result in an increased production for the current year.

EUROPE.

France, Austria-Hungary, and Italy, respectively, increased their productions in 1906 over those in 1905, while Spain (the largest lead producer in Europe) and Belgium maintained their productions equivalent to those of the previous year, but Germany (the second largest producer) and England failed to equal their records for the preceding year.

AUSTRALIA.

Unusual activity and excellent financial success marked mining in Australia. Yet, as far as may be judged from the best figures, the production fell off. This was doubtless due in part to the extra attention directed to zinc mining and milling and in part to losses through fire and creeps.

AFRICA.

In Africa, at Broken Hill, Rhodesia, rich lead deposits were developed, which will be actively mined this year and smelted on the property. Similarly, in German southwest Africa, at Otavi, the high-grade replacement deposits of copper, lead, and zinc in limestone were worked, and after various experiments in milling and separation it was decided to erect smelting works during the current year.

REDUCTION.

In concentration and separation of lead ores considerable progress was made last year, namely, in saving values from slimes, in perfecting separation by application of various methods to individual ores, and by adoption of many improved devices. These several features are so closely associated with the character and occurrence of the ores that they are described in detail in connection with those subjects in the respective States under "Resources."

In lead smelting unusual activity has been manifested both in improvement of practices and in increasing capacity. Of special significance is the adoption, after thorough experiment, by the American Smelting and Refining Company, of a modified form of the Huntington-Heberlein process of roasting. While two high-grade plants, that of the United States Metals Refining Company at Grasselli, Ind., and that of the Canadian Smelting Company (Limited), at Trail, British Columbia, used the Betts process. The United States Metals Company conducted an experimental run in 1906, and early in 1907 stated that its plant was running at about 75 per cent of its estimated capacity of 75 tons of refined lead a day. The Pennsylvania Smelting Company, of Pittsburg, doubled its capacity for refining lead bullion and increased its ore-smelting capacity 25 per cent. The Kellar and Indiana Consolidated Smelting Company at Kellar, Wash., completed its smelter in March, 1907, and expected to begin operations by the first of June. The Rigby Mining and Reduction Company expected to start its new lead smelter at Mayer, Ariz., early in the current year. The St. Joseph Company in southeastern Missouri and the Granby Company in southwestern Missouri made important additions to their furnace equipment. The plant of the Copper-Lead Smelting Company at Seattle had not been erected at last accounts. The intended erection of a lead smelter at Tintic, Utah, of 500 tons capacity is announced.

In Mexico the American Smelters Securities Company began operating at Velardena, Durango, a plant designed for a capacity of 600 tons lead ore and 900 tons of copper ore, and its parent company, the American Smelting and Refining Company, is building a a 500-ton lead plant in Chihuahua. The following custom plants were completed: At Oaxaca, one of 100 tons, another of 250 tons; at Guerrero, one of 40 tons; at Guaymas, Sonora, one of 500 tons capacity.

In Canada at the electrolytic refinery of the Consolidated Mining and Smelting Company of Canada (Limited), located at Trail, gold, silver, copper, and lead are treated, and a very high grade of refined lead is made. In a series of analyses recently made of the pig lead products of smelters throughout the world, the sample produced by these works yielded: Lead 99.989, silver 0.0025, gold 0.0003, tin 0.0007, arsenic 0.0020, zinc 0.0002, and iron 0.0039. The plant also produces antimony.

TRADE.

IMPORTS AND EXPORTS.

In recent years the production of lead in the world and also in the United States has steadily increased. The consumption of lead in the world and also in this country has likewise increased. While a large part of the increase in the world's production has been contributed by this country, a larger share of the increase in consumption has been by this country, and considerable quantities of lead are regularly imported, some of which remains for domestic consumption, some for manufacture under drawback, and some for smelting and refining in bond. The statistics for these several items are given below according to the records of the Department of Commerce and Labor.

Lead imported and entered for consumption in the United States, 1900–1906, in 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
1906	[a]44,560,258	[a]755,545	24,882,983	960,998	346,177	17,250	4,503	[a]1,738,296

[a] Exclusive of 587,731 pounds of base bullion, valued at $15,635.

Sources and quantities of imports of lead, 1902–1906, in pounds.

Country.	1902.	1903.	1904.	1905.	1906.
United Kingdom	792,607	1,552,772	494,556	1,589,859	9,852,760
Germany	952,878	1,409,926	731,222	250,241	2,006,369
Other European countries	1,342,193	451,331	165,661	117,699	3,920,313
Total refined pig lead	3,087,678	3,414,029	1,391,439	1,957,799	15,779,442
British North America	19,464,937	19,200,806	17,903,798	16,362,916	18,514,244
Mexico	187,484,666	186,136,779	205,805,911	175,167,694	133,512,526
South America			579,918	3,154,483	315,265
Total ore and base bullion	206,949,603	205,337,585	224,289,627	194,685,093	152,342,035
Other countries	5,195,174	4,061,872	22,246	112,516	147,462
Total imports	215,232,455	212,813,486	225,703,312	196,755,408	168,268,939

Lead, and manufactures of lead, of domestic production, exported, 1900–1906, in pounds.

Year.	Manufactures of lead.		Pigs, bars, and old.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1900	[a] 363,600	[b] $130,758 [c] 240,149	1,993,773	$88,664	$459,571
1901	[a] 490,460	[b] 178,752 [c] 230,940	4,787,107	214,842	624,534
1902	[a] 454,423	[b] 153,309 [c] 256,153	6,542,760	286,548	696,010
1903	[a] 364,220	[b] 127,530 [c] 357,622	112,544	6,210	491,362
1904	[a] 439,953	[b] 160,863 [c] 451,785	70,408	3,478	616,126
1905	[a] 445,002	[b] 156,162 [c] 506,076	125,332	5,623	667,861
1906	[a] 505,750	[b] 175,719 [c] 590,992	147,551	9,065	775,776

[a] Type. [b] Value of type. [c] Value of all other manufactures.

CONSUMPTION OF LEAD IN THE UNITED STATES.

The annual consumption of lead in the United States from 1902 to 1906, inclusive, as estimated in former years from the best available sources, was as follows:

Estimated annual consumption of lead in the United States, 1902–1906.

1902 ....short tons..	332,484	1905 ....short tons..	347,015
1903 ....do....	300,167	1906 ....do....	376,300
1904 ....do....	319,543		

The domestic consumption in 1906, based on end products only, is stated in detail below. Stocks, both domestic and foreign, and production are in terms of refined lead; imports and exports are in finished state, and antimonial lead is in marketable form, while lead in ores and bullion is excluded. The figures for refined and antimonial lead and for domestic stocks are based upon direct returns from all known operating refineries and from all known smelters producing pig lead from the soft lead ores of the Mississippi Valley. All other figures are from statistics compiled by the Bureau of Statistics of the Department of Commerce and Labor.

Consumption of lead in the United States in 1906, in short tons.

Supply:		
Stock, domestic, beginning of year	3,975	
Stock, foreign, beginning of year	56	
Total production, refined lead	404,669	
Total production, antimonial lead	10,546	
Imports, foreign refined	11,763	
Total available		431,009
Withdrawn:		
Stock, domestic, close of year	4,571	
Stock, foreign, in bond, close of year	64	
Refined, in bond, from foreign base bullion and ores and exported	48,558	
Lead in manufactures exported under drawback	1,516	
Total withdrawn		54,709
Apparent consumption of lead in the United States in 1906		376,300

Increase in consumption in 1906 over 1905, 29,285 tons, or 8.44 per cent.

WORLD'S CONSUMPTION IN 1906.

The world's consumption of lead can not be figured precisely, owing to differences in significance of totals afforded by the several countries and to delays in obtaining figures from some of them. The approximate world's consumption of lead in 1906 (as compiled from figures on consumption by the respective countries by the Metallgesellschaft and the Metallurgische Gesellschaft, A.-G., except for this country, for which the figures of this office are used) is 921,679 metric tons. In this total world's consumption the United States led with 341,379 metric tons, or 37.03 per cent, and Great Britain and Germany were next with 176,200 and 151,800 metric tons, respectively.

MARKET AND PRICES.

During 1906 consumption increased more than production, thus causing a strong market. This increase is in large measure to be attributed to the general expansion in manufactures, in which lead enjoyed a good share.

The average price of lead for the year at New York was 5.7 cents per pound, which is the highest for about a quarter of a century. The price in the New York market stood at 5.60 until the middle of February, when it declined to 5.35, and continued low until the latter part of April. Then it rose to 5.50, and continued to increase until it reached 5.75 early in May, at which level it remained, until in December it rose still higher, and at the close of the year stood at the maximum price of 6 cents per pound. In the following table are shown the highest and the lowest prices of lead at New York in each month during the last six years. All figures for prices are for cents per pound. Those for 1906 are based upon daily quotations published in the Engineering and Mining Journal, and those for preceding years on quotations published in the Iron Age.

Highest and lowest prices of lead at New York City, monthly, 1901–1906, in cents per pound.

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1906	5.60	5.60	5.60	5.35	5.35	5.35	5.50	5.35

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1906	5.75	5.50	5.75	5.75	5.75	5.75	5.75	5.75

Highest and lowest prices of lead at New York City, monthly, 1901–1906, in cents per pound—Continued.

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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
1906	5.75	5.75	5.75	5.75	5.75	5.75	6.00	5.75

SUMMARY OF STATISTICS.

The following tabular statement gives the general items regarding domestic and world production and consumption. The figures for domestic items are those compiled by this office, and the figures for the world items are based upon statistics compiled by the Metallgesellschaft and the Metallurgische Gesellschaft, A.-G.

Although in figuring the separate totals for domestic production and consumption of refined lead, the item for production of antimonial lead is not included in refined lead but is included in supply for consumption, as it is an end product, yet for purposes of comparison in figuring excess of production of refined lead over consumption, this item—production of antimonial lead—is treated similarly on both sides.

Figures for world production and consumption of lead are necessarily approximate. This is true since totals for different countries are compiled on different bases not covering the same and only the same items, and also because those for certain countries are doubtless in part estimates, owing to delay in securing figures for actual production. This fact will affect the corrections of the comparative statistics showing the percentages, which the production and consumption of the United States are of the production and consumption of the world. As to changing the rank of this country, however, the margin in both production and consumption between this country and that next in rank is so great that ordinary changes in estimates would not change the rank of the United States. This tabular statement may thus be of value in presenting general comparative statistics.

Summary of general statistics, in short tons.

Production of refined lead in United States	404, 669
Percentage of increase in production of refined lead in 1906 over that for 1905	1.2
Consumption of lead in United States	376, 300
Percentage of increase in consumption of lead in 1906 over that for 1905	8.4
Excess production of refined lead over consumption of same	38, 915
Production of lead in United States from domestic sources	350, 000
Percentage of increase in production of lead from domestic sources in 1906 over that for 1905	9.3
World production (approximate)	1, 144, 996
World consumption (approximate)	1, 032, 280
Excess world production over world consumption (approximate)	112, 716
United States percentage of world production	35.3
United States percentage world consumption	37.0
World rank of United States in production of lead	First.
World rank of United States in consumption of lead	First.

ZINC.

By J. M. Boutwell.

INTRODUCTION.

This report is designed to present a concise statement of the condition and progress of the zinc industry in the United States in 1906. It treats of statistics of production and consumption, development of ore resources, progress in reduction, and conditions of trade.

The statistics for production in this country are based upon actual confidential returns made direct to the Survey by every known producing zinc-smelting company in the country. Those for domestic consumption are taken in part from these smelter returns and in part from records of the Department of Commerce and Labor, while the tables for foreign production and consumption are compiled from the statistical statements of foreign metal dealers as credited. The data regarding resources, reduction, and trade were gathered through personal observation on the ground, by conference and correspondence, and from publications. The statistics for domestic production, being compiled from individual company statements, are dependent for their correctness upon the correctness of these individual reports.

The work of collecting statistics and information regarding mineral resources is now done under the supervision of geologists of the Survey. To Mr. Charles Kirchhoff, who by his conduct of the statistical work on zinc since the organization of this division laid a valuable foundation for future work, the writer gives hearty thanks for kindly interest and advice. Special endeavor has been made to obtain complete and accurate statistics for this report, no pains being spared to secure correctness. The writer desires to acknowledge the universally cordial and appreciative spirit of cooperation with which producers have responded to his inquiries.

STATE OF INDUSTRY.

The zinc industry throughout the world in all its branches, from mining to manufactures, experienced an unusually successful year in 1906. An unprecedented demand for spelter and pigment drove the price steadily upward, and thus encouraged active development of resources and expansion of reduction capacity. Zinc resources hitherto valueless, including abandoned veins, old dumps, accumulations of tailings, as well as newly discovered deposits, have been actively exploited. Following the successful outcome of experiments in various methods of ore dressing and valuable improvements on old methods, a number of new mills have been built, considerable additions to old ones have been made, and milling practice in general has been refined. Several new smelters are now in process of erection, and the capacity of old plants has been notably increased, so that at the close of 1906 the capacity for milling and smelting was much larger than in 1905, and will be added to considerably during 1907.

Further improvements in concentration, separation, and smelting are most desirable in order to attain higher recovery and lower costs. The industry has experienced comparatively little inconvenience from labor troubles, but car shortages in the Rocky Mountains somewhat reduced the output, while fuel shortage in the extreme Northwest seriously hampered operations for a considerable period of time.

The result of these various activities has been greatly to increase production. The United States added much to its production as well as to its consumption, leading the countries of the world in consumption, and falling short by only a few thousand tons of leading Germany in production.

PRODUCTION.

The production of spelter (crude metallic zinc) in the United States in 1906 was 224,770 short tons. This production, which includes 25,076 tons of spelter obtained from the smelting of foreign ores, shows an increase of 20,921 tons, or 10.3 per cent over the preceding year, and is the largest production in the history of the industry. The exact annual progress is indicated in the following table:

Annual production of spelter in the United States, 1873–1906, in short tons.

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	1906	224,770

PRODUCTION BY STATES.

The total production of the country may be apportioned either to the localities in which the ores were smelted or to those whence they were derived. The former apportionment, which was the one followed in these reports in past years, is of special interest to the shipper, manufacturer, and consumer. On the other hand, the source of zinc ores is of leading interest to ore producers and buyers, and is of first importance as regards resources. Each mode of statement thus possesses its own special value, and accordingly in this report the production is apportioned to show both smelting centers and sources of ores. The two production totals have been compiled from actual returns furnished by every company in the United States known to have produced spelter in 1906. Only primary zinc (spelter derived directly from zinc ores) is included, about 2,500 tons made from secondary sources, such as dross spelter, being excluded.

The following table is designed to show the sources of all ores and concentrates smelted for zinc in the United States in 1906, the quantities of each from each source, and the quantity of spelter actually produced from the materials derived from these respective sources.

Production of spelter in the United States in 1906, apportioned according to source of ore, in short tons.

Rank of State.	Source.	Spelter.	Smelting ore.	Concentrates.	Percentage of total spelter derived from United States ores
17	Arizona	64	134		0.032
7	Arkansas	1,801	4,157		.90
2	Colorado	32,456	65,379	43,754	16.25
11	Idaho	573	1,907		.29
14	Illinois	282	671		.14
15	Iowa	201		670	.10
5	Kansas	3,902		14,424	1.96
13	Kentucky	335		950	.17
1	Missouri	130,348	111,639	151,140	65.27
9	Montana	1,415	602	3,726	.71
8	Nevada	1,768	5,948		.88
3	New Jersey	11,206		28,348	5.61
12	New Mexico	555	1,986		.28
16	Tennessee	124	135	250	.06
18	Texas	8	24		.004
6	Utah	2,449	5,933	3,122	1.23
10	Virginia	1,143		2,547	.57
19	Washington	7	21		.004
4	Wisconsin	11,057	8,622	15,509	5.54
	Total from United States ores	199,694	207,158	264,440	100.000
	Foreign:				
	British Columbia	201	348	102	[a] .80
	Mexico	24,875	84,069	2,583	[a] 99.20
	Total from foreign ores	25,076	84,417	2,685	[a] 100.00
	Grand total	224,770	291,575	267,125	

[a] Derived from foreign ores.

The following table is designed to show the localities in which spelter was made.

Production of spelter in the United States, 1902–1906, apportioned according to locality in which smelted, in short tons.

	1902.	1903.	1904.	1905.	1906.
Colorado		877	4,871	6,599	6,260
Eastern and Southern States	12,180	12,301	[a] 14,893	[a] 24,513	29,930
Illinois	[b] 47,096	[b] 47,659	47,740	46,606	47,939
Kansas	86,564	88,388	107,048	114,287	129,564
Missouri	11,087	9,994	12,150	11,844	11,077
Total	[c] 156,927	[d] 159,219	[e] 186,702	203,849	[f] 224,770

[a] Including West Virginia.
[b] Including Indiana.
[c] Including 2,675 short tons dross spelter.
[d] Including 3,302 short tons dross spelter.
[e] Including 3,300 short tons dross spelter.
[f] Primary spelter derived direct from ores and exclusive of 1,500 tons of dross spelter.

COMPARISON OF SMELTER AND MINE RETURNS.

The figures for production of spelter by the respective States given above are based on actual returns from individual zinc smelters. Those given in the following sections in connection with the detailed descriptions of mining developments in the several States (pp. 11–24) are based on actual reports by mines. Theoretically these State totals as compiled from smelter reports and from mine reports, respectively, should agree. For various reasons, doubtless well known to the mine and smelter operators themselves, these totals frequently differ considerably. For purposes of comparison and discussion the totals secured by the two methods are shown in the table on page 9.

The smelter totals are made up of the total production reported by all companies for each State respectively, and thus represent actual recovery. For compiling the mine tables each producing property is requested to report actual tonnage of zinc ores sold and contents of zinc in crude ore and concentrates shipped reckoned by assay value. From that zinc content 25 per cent is deducted for losses, and the balances thus obtained from all producing properties in each State are combined to afford the total for the respective States.

It is clear by either method the correctness of the totals is dependent upon complete and correct returns from every producing mine and smelter, respectively. It is further essential to the correctness of the mine totals that the theoretical recovery be correctly estimated.

As to the degree of accuracy of the totals, every possible precaution is taken to have the original reports, both from smelters and from mines, correct; yet unintentional errors have in some cases been detected and eliminated. It is obvious, however, that the individual reports, though open to certain checks and provisions, must eventually be accepted, as from the very nature of the case it is impracticable to go behind company reports. At this point the general chance of error in the smelter reports ends. In the mine reports, however, the estimation of smelter from tonnage of ore by application of a constant for losses in treatment affords an additional source for discrepancy. Thus of the two it would appear that theoretically, complete and accurate smelter returns should afford the most correct totals of production. In actual practice the smelter totals are less liable to error and the mine totals are somewhat more comprehensive in that they include all ores before diversion into various channels and regardless of final form. Thus there is excluded from the smelter totals, which, it will be recalled, represent solely actual smelter production, (1) about 24,800 short tons of zinc ores which were mined in this country and not smelted as they were exported, (2) the zinc ores which went into making 154,675,188 pounds of zinc oxide and 13,558,000 pounds of zinc-lead pigment.

As to the actual discrepancies shown in the accompanying comparative table, it is to be noted, first, that no mine totals for the Mississippi Valley and Eastern States were made up, as that branch of this work was not then established; and, second, that in most cases the discrepancies, large as they may appear in certain instances, may be reasonably ascribed to the above-mentioned items.

Comparison of State totals, based on smelter and mine reports, in short tons.

State.	Totals based on smelter reports.	Totals estimated from mine reports.	Differences.	
			Smelter excess.	Mine excess.
Arizona	64	[a] 64		
Arkansas	1,801	[a] 1,801		
California		103		103
Colorado	32,456	43,483		11,027
Idaho	573	1,033		460
Illinois	282	[a] 282		
Iowa	201	[a] 201		
Kansas	3,902	[a] 3,902		
Kentucky	335	[a] 335		
Missouri	130,348	[a] 130,348		
Montana	1,415	3,290		1,875
Nevada	1,768	1,443	325	
New Jersey	11,206	[a] 11,206		
New Mexico	555	8,646		8,091
South Dakota		12		12
Tennessee	124	[a] 124		
Texas	8	[a] 8		
Utah	2,449	3,238		789
Virginia	1,143	[a] 1,143		
Washington	7	[a] 7		
Wisconsin	11,057	[a] 11,057		
Total	199,694	221,726		

[a] No statistics of mine production for these States were collected. Smelter figures used as basis of comparison.

In considering these differences, as shown above, it is to be noted that no mine totals for the Mississippi Valley and Eastern States are given, as in the absence of mine statistical work in those areas last year mine reports were not made up. The totals for Arkansas, Illinois, Iowa, Kansas, Kentucky, Missouri, Tennessee, Texas, Virginia, and Wisconsin are thus eliminated from discussion.

In the remaining States the differences generally arise from diversion of zinc reported in ores to other use than for spelter, principally to exports and manufacture of zinc oxide, or to difference in time which must elapse between the date of shipping ore and the date when it is made up into spelter and reported as such. Thus the 64 tons of spelter from Arizona reported by smelters were found to have been derived from ores mined and shipped in 1905 and therefore properly included in mine reports for that year, but to have been made into spelter in 1906 and therefore properly reported by smelters as spelter production in that year. Similarly, the case of the Idaho difference is chiefly due to the fact that ores shipped by a certain mining company in 1906, and reported by it for that year, were not smelted in 1906 and were thus properly omitted from smelter report; in fact, at date of writing they were in the smelter's ore bins. Of the estimate of 115 tons of zinc from the California zinc ores, the greater part is believed to have gone into the manufacture of chemicals, and much, if not all, of the remainder failed to reach smelters, and accordingly none is credited as spelter. For Washington the small production which smelters reported, and the excess shown by their reports over that from mine reports is doubtless due to failure of zinc-producing mines to report output.

These minor items are readily explained and inconsequential, however, as compared with the differences in New Mexico and Colorado, by which mine reports show excess of 8,091 and 11,027 tons, respectively. In this connection it is to be clearly observed that the mine totals are estimated from all zinc ores sold, while the smelter totals show only that zinc which went into spelter. As regards the differences between the totals for New Mexico, a series of inquiries seems to show that through a miscredit in bookkeeping by smelters the smelter total for that State is several thousand tons less than it should be, but not enough to eliminate the discrepancy. The remaining excesses on the mine side for this State and for Colorado are explained to a large extent by the fact that a large tonnage of zinc ore from each of these States was used in the manufacture of zinc oxide and zinc-lead pigment, and further that considerable quantities of Colorado zinc ores were utilized in the Mississippi Valley in the manufacture of sulphuric acid. After making the proper allowance for these facts there still remains an excess on the mine side, much of which may be safely assigned to exports; for although a large portion of the 24,800 tons of crude ores exported were derived from New Jersey, a portion was from New Mexico and other Western States.

ZINC PIGMENTS.

The production of zinc oxide, or zinc white, in this country in 1906 was 154,675,188 pounds, or 74,680 short tons, and in 1905, 137,206,000 pounds, or 68,603 short tons, an increase of 6,077 tons, or 8.9 per cent. The production of zinc-lead pigment in 1906 was 16,258,000 pounds, or 8,129 short tons, and in 1905, 13,558,000 pounds, or 6,779 short tons, an increase of 1,350 tons, or 19.9 per cent. The price at works averaged 4 cents, approximately the same as for 1905, though the price advanced toward the close of the year. The figures show the strength and striking progress of this industry.

Most of the zinc oxide produced in this country is made from ores, only a relatively small portion being made from spelter. The main sources of zinc used for this purpose are New Jersey, New Mexico, Colorado, Wisconsin, Missouri, and Kansas. The manufacture of zinc oxide and of zinc-lead is restricted to such a small number of companies that little more than the totals for the entire country can be published without disclosing their private business.

In 1906 the Ozark Smelting and Mining Company completed the erection of, and successfully operated, works at Coffeyville, Kans. This plant is the outcome of through experimentation, and is designed for the manufacture of zinc-lead pigment directly from mixed ore without preliminary separation.

At the oxide department of the Mineral Point Zinc Works of the New Jersey Zinc Company, at Mineral Point, Wis.,[a] 36 Wetherill furnaces are employed. The capacity of the Palmerton Works, Palmerton, Pa., of the same company, was increased from 700 to 800 barrels of 300 pounds each per day.[b] The capacity of the plant of the United States Smelting Company, at Canyon, Colo., for the manufacture of pigment, was also largely increased, and it is announced that the Tri-Bullion Smelting and Development Company, which produced carbonate zinc ores from its mines at Kelly, N. Mex., will erect a large oxide plant at Canyon, Colo.

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[a] Eng. and Min. Jour., September 1, 1906.
[b] Paint, Oil, and Drug Review, March 28, 1906, p. 25.

RESOURCES.

GENERAL.

The known available resources of zinc were greatly increased during 1906. This remarkable extension was due to a combination of factors. The strong demand by ore buyers, and favorable prices, encouraged active and wide exploration for ores, and stimulated work on improving methods of treatment particularly concentration. These improvements in milling, together with prevailing higher prices, made it possible to handle successfully ores which otherwise would have been too low grade. These activities are general throughout this country and abroad, particularly in Australia and Mexico.

EASTERN AND SOUTHERN STATES.

NEW JERSEY.

The Franklin deposits yielded to the New Jersey Zinc Company their regular enormous output of mixed zinc ore. The ore body is an immense folded lens in crystalline limestone, adjacent to intrusive granite included in a pre-Cambrian metamorphic series. The ore is made up of franklinite, zincite, and willemite in a gangue of calcite and garnet. It is treated by Wetherill magnetic separators, and divided into (1) a willemite product, used for making spelter; (2) a franklinite product, used for making zinc oxide, with a cinder that goes into the spiegeleisen, and (3) a half and half that is made into zinc oxide. Considerable exports of willemite were made to Europe via New York in 1906. The management of the mine was changed during the year. Additional mineral-bearing ground to the south of this property was taken up by the company and developed.

The results of a detailed study of these deposits and related geology will shortly be published by the Survey.

MAINE.

Under the unusually favorable commercial conditions that prevailed a number of old mines in Maine were reopened and actively operated. A deposit near Cherryfield, discovered in 1878, had been opened to a depth of over 100 feet. In 1906 the property was reopened and actively worked, and it is now reliably reported that a mill has been erected and that shipments aggregating 40 tons, valued at $1,000, were made last winter. The ore consists of zinc blende and a little argentiferous galena.

At Deer Isle a zinc and lead body was opened about thirty years ago, but abandoned, owing to the refractory character of the ore and financial mismanagement. In August, 1906, the workings were pumped out, to ascertain the character and amount of the ore present and whether they could be treated under certain new processes. During the year 75 tons of ore, running 25 per cent zinc and 9 per cent lead, with traces of gold and silver, were mined, and during the first half of 1907, 200 tons were taken out.

In West Pembroke, southeast of Ayers Junction, deposits of low-grade zinc ore were prospected at about a dozen points. They have been considered typical of the disseminated sulphides of that region and, accordingly, may be briefly described.[a] The ore is composed of sphalerite, galena, pyrite, and chalcopyrite in a gangue of quartz and calcite. It occurs disseminated through irregular bands of greenstone breccia, chiefly in the matrix, but occasionally in amygdules in amygdaloidal fragments.

A few tons of zinc ore were exported from Maine during the year.

NEW HAMPSHIRE.

An event of international interest in the zinc industry was the test of the Lungwitz process by the Warren Zinc Separating Company at its property near Warren, N. H. On this property it is reliably stated that a large body of ore has been opened, which runs zinc 35 per cent, lead 10 per cent, and silver 10 to 12 ounces. Difficulty has been experienced, however, in effecting satisfactory separation. After various experiments, a product was secured by a Wetherill separator that carried about 50 per cent zinc, but owing to other factors this was not commercially successful. A special furnace was designed for preliminary roasting, which made it possible to raise the Wetherill product to 55 and 56 per cent zinc. The mill was soon after destroyed by fire. A blast furnace was built in the fall of 1905 at a cost of $40,000, that stood a pressure of 120 pounds to the square inch and a hearth temperature of 1,500 degrees Centigrade. It was designed to separate the distillation and boiling points of zinc, restraining the latter by roasting under pressure.[b] In the spring of 1906 a trial run was made, which resulted unsatisfactorily. It is believed by those directly interested, however, that under certain more favorable conditions the furnace may be successfully operated. At last reports another trial was contemplated. Pending the settlement of the problem of treatment, underground development of the property was carried on and a new shaft was sunk.

Last year the Silver Lake mine, near Madison, in Carroll County, and the concentration mill on the property, were operated on a small scale. The ore is stated to be an intimate mixture of zinc and lead and to occur in narrow veins.

NEW YORK.

For many decades zinc ores have been known to occur in northern New York, and in 1903 the old mines at Ellenville, N. Y., were worked. In 1906 a lease was taken of the old Balmat mine, between Edwards and Gouverneur, in St. Lawrence County, which was opened early in the last century. The ore is stated to be a mixture of blende, galena, and pyrite, and to occur in a narrow northeast-southwest vein ranging up to 3 feet in width in the serpentine country rock.

Recently the discovery of a new body of good size and grade three-fourths of a mile north of Edwards has been reported. It is stated that a series of test pits have revealed the presence of zinc ore in the north end of a crystalline limestone member of a pre-Cambrian metamorphic series. It occurs in bunches and streaks lying along the zone

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[a] Smith, G. O., Note on a mineral prospect in Maine: Bull. U. S. Geol. Survey No. 315, 1906, pp. 118-119.

[b] Gordon, F. W., The Lungwitz process of zinc smelting: Eng. and Min. Jour., pt. 1, April 28, and pt. 2, July 14, 1906.

parallel with the strata of the limestone for a length of 2,000 feet. The ore is composed chiefly of massive blende, associated with some granular galena and crystalline pyrite. About 3,000 tons have been mined in the course of exploratory work, and it assays up to 48 per cent zinc. Experiments in magnetic concentration have proven successful. The property is well situated for mining and shipping operations.

PENNSYLVANIA.

The old zinc mines in Lehigh County near Friedensville, 4 miles south of South Bethlehem, are to be unwatered and mining operations resumed. This property was discovered in 1845, and after being under litigation for sixteen years was purchased by the Lehigh Zinc Company and actively worked on a large scale for many years.[a] The ore is stated to occur in the form of massive blende in the east-west veins, which stand nearly vertical between walls of dolomitic limestone. In the early days when mining was by open-cut system, 1,200 to 1,500 tons a year were taken out. Later, during the active period of the Lehigh Company, when the ores were concentrated and smelted on the spot, both spelter and zinc oxide were produced.

VIRGINIA.[b]

Considerable activity is being shown in the zinc industry in the central Appalachians. New occurrences are being found. Old mines are being reopened, and reduction works planned.

The zinc deposits occur in Virginia (1) in the Great Valley region of the southwestern part, and (2) in the Piedmont region in the west-central part. The former deposits have been mined chiefly in Wythe County, though also worked in Botetourt, Roanoke, Montgomery, Pulaski, Smyth, and Russell counties. Wythe County has yielded nine-tenths of the lead and zinc ores produced in Virginia, most of it from the mines at Bertha and Austinville.

During 1906, as the exhaustion of the soft or oxidized ores became more imminent, exploration for sulphur ores in hard limestone was was very active. Good reserves of workable sulphide ores have been found, and especially in Wythe County at Austinville extensive and valuable bodies of zinc ores have been developed. At Cedar Springs shoots of high-grade blende have been opened, and in Smyth County in Rye Valley recent developments are promising.

In the Piedmont region in Albemarle County, northeast of Faber, zinc occurs in a vein, parallel and adjacent to a diorite dike, in metamorphosed crystalline schists of undetermined but probably Cambrian or post-Cambrian age. The ore consists of blende associated with galena in a gangue of quartz and fluorspar. The separation of blende from fluorspar, and of the zinc and lead from each other, is accomplished in an 80-ton mill.

TENNESSEE.

The zinc deposits of East Tennessee lie geographically and geologically in the extension of the southwestern Virginia zone. The same limestone carries the same types of ore in similar occurrences

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[a] Drinker, H. S., Mines and works of Lehigh Zinc Company: Trans. Am. Inst. Min. Eng., vol. 1, 1871–1873, p. 67–75.

[b] Watson, T. R., Lead and zinc deposits: Bull. Geol. Survey Virginia No. 1.

as far southwest as Knoxville. Thus smithsonite and calamine in superficial portions, and blende below in a gangue of dolomite and calcite, occur in breccias along strong lines of deformation in the Cambro-Ordovician limestone. Zinc has been found in Bradley, Claiborne, Jefferson, Knox, and Union counties. The Mossy Creek deposit at Jefferson City, Jefferson County, has been the chief producer; in 1905 two other properties, one in Jefferson and the other in Bradley County, produced. Last year there was considerable development.

KENTUCKY.[a]

In the western portion of the State in Crittenden, Livingston, Caldwell, and the adjacent portions of Christian, Trigg, and Lyon counties, a considerable fluorite industry has been developed, and in connection therewith zinc deposits are mined; more than 175 properties have been worked. Some excellent deposits of smithsonite and sphalerite ores have been found. Sphalerite occurs sparingly, filling fissures and replacing cement in breccias, but, principally below the groundwater level, replacing limestone country rock. The success of the zinc industry in this region lies in satisfactorily concentrating and separating the fluorite-zinc lead ores, the outcome of a considerable amount of experimenting which is now going on promising to be favorable. The Sanders Ore Separating Company at Marion, Ky.,, has perfected a flotation process for treating fluorite-blende ores, in which a sulphate of alumina, containing an excess of Al_2O_3, is successfully employed for floating the blende. In this way the company, making a concentrate containing 58 to 60 per cent zinc with a practical elimination of the fluorite when it does not exceed 40 to 50 per cent, has produced at the small mill equipped with 3 tables and 1 flotation tank, 130,000 pounds of zinc sulphides, and 85,000 pounds of lead. Two mills in which this process will be used have just been built, one for the Southern Lead and Zinc Company, of Marion, the other for the Northern Mining Company, of Elizabethtown, Ill.

MISSISSIPPI VALLEY STATES.

The zinc industry in the valley, including mining and reduction, has enjoyed marked prosperity. As to resources, the larger camps have maintained their previous records; a number of newer districts have developed strongly, and the known productive ground has been significantly extended both in depth and area. In reduction the relative growth has been even greater, as while the improvements in methods of concentration are restricted and are in proportion to local development, the largely increased smelter capacity of plants located in this region has kept pace with foreign as well as local growth. This later development has been furthered by the discovery of important new resources of natural gas.

In 1906 the following States, including Arkansas, Illinois, Iowa, Kansas, Kentucky, Missouri, Tennessee, and Wisconsin, contributed 125,224 tons of zinc-smelting ores, and 82,880 tons of zinc concentrates, which together yielded 148,050 tons, or 74 per cent, of the

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[a] Ulrich, E. O., and Smith, W. S. T., Lead, zinc, and fluorite deposits of western Kentucky: Professional Paper U. S. Geol. Survey No. 36, 1905.

spelter made from United States ores, while 188,580 tons, or over 83 per cent, of all spelter produced in 1906 in the United States was made in the Mississippi Valley.

MISSOURI.

Last year Missouri again far outdistanced all others in the production of zinc ore.

It afforded (according to actual smelter returns) 111,639 tons of smelting ore and 151,141 tons of concentrates, which together yielded 130,348 tons, or 65.27 per cent of the total spelter derived from United States ore. A large additional output of zinc ore, which went into zinc oxide, and a smaller quantity used in making acid, greatly increased the total production of zinc ores for this State.

This product (except a small quantity of zinc ores from southeast Missouri) was mined in the district known variously as the Missouri-Kansas, the Joplin, or the southwest Missouri district. It lies mainly in southwest Missouri, and includes on the west a considerable area in southeastern Kansas and on the south the northwestern portion of Arkansas and the northeastern section of Indian Territory, respectively.

The quantity and value of the zinc ore produced in 1905–6 by each camp in this district is given in the following table. The figures are from local sources, those for 1906 being compiled by Mr. Jesse A. Zook, of Joplin:

Zinc-ore shipments from the Missouri-Kansas district, in short tons.

	1906.		1905.	
	Quantity.	Value.	Quantity.	Value.
Joplin	68,744	$3,112,483	70,481	$3,404,980
Webb-Carterville	64,172	2,842,437	64,047	2,877,855
Galena-Empire [a]	29,053	1,226,591	21,113	948,820
Duenweg	17,984	793,500	15,300	954,760
Aurora	15,147	539,118	17,666	616,790
Badger [a]	14,100	642,299	8,892	421,400
Alba	14,021	650,874	18,048 (Alba and Neck City)	864,985 (Alba and Neck City)
Neck City	11,249	523,062		
Granby	10,895	341,120	10,974	306,940
Oronogo	8,768	382,558	6,831	322,230
Beef Branch	5,691 (Beef Branch and Spring City-Spurgeon)	190,663 (Beef Branch and Spring City-Spurgeon)	1,635	37,665
Spring City-Spurgeon			2,723	89,165
Prosperity	4,498	195,876	....	....
Carthage	3,575	172,173	5,704	272,485
Baxter Springs [b]	3,242	124,528	2,670	103,480
Mitchell	2,306 (Mitchell and Sherwood)	106,186 (Mitchell and Sherwood)	1,996	94,155
Sherwood			....	....
Zincite	1,592	71,558	2,150	100,405
Stotts City	1,161	51,638	579	33,325
Cave Springs	1,151 (Cave Springs and Central City)	49,841 (Cave Springs and Central City)	63	2,700
Central City			1,167	51,850
Wentworth	368	16,359	....	....
Springfield	324	14,672	....	....
Sarcoxie	230	9,315	....	....
Reeds	87	4,157	694	31,040
Playter [a]	80	3,195	....	....
Carl Junction	46	2,119	62	3,100
Diamond	44	1,824	425	19,665
Miscellaneous [c]	185	5,959	673	27,175
Total	278,713	12,074,105	253,893	11,584,970

[a] Kansas.
[b] The ore credited to Baxter Springs, Kans., was derived from Quapaw Reservation, Ind. T.
[c] Includes output from Morgan County, Mo., Mansfield, Mo., and Harrison and Zinc, Ark.

The ores occur in a calcareous country rock of the Carboniferous age (Boone formation), either as breccia deposits ("runs") or as bedded deposits ("sheets").[a] The former are richer, but are limited and more irregular. The latter are lower grade, but are extensive and more persistent. The ores are made up chiefly of sphalerite, with minor quantities of galena (also, above water level, small portions of smithsonite, calamine, and cerussite), together with pyrite and marcasite, in a gangue of calcite and quartz. "Dirt should contain 5 per cent blende in order to make a mine pay under the present average conditions, though under specially favorable circumstances 3 per cent has yielded handsome profits."[b] Development is shallow, averaging somewhat less than 150 feet in depth, and mining and milling developments have until recently been conducted on a comparatively small and conservative basis. This district is most favorably situated to secure low reduction and shipping rates, being immediately adjacent to the natural-gas fields of Kansas on the west and the Indian Territory on the south. The zinc ores mined in this State are smelted at works in the following States, given in the order of the quantities treated: Kansas, Illinois, West Virginia, Missouri, and Wisconsin.

The increased production in 1906 was the result of several factors, primarily strong demand and high prices; secondarily, the development of new ore bodies, improvement in milling practice, a significant increase in mill capacity, and an extension of utilization of natural gas.

The expansion of productive ground in Missouri has been by proving extensive "sheet" deposits, especially in the Webb City, Oronogo, and Carterville area; by discovering "sheet" deposits at greater depths than hitherto known, and by making a new deep record at Aurora by finding ore at 300 feet. Drilling has located many other new bodies, including important discoveries south and southeast of Joplin, in the Granby area. These newly proved deeper deposits have not been sufficiently explored as yet to determine their extent or richness. The main increases in production were by Alba-Neck City, which supplied about two-thirds of the total amount of gain in mining in Missouri, and by Oronogo, which contributed about one-sixth of that increase. Webb City and Carterville, in which the largest extension of productive ground was made, a little more than held their own, and Joplin fell off 1,740 tons.

These important discoveries and reserves have led to a notable increase in capacity and number of mills. Thus while a 100-ton mill was only recently regarded as the limit of capacity, now mills of 200 to 300 tons capacity are not uncommon, and the American Zinc, Lead and Smelting Company has four new 600-ton mills and the Underwriters' Land Company is operating a mill of 1,000 tons capacity (reported to be largest single zinc mill in the world), equipped with the most complete labor-saving devices, and according to best modern milling practice. Larger, heavier, and improved milling machinery is being generally adopted. As a direct result of these milling improvements, a gain of from 5 to 7 per cent in extraction is reported.

These factors, together with increased utilization of natural gas, have brought about a significant decrease in cost. On the other hand, this gain has been nearly balanced by a considerable rise in the

[a] Smith, W. S. T., and Siebenthal, C. E., Description of the Joplin district: Geologic Atlas U. S., folio 148, U. S. Geol. Survey, 1907.

[b] Guengerich, C., Zinc industry of the Joplin district, Mines and Minerals, December, 1906.

cost of labor and of certain supplies. Thus "drill runners" now receive \$3 per eight hours, muckers \$2.50 per eight hours, jig men \$3.50 to \$4 for ten hours, and surface laborers \$2.50 for ten hours.

In general, the large reserves of workable ore and the improved milling conditions favor a splendid future for this district and leave, as the most needed improvement, the increased use of automatic and labor-saving devices.

KANSAS.

The position in the zinc industry occupied by this State depends on its smelting rather than on its mining activities. Thus the presence of usable supplies of natural gas and the geographic position of the State combine to make it the leading zinc-smelting State. In 1906 nearly 58 per cent of all spelter made in this country was produced by smelters located in Kansas, and of the 20,921 tons increase of production of spelter in this country in 1906 over 1905, 15,277 tons, or 73 per cent of the entire increase of zinc, was produced by Kansas smelters, while zinc ores produced by Kansas mines, as reported by smelters, amounted to 14,424 tons of concentrates, which yielded 3,902 tons of spelter.

Kansas has participated to a large degree in the general prosperity of the Missouri-Kansas district. Of the total increase in the production of zinc ore in the Missouri-Kansas district in 1906 a large quantity was contributed by Kansas, and the greater part of this was derived from the Galena district, which is situated a few miles west of Joplin.

ARKANSAS

The production of zinc ore from this State last year was greater than during any previous year. The total reported by smelters shows 4,157 tons, which yielded 1,801 tons of spelter. Twenty properties alone shipped a total of 2,254 tons, as against 2,205 in 1905 and 2,090 in 1904.[a]

In the northwestern counties—Marion, Boone, Searcy, Newton, and Baxter—especially in the first two, mining development has been active. Good bodies are reported to have been developed at depths from 60 to 160 feet, which yield a good grade of concentrates. Over 25 mills have now been erected, of capacities ranging from 40 to 200 tons per day—averaging 100 tons. Hitherto the ore output from this section has been hauled by team 90 miles to Springfield, Mo. In January the White River branch of the Iron Mountain division of the Missouri Pacific Railway was completed from Aurora, Mo., to Newport, Ark. This extends through the Sugar Orchard district and within 8 miles of the Dodd City district and 5 to 10 miles of the Rush Creek district, and arrangements for building a branch line to these and other points are said to be on foot at the present time.

OKLAHOMA (INDIAN TERRITORY).

The rapid development of the Kansas area from Galena on the north to Baxter Springs on the south has encouraged exploration in the southern extension of that area, in the northeastern portion of Indian Territory.

[a] Personal communication, by courtesy of the Missouri Pacific Railway, of totals compiled by R. W. Willett.

In the Quapaw district some good bodies of high-grade zinc ore are reported.

Immediately south and southwest drilling is being carried on to excellent advantage. Ore from the vicinity of Miami, showing massive sphalerite, with some galena, is stated to have been found in considerable quantities.

The Lanyon-Starr smelter at Bartlesville was started in February, and it is probable that the new resources of natural gas in this region, together with the discoveries of the above-mentioned ore bodies in the southern extension of the zinc-producing ground, will lead to the erection of several other smelters in the near future.

ILLINOIS.

The production of 672 tons of smelting ore, yielding 282 tons of spelter, was derived chiefly from Jo Daviess County, in the northwest corner of the State. A relatively small portion was afforded by Pope County, in southern Illinois, adjoining the Kentucky district. While the northern district has enjoyed the general mining development and prosperity of the Wisconsin field, the chief progress of the industry in this State has been in smelting. The extensive and efficient spelter and oxide plant of the Mineral Point Zinc Company at Depue started operations early in the year, and probably the plant of the Hegeler Brothers at Danville, though not yet running, will be started during the current year. The production of spelter by the Illinois zinc plant, including the plants at La Salle and Peru, in La Salle County; at Depue, in Bureau County, and at Sandoval, in Marion County, amounted to 47,939 tons, or about 21 per cent of the spelter made in the United States, thus giving the State second rank.

IOWA.

This State afforded 670 tons of concentrates, which yielded 201 tons of spelter. The mining operations were confined to the area in the eastern part of the State adjacent to the southwest Wisconsin field and are chiefly restricted to smithsonite ores.

WISCONSIN.

The zinc industry in the southwest part of this State has been developed within the last few years into a profitable business. Ore deposits, principally of lead, were recognized before 1867 and worked in various epochs, especially during the period of the civil war.

The surface-oxidized portions of bodies of zinc ore were early worked down to water level and practically exhausted. In the sulphide ores the difficulty in separating the sphalerite from its gangue of iron sulphide discouraged further mining, and the zinc industry lay dormant until the recent rise in prices and improvements in treatment.

In 1906, in an area including portions of Grant, Iowa, and Lafayette counties, excluding adjoining portions of this district in northwestern Illinois and eastern Iowa, measuring about 50 miles across, 14 camps yielded a large production of zinc ores, and a considerable number of other mines in these and other camps promise to produce.

The production of some of the larger camps for the early months in the current year is reported to have been about double that of corresponding months last year.

Smelter reports to the Survey credit Wisconsin with producing in 1906 15,509 tons of concentrates and 8,622 tons of smelting ores, the total of 24,131 tons yielding 11,057 tons, or 4.9 per cent of all the spelter from domestic ores, thus making the State rank fourth. For purposes of showing distribution, a newspaper which gives the State a much larger production is quoted as follows:

Production of zinc ores in Wisconsin in 1906.[a]

	Pounds.		Pounds.
Platteville	17, 817, 820	Livingston	2, 767, 910
Cuba City	10, 249, 891	Dodgeville	1, 317, 060
Linden	9, 353, 100	Mifflin	1, 014, 740
Hazel Green	8, 032, 820	Shullsburg	956, 500
Highland	8, 008, 040	Potosi	485, 600
Mineral Point	7, 008, 720	Montfort	85, 000
Benton	6, 176, 830		
Rewey	2, 768, 880	Total	76, 042, 911

The ore deposits in this district are found in all formations from Niagara (dolomite Silurian) to Cambrian sandstone. The productive bodies are confined to all divisions of the galena dolomite, particularly to the basal members, and to the highest divisions of the Platteville limestone.[b] They occur as veins in cracks in country rock and are known as (1) crevices and openings, (2) honeycomb or sprangle runs, (3) pitches and flats, and (4) disseminated deposits.[c] The ores are made up of sphalerite, which forms the main source of zinc, smithsonite (mainly above water level used solely for oxide), and hydrozincite, galena, cerussite, and anglesite in a gangue of marcasite and pyrite, calcite, dolomite, and barite.

The intimate association of the marcasite ("mundic") with the sphalerite could not be overcome sufficiently to secure a commercially satisfactory separation, the best jig products running only 20 to 50 per cent and 20 to 75 per cent mundic. By a preliminary roast, the iron sulphide becomes sufficiently magnetized to be separated by regular magnetic processes, so as to leave a 54 to 58 per cent zinc product. This fact, together with low mining and treatment costs, low wages, and ample railroad facilities by branches of four great systems, has resulted in almost doubling the industry in this district during the last year. In the winter and spring of 1906 it is reliably stated that 300 to 400 churn drills were in operation here, and as a result of discoveries, a large number of leases were made, over one hundred mines worked, and many valuable new ore bodies developed. At the close of the year about 60 mills were running, and it was estimated that within a year 50 more would be in operation. An electric road 60 miles in length to serve the principal camps has been projected, and it is understood that a new smelter for treating the ores from these camps will be erected, probably at Galena, Ill. The output of sulphide ores is at present bought by 5 smelters for manufacturing the spelter. The oxidized ores are used in making

[a] Lewis, J. H., Daily Mining Record, Denver, March 20, 1907.
[b] Grant, U. S., and Burchard, E. F., Description of Lancaster-Mineral Point district, Geologic Atlas U. S., folio 145, U. S. Geol. Survey, 1905.
[c] Bain, H. F., Zinc and lead deposits of the upper Mississippi Valley, Bull. U. S. Geol. Survey No. 294, 1907, p. 53.

zinc oxide, and the iron sulphide is used for the manufacture of sulphuric acid.

WESTERN STATES.

GENERAL STATEMENT.

In 1906 the Western States contributed for the manufacture of spelter (according to direct returns from smelters) 50,602 tons of zinc concentrates, and 81,910 tons of smelting ore, a total of 132,512 tons of zinc ore, which yielded 39,295 tons, or 19.67 per cent of all spelter made in this country from United States ores. An estimate of total zinc contents of all zinc ores mined in the West in 1906, based on total tonnage of ores mined and assay contents of zinc as reported by individual mines, including, in addition to those utilized for spelter, those used for zinc oxide, for acid, and for export, gives 21,949 tons more, or a total of 61,236 tons of zinc. This rapid increase in output has naturally far outstripped the capacity of local mills, smelters, and transportation facilities. Thus, a sufficient number of cars for moving ores could not be obtained, while local mills and smelters found themselves more than once unable to handle the supplies of ore offered. During the late fall a shortage of fuel threatened serious losses, notably in the northern Great Basin region.

The most important ore resources developed were in Colorado and New Mexico, though valuable bodies were opened in Utah, Idaho, Nevada, Arizona, and a first shipment was made by California.

Concentration of ores used in making spelter is required in about the same degree for western and for valley ores; 62 per cent of those derived from the West required concentration, and 67 per cent of those mined in the Mississippi Valley.

The complex character of the western ores, carrying three or four and sometimes more, desirable metals, renders most difficult their satisfactory concentration and separation. Considerable progress in improvement and adaptation of various methods has been made, however, and a number of mills have been erected.

In general, the best results appear to have been obtained by hand sorting and wet concentration, supplemented by either magnetic or electrostatic separation. The sorting is much facilitated by use of a belt conveyor. Concentration by the usual jigging and table methods eliminates silica, and yields a lead concentrate commonly containing the bulk of the gold and silver, and a zinc middling holding the iron with varying amounts of gold and silver.

The separation of the zinc from the associated iron sulphides is in several cases satisfactorily effected by magnetic separation with Wetherill machines, in some cases by the International, German, Ding, etc., magnetic machines, and in other cases by electrostatic machines, most commonly the Blake-Morscher, while on certain ores both the Wetherill and Blake-Morscher are employed. Various processes, including dry milling and flotation, and special devices and improvements were tested, and, as will be noted under the respective States, gave promising results.

Of the 39,287 tons of spelter obtained from western ores, only 15.93 per cent was made in the West, nearly all the remainder being treated at the smelters in the natural-gas region of Kansas. The higher cost of fuel in the West in comparison with the cost of cheap gas in Kansas and Indian Territory, and of labor as compared with wages in Europe, has naturally retarded the progress of zinc smelting in the West. The higher smelting costs in the West, even with transportation charges added, are largely responsible for the great shipments to the East and for the considerable exportation of Western zinc ores. The intimate association of so many desirable metals has also offered serious difficulties in the way of western zinc smelting. Still another difficulty has been to secure a smelter process which will give satisfactory results. Considerable improvements in the zinc smelter plants of Colorado were made and the erection of a new one is announced.

COLORADO.

The zinc industry in Colorado in 1906 continued its wide and profitable expansion, exceeding all records. The production for use in spelter, according to returns from smelters, was 43,754 tons of zinc concentrates, 65,379 tons of smelting ore, together with 109,133 tons of ore, which yielded 32,456 tons, or 16.25 per cent of the spelter made in this country from United States ores. Thus Colorado ranks second, being surpassed in domestic production by Missouri alone. In addition to this considerable quantities of zinc ores were used in making lead-zinc white, zinc oxide, and acid, and for export. The production far exceeded that of all other Western States combined. General conditions have been favorable, but car shortages, especially at Leadville, and insufficient smelter capacity served to reduce the total production.

A number of bodies of zinc ore in active mines were developed, and several old mines that had been abandoned on account of the zincky character of the ores were opened. The developments have been so numerous and so extensive that they can not be specified here. The large replacement ore bodies in the limestones at Leadville afforded the bulk of the State's output, the totals from this camp alone exceeding those of all other western camps. In Summit County large quantities of zinc ore of smelting and concentrating grade have been opened at Breckenridge, and developments have been successful at Kokomo. Important developments were also made at Georgetown, Rico, Creede, Silverton, Redcliffe, and Montezuma.

The leading problem in Colorado has been not to find zinc ores, for there are an abundance of them known, and some of them very high grade, but to secure adequate treatment.

The active investigation of various methods of treating these complex ores, which was carried on throughout the mining areas of this State in 1906, showed many results in the form of improved equipments to old mills and in the erection of many new ones. Thus six mills are now running on Leadville ore and others are building, while numerous additions (as that of the 100-ton unit to the Western Mining Company's plant) are being made. Several small mills are now stated to be running at Georgetown.

For the Colorado ores electrostatic treatment with Blake-Morscher machines is proving satisfactory, especially for weakly magnetic ores, while in several cases the magnetic separation with Wetherill machines is adequate. At the new Wilfley mill at Kokomo a special roaster is used to prepare the ores for treatment by Dings magnetic separator. At Rico the United Rico Mines Company has been strongly reorganized, and after proving extensive bodies of zinc ores, and conducting experiments on treatment of the same, is now erecting a mill in which the Stallman-Germer flotation process is to be used. In smelting the great development of zinc resources in this State and elsewhere in the West has opened a larger field than the single spelter plant in this State—the United States Zinc Company's at Pueblo—can fill. Accordingly, despite the fact that this locality is less favored for fuel and labor than the others, the zinc spelter industry is growing. During the year additions were made to the Pueblo spelter plant and to the plant of the United States Smelting Company at Canyon, and at date of writing the announcement is made that the Tri-Bullion Smelting and Development Company has decided to erect a large oxide plant at Canyon.

NEW MEXICO.

The production in New Mexico in 1906 was chiefly by the two great zinc mines of the State, the Kelly and the Graphic, in the Magdalena Mountains, Socorro County, owned and operated by the Tri-Bullion Smelting and Development Company and the Ozark Mining and Smelting Company, respectively. The ores are mainly restricted to limestones adjacent to igneous masses and appear to be of contact-metamorphic origin. The carbonate ores pass in depth into bodies of sulphide ores. This demand for the New Mexico ores was strengthened by the successful outcome of experiments by the Ozark Mining and Smelting Company (affiliated with the Sherwin-Williams Paint Company) in making pigments directly from mixed zinc-lead ores without preliminary separation, which resulted in the erection in February, 1907, of a plant for this purpose at Coffeyville, Kans. The larger portion of the ores found in this State are used in the manufacture of pigment. Considerable quantities of second-class sulphide ore are shipped to Germany, and a relatively minor portion goes to Kansas, Missouri, and Colorado for spelter. From this fact it may be readily understood that the smelter returns alone necessarily give a most incomplete indication of the zinc industry of the Territory. (Supplementary data shows that they are somewhat too low.) In this instance the mine returns afford the most complete index. The outlook for the continuance of the great and successful development of the zinc industry in New Mexico is most promising.

UTAH.

The production of zinc in Utah in 1906 almost doubled that of the preceding record year. It was contributed chiefly by the Daly-Judge and Daly-West mines at Park City, the former affording a large percentage of crude sulphide ores, and by the Scranton mine at North Tintic, which shipped a high-grade smelting ore, largely carbonate. Considerable work was done on newly opened deposits in the Star district, Beaver County. Beyond experimental tests, little was accomplished toward the utilization of the fissure zinc ore at Bingham, nor the known reserves of the Horn silver mine.

In concentration important progress was made at the 50-ton plant of the Western Ore Separating Company erected late in September, 1905, at Salt Lake City. Ores and concentrates carrying at least 20 per cent zinc were treated by the Blake-Morscher machines, and 45 to 50 per cent zinc product and iron product made, the former being shipped to Iola, Kans., and the latter sold to local smelters. Valuable improvements were made on the separator, and thoroughly successful experiments with the Elmore vacuum oil process were conducted. It is stated, however, that freight charges were prohibitive, and the plant was shut down near the end of the year 1906. In the Peck mill near Milford, some test runs on the zinc dump of the Horn silver mine were carried on, but no shipments were made during the year. At the May Day mine, the old mill was refitted for treating the zinc ores of that property by dry process. The outcome is unknown.

For smelting, about one-third of the zinc product went to Colorado, and the remainder to the smelters in the Kansas gas region.

With the extensive deposits of both carbonate and sulphide known in the region tributary to Salt Lake, it would seem improbable that this promising zinc field can be left undeveloped much longer.

IDAHO.

The zinc content of the lead ores in the great mines of the Coeur d'Alene formerly caused a considerable inconvenience, but as the bodies have been followed to greater depths, the zinc, it is reliably stated, has decreased until at present it is negligible, not being high enough to interfere and too low to save. In certain outlying properties, however, the zinc is sufficiently high to warrant mining for it alone. Thus, the Success Mining Company conducted successful underground exploration of its property, the old Granite mine in Ninemile Canyon, 4½ miles west of Wallace, demonstrating valuable zinc-lead ore shoots, and started up, in October, 1906, a new enlarged mill of 150 tons capacity, equipped with jigs, tables, screens, and settling tanks. The ordinary wet methods are stated to have yielded a 45 to 50 per cent zinc product, and a 55 to 60 per cent lead product, with 40 to 45 ounces of silver; this was shipped east for smelting, and constituted the principal output from the State. The old Frisco mine, at Gem, which was closed down some years ago owing to the zincky character of ores and to water, was reopened and a mill equipped to treat 450 tons of ore a day by the usual methods, supplemented by the Ding magnetic separators. It was expected to be running early in 1907, and to yield a 40 to 42 per cent zinc and 45 per cent lead product. The ore of the Hercules mine carries zinc, and a shipment of hand-sorted material was made. Considerable work has been done in developing the prospects in Upper Pine Creek, south of Kellogg. These ores carry about 30 per cent zinc. The Federal Company, operating the Douglas mine, made a shipment for treatment tests, as did the Highland Chief, Nabob, Surprise, and other properties.

In the Wood River district of southern Idaho one important shipment of the previous year was closed, but another was in active operation, shipping, as usual, until the small mill was closed for improvements. Still other exploration was conducted on other properties.

MONTANA.

The production of zinc by Montana in 1906, the second year it was engaged in this industry, was more than double that of 1905. This increase was in spite of the entire destruction in July, 1906, of the concentrating plant at Butte, owned and operated by the Montana Zinc Company, the largest interest in this industry in the State.

This loss precipitated unfortunate financial difficulties, which, however, were satisfactorily settled in November. It was then planned to reorganize as the Butte Copper and Zinc Company and to erect a new mill of latest pattern to treat the zinc ores of its properties, including the Emma and Zeremia claims, by the electrostatic process with Blake-Morscher machines. It was expected that the plant would be in operation by September, 1907.

The ores of the Lexington, the Alice, and other properties in the vicinity of Butte carry high zinc values, and it is reported that plans are on foot for extracting them. Various attempts have been made to save the zinc in ores from several small camps in the State, but, so far as learned, they have not as yet proved successful.

NEVADA.

In 1906 the zinc production of this State more than quadrupled that of the preceding year. The chief producer was the Potosi mine, in Lincoln County, and new producers were added. At the Nevada Commonwealth Mining and Milling Company's plant, in Washoe County, a mill of 150 tons capacity began operation early in 1907 for treating the complex zinc-lead ores of that property. The ores of this State were smelted in Kansas and Colorado.

ARIZONA.

No ore shipments were reported from this State last year, the ores for the spelter credited being mined and shipped in 1905, but smelted and settled for in 1906. Nevertheless, several properties are said to have developed large bodies of zinc ores and to be planning for treatment of the same, so that it is not improbable that the current year will witness Arizona's largest zinc production.

CALIFORNIA.

California's history as a zinc producer began in 1906. Zinc deposits were developed in Orange, Shasta, Mariposa, and San Bernardino counties, and shipments were made from the Silverado mine (Orange County), operated by the Western Zinc Company. A mixed ore carrying sphalerite and pyrite is concentrated at the mine, and the product is used for the manufacture of chemicals at San Francisco. The zinc-bearing copper sulphide ores at the Afterthought mine, in Shasta County, were treated experimentally for making zinc oxide, and methods of treatment to save the zinc values in those at the Bully Hill mine were considered.

FOREIGN.

BRITISH COLUMBIA.

In 1906 102 tons of concentrates and 348 tons of smelting ore were imported from Canada for smelting in this country, and yielded, according to direct returns from smelters, 201 tons of spelter. Returns from all the smelters in Canada state that no zinc ores from the United States were smelted in Canada; 654 tons of zinc are reported to have been made in that country.

The possibilities presented by the zinc mines of British Columbia led to the appointment of a commission of experts in the main branches of the zinc industry, under the general direction of the Dominion superintendent of mines, to examine the zinc mines and prospects of British Columbia and to investigate the treatment and marketing of their ores.

As a result of these investigations it appears that considerable deposits of sulphide zinc ores of commercial grade have been opened in Ainsworth, Slocan, East Kootenai, and Nelson, while others have been prospected in the Clayoquot division of Vancouver Island, Texada Island, in the New Westminster district of the main coast, and in Similkameen, Kamloops, Kettle River, Revelstoke, Arrow Lake, Illecillewaet, Lardeau, Steele, and Golden districts in the interior of British Columbia.

The largest developments were found in Slocan and Ainsworth, and believed to afford an annual output of 15,000 and 16,000 tons of 50 per cent grade. The low-grade ores were found to yield best results when concentrated by magnetic processes, and local smelting was recommended.

A zinc smelter was completed at Frank, Alberta, in a region conveniently located with reference to extensive coal fields. In treating a shipment of zinc ores from the Slocan district, defects in the apparatus were developed, and it is understood that this plant has since remained closed. A smelting plant of 10 tons total capacity for treating zinc ores by the electrothermal process is being erected at Nelson. Although the ore and enterprise to develop the same appear sufficient, the future of the zinc industry in Canada will probably depend largely on the United States tariff on zinc imports and on the perfection of local concentration and smelting practice.

MEXICO.

The demand for zinc ores by the United States in excess of the domestic supply, especially for the extremely desirable oxidized ores, have led to wide and successful exploration and exploitation of extensive zinc deposits in Mexico. Regular shipments are made from camps in the States of Nuevo-Leon, Coahuila, and Chihuahua, and deposits are being opened elsewhere as far south as Guererro.

Shipments of zinc ores from Mexico treated in the United States (Missouri, Kansas, and Colorado) in 1906 amounted to 2,583 tons of concentrates and 84,069 tons of crude ore, together 86,652 tons, which yielded 24,875 tons of spelter. Most of these were carbonate ores, though some were mixed, and in depths will doubtless develop into sulphide ores. The erection of a zinc smelter in Chihuahua is considered, but the lack of suitable fuel supply is a serious difficulty; the erection of one at Laredo, Tex., and of another at Osceola, Okla. (Ind. T.), in the natural-gas fields, is also reported.

Under the present freight charges costs of shipping and treating in Kansas are slightly less than for those abroad. Several mills have been erected and others are in process of construction. The American Smelters Securities Company has equipped the mills at its mines at Velardeña, Durango, and at its Tecolotes mine at Santa Barbara, with magnetic separators. A concentrating plant at the Tiro General, Charcas, San Luis Potosi, has been equipped with Sutton-Steele dry tables and with Sutton-Steele dielectric separators.

AUSTRALIA.

The greatest development of zinc resources and of concentration of zinc ores during the year has been in Australia in the Broken Hill district. Enormous accumulations of zinciferous tailings, after lying idle for years, are attracting investors. In view of the rising price of spelter much investigation of concentration has been carried on, several flotation processes, besides magnetic, being tried. As a result a number of large mills of great capacity are in various stages of construction and zinc smelting to provide spelter for local consumption is planned. Several large smelters are being built in Europe to treat the anticipated production of zinc concentrates. Other things being equal, this Australian output is expected to exert considerable influence upon the price of zinc in the near future.

EUROPE.

In Europe, Belgium and Silesia continue to be the largest producers. Large Norwegian deposits near Christiania are to be worked by a German company. In Russia calamine was mined as usual and treated at the smelting works at Bendin, Constantine, and Pauline. Turkey also entered as a new producer of zinc.

ASIA.

In Japan a company has been organized to conduct zinc-smelting business in answer to local demand.

AFRICA.

In Africa the Djebel Ouasta mine in Constantine, Department of Algeria, has worked its large deposit, while in mid-Africa, in Rhodesia, zinc deposits were opened and a trial shipment of zinc ore from Beira to Swansea, Wales, was made.

REDUCTION.

CONCENTRATION AND SEPARATION.

In the entire field of zinc manufacture no single factor has contributed as much toward the expansion of the zinc industry as improvements in concentration and separation. Great activity has been manifested along these lines in recent years, and the year 1906 witnessed the successful outcome of several important investigations and the actual application of results, especially in America and in Australia.

In this country considerable progress has been made in the adoption of magnetic electrostatic and flotation processes. Noteworthy is the success in treating low-grade lead ores in Wisconsin by magnetic separation, most frequently with the Cleveland-Knowles machine, following preliminary roasting in a special roaster, usually of the Galena type, a concentrate averaging 58 per cent zinc being secured. Success has also been attained in Colorado by the adoption of Wetherill separators.

In electrostatic separation improvements were made on the Blake-Morscher machine, and it was found to meet the requirements of the complex ores of Leadville and other camps in Colorado, and also of the Great Basin ores at the Salt Lake plant. Sutton-Steele dry tables and dielectric separators have been installed at Charcas, San Luis Potosi, Mexico. A flotation process for separating fluorite-blende ores has been developed with great success by the Sanders Zinc Separating Company at Marion, Ky. A dilute solution of sulphate of alumina, containing an excess of Al_2O_3, is employed for floating the blende, and a 59 per cent zinc product obtained. Critical experiments with the Elmore process were successfully carried on at the Lanyon mill, Salt Lake City, Utah. At Rico, Colo., following a series of experiments, a plant is being erected in which the Stallman-Germer flotation process will be used. In southwest Missouri concentration is largely employed. Progress in milling was not particularly in the adopting of new processes, but in the enlargement of plants, the erection of large mills, equipment with latest and best machinery, and the general refinement of mill practice. In Australia extensive experiments in separating these zinc and lead sulphides have been watched with deepest interest by all concerned in this difficult problem. Besides the usual methods of magnetic separation, a number of special flotation processes were developed. The Delprat and Potter processes, the former using salt cake and the latter free acid, were most extensively adopted. The Delprat is reported to be successfully treating 4,500 tons of tailings weekly at the Proprietary mine, while the Potter, which was the original flotation process, has recently been replaced in the operations of the Zinc Corporation by the Cattemole process, which uses oil as the flotation medium and is a modification of the original Elmore process. In another the De Baray process is used as the flotation medium. It is stated that the acid systems yield 40 to 42 per cent zinc concentrates, and the Cattemole oil process 43 to 45 per cent. As a result of these experiments active operations in the zinc industry were undertaken. The Broken Hill Proprietary, reported to own a dump containing over 2,500,000 tons of zincky tailings, erected an extensive plant, and a body of Australian and English capitalists, incorporating as the Zinc Corporation, secured dumps of zinc tailings carrying 17 to 19 per cent zinc reported to amount to 1,275,000 tons and roughly estimated to contain 900,000 tons of zinc, 350,000 tons of lead, and 22,000,000 ounces of silver.

SMELTING.

The favorable market for zinc, leading to increased ore shipments, also the profitable margin between the price of zinc in ore and in spelter, served greatly to stimulate the zinc-smelting business. One extensive new plant has started operations, several new smelters are being erected, others are planned, and the capacities of old plants are being increased.

The growth has been general rather than limited to any locality or department, although considerable outlays for equipment were made to meet the growing demand for zinc oxide, as well as for treating the rapidly increasing output from the far West and Mexico.

An extensive plant for making both zinc oxide and spelter was erected by the Mineral Point Zinc Company at Depue, Ill. In March, 1907, two blocks of the new plant at Dearing, Kans., were fired up, and at present all four blocks of 600 retorts each are in full operation. This plant, together with the older one at Caney, Kans., owned by the Caney Zinc Company, was purchased in January, 1906, by the newly organized American Zinc, Lead, and Smelting Company.

In the selection of sites for new smelters the threatened exhaustion of the gas supply in the Kansas field led builders to look elsewhere. Reliable information has been received, however, that a new supply of gas has recently been struck in Kansas, which promises greatly to extend the smelting life of that section. Before this discovery, however, the indications for gas supply in Indian Territory, together with the recent ore developments in the region south from the southwest Missouri lead-zinc fields in Arkansas and Oklahoma (Indian Territory), appear to have attracted builders. Thus the new Lanyon Starr smelter, located at Bartlesville, Ind. T., was completed in 1906, and reported to be fired up in February, 1907. This was originally planned for four blocks, with capacity of 450 tons of ore a week, and an extension of two blocks, giving a capacity of 600–750 tons. The National Zinc Company is stated to have secured a 10,000-acre tract of gas-producing land in Indian Territory and to have broken ground for a zinc-smelting plant of 500 tons daily capacity. The Hegeler Brothers report that the works which they are constructing at Danville, Ill., are not yet completed, but they are expected to start up in 1907. A concentrator is now being constructed by the United Rico Mines Company at Rico, Colo., in the expectation of treating zinc ores on a large scale, and the United States Smelting Company is considerably increasing the capacity of its Pueblo plant. The Wallace Ore Reduction Company is stated to be planning the erection of a large zinc smelter at Denver, Colo. The necessary addition for treating zinc ores is being made at the new Heinze-Coram smelter at Basin, Mont., and the erection of several other smelters is understood to be contemplated.

In addition to the new furnaces with 1,600 retorts fired up at the new Depue plant of the Mineral Point Company and the 2,400 retorts started up by the American Zinc, Lead, and Smelting Company at its new Dearing plant, the capacity of other smelters has been significantly increased. Among the more important enlargements was that by the Cockerill Zinc Company to its Pittsburg, Kans., plant of three blocks of furnaces, a total of 672 retorts; by the Matthiesson and Hegeler Zinc Company to its plant at La Salle, Ill., of 300 retorts; by the Caney Zinc Company (American Zinc, Lead, and Smelting Company) to its Caney plant, one furnace of 300 retorts; by the Sandoval Zinc Company at Sandoval, Ill., two furnaces; by the United Zinc and Chemical Company, to its plant at Iola, Kans., two furnaces, each of 240 large retorts (muffles), and by the Illinois Zinc Company of 40 retorts.

In other countries, also, smelting developments have been active. Thus, in Canada a smelter is now prepared to further the development of the zinc industry, though it treated no ores from this country in 1906. In Mexico, in connection with the active development of zinc resources, the erection of smelters is being considered. An application for the establishment of one at Coahuila, or Nuevo Leon, at a cost of $5,000,000, is announced.

In Europe extensive preparations are being made for smelting rapidly increasing shipments of zinc ores, received chiefly from Australia. Thus, the Central Zinc Company of the Sulphide Corporation, of Australia, is erecting an important plant at Hartlepool, in northern England, near the mouth of the Tees. In South Swansea the upper Bank plant, one of six now operating there on smelting zinc, is being doubled in capacity to 120 tons a week. Beer, Sondheimer & Co. is constructing extensive works on the docks at Hamburg for handling and reducing zinc ores. In these works a new process will be employed in which the essential feature is preliminary distillation of ore in special furnaces, the zinc being collected as zinc oxide. In Australia the Broken Hill Proprietary Company has erected new works in New South Wales for treating concentrates. The Sulphide Corporation is operating at Cockle Creek, and plans to increase the capacity of that plant during the current year, while the Zinc Corporation is reported to be constructing works near South Block Mine, Broken Hill, for treating zinc tailings.

TRADE CONDITIONS.

WORLD'S PRODUCTION.

The world's production of spelter in 1906 increased 48,730 tons, or 6.7 per cent. Of this the principal share was contributed by the United States, which exceeded its production of the preceding year by 20,921 tons, or 10.3 per cent. The next larger gains were made by Belgium and Silesia, with 7,722 and 7,039 tons, respectively, indicating an increase of 4.7 and 4.8 per cent. The production of the United States comprised 28.9 per cent, nearly one-third of the entire production of the world. The following totals for foreign countries are those published by the Henry R. Merton Company, of London:

The world's production of zinc, 1904–1906, in short tons.

Country.	1904.	1905.	1906.
Australia			1,131
Austria and Italy	10,192	10,315	11,883
Belgium	154,314	160,496	168,067
France and Spain	54,107	55,524	59,293
Great Britain	50,949	56,140	57,971
Holland	14,442	15,176	16,150
Poland	11,693	8,422	10,595
Rhine District (Germany)	72,083	74,127	75,729
Silesia (Germany)	138,538	143,243	150,282
United States	186,704	203,849	224,770
Total	693,022	727,292	775,871
United States percentage of world's production	26.9	28.0	28.9

IMPORTS AND EXPORTS.

The imports and exports of zinc in its different forms by the United States for the years 1902–1906, as reported by the Bureau of Statistics of the Department of Commerce and Labor, were as follows:

Zinc imported and entered for consumption in the United States, 1902–1906, in short tons.

Year.	Block or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
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
1906	1,021	240,632	22	3,236	79	7,647	2,904	[a] 254,419

[a] Not including more than 41,174 short tons of zinc ore, valued at $989,880. The tonnage of a part of this ore import was not given prior to July 1, 1906.

Exports of zinc ore and of manufactures of zinc of domestic production, 1902–1906, in short tons.

Year.	Zinc ore.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
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
1906	27,720	733,300	4,670	583,526	204,269	[a] 1,521,095

[a] Not including 15,887 short tons of zinc dross, valued at $1,103,706.

Imports of zinc oxide, 1901–1906, in short tons.

Year.	Dry.	In oil.	Year.	Dry.	In oil.
1901	1,800	64	1904	1,293	112
1902	1,636	82	1905	1,718	171
1903	1,744	83	1906	2,096	146

Exports of zinc oxide, 1904–1906.

1904	short tons	8,157	$628,494
1905	do	11,280	810,203
1906	do	15,578	1,149,297

CUSTOMS DUTIES ON ZINC ORES.

The agitation of the question regarding the classification of certain zinc ores under customs acts and the assessment of duties on them was brought to a head early in 1906. It was originally maintained by certain mine operators, notably those of Joplin, Mo., that under prevailing practices importation by smelter companies of oxidized ores of zinc, which could be both bought and smelted more cheaply than their sulphide ores, tended to injure the zinc-mining industry in this country. Accordingly, on February 12, 1906, the Secretary of the Treasury issued the following order: "You are hereby instructed, following the advice of the Attorney-General, to classify ores chiefly valuable for the zinc which they contain, as metallic mineral substances in a crude state, under paragraph 183 of the existing tariff act, at the rate of 20 per cent ad valorem. You will admit calamine, silicate of zinc, free under paragraph 514." Against this ruling the zinc-smelting interests brought a test case in the name of the Kansas City Spelter Company.

The tariff act of 1907 contains the following paragraphs:

Art. 181. Lead-bearing ore of all kinds, 1½ cents per pound on the lead contained therein, etc.

Art. 183. Metallic mineral substances in a crude state and metals unwrought not specially provided for in this act, 20 per centum ad valorem, etc.

FREE LIST.

Art. 514. Calamine.

Art. 614. Minerals, crude or not advanced in value or condition, by refining or regrinding or by other processes of manufacture.

The parties to the controversy presented evidence in support of their respective contentions before the Board of United States General Appraisers. The contention of the importers was that the carbonates and silicates of zinc are free of duty under the provision in paragraph 514 for calamine, and that the others, the sulphides of zinc, or blende, are free under paragraph 614 as crude minerals.

The record in these cases is voluminous, consisting of the testimony of many witnesses on both sides, supplemented by references to and extracts from a large number of scientific authorities.

The conclusion of the Board of General Appraisers was—

that the carbonates and silicates of zinc are included within the meaning of the term calamine as used in paragraph 514, and that they are free of duty under said paragraph and also under paragraph 614, and that the sulphide of zinc is free under the paragraph last named as crude minerals, etc., subject, however, to the qualification that when lead is found in these ores duty shall be taken on the amount of lead contained therein as described in paragraph 181.

The substance and present status of the entire matter is concisely summarized in direct advice of the Secretary of the Treasury to the Survey under date of March 25, 1907, in which he says:

I have the honor to state that the zinc ores are not provided for eo nomine in the tariff act of July 24, 1897, but it is the practice of collectors of customs, approved by this Department, to assess duty upon zinc ores other than calamine, under paragraph 183 of the said act, a copy of which is herewith inclosed, as metallic mineral substances in a crude state at the rate of 20 per cent ad valorem. A number of protests filed with collectors against this classification have been decided in favor of the importers, the merchandise being held to be entitled to admission free of duty, under paragraph 614, as crude minerals, and a number of protests against the classification under paragraph 183 are still pending.

Calamine is admitted free of duty under paragraph 514, but the Department holds that the term "calamine" should be confined to ores whose component material of chief value is carbonate of zinc and that only ores whose component material is carbonate or silicate of zinc fall within the term "calamine."

Zinc ores or other ores containing lead in commercial quantities are admitted free of duty save for the lead contained therein, which is assessed with duty under paragraph 181 at the rate of 1½ cents per pound.

CONSUMPTION.

The home consumption of spelter in the United States in 1906 was 220,781 tons, an increase over that of the preceding year of 20,343 tons, or 10.6 per cent. The consumption from 1900 to 1905, in tons, has been as follows: 1900, 99,399; 1901, 141,697; 1902, 152,682; 1903, 154,381; 1904, 180,911; 1905, 200,438.

Consumption of spelter in the United States in 1906, in short tons.

Supply:		
Stock at beginning of year	3,463	
Production	224,770	
Imports for consumption	1,043	
Total available		229,276
Withdrawn:		
Stock at close of year	3,824	
Exports, foreign, in bond	1	
Exports, domestic	4,670	
Total withdrawn		8,495
Apparent domestic consumption		220,781

Statistics regarding the uses of spelter were not collected by the Survey for 1906, owing to the already numerous new features attempted. The hearty spirit of cooperation shown by producers of spelter in furnishing their statistics encourages an effort to secure statistics on consumption from the consumers in the future. The following table, as prepared by Mr. W. R. Ingalls and published in the Engineering and Mining Journal, gives the principal purposes for which spelter was used in this country in 1905 and 1906:

Uses of spelter in the United States.

Purpose.	1905.		1906.	
	Quantity.	Per cent.	Quantity.	Per cent.
	Short tons.		*Short tons.*	
Galvanizing	100,000	50	124,000	55
Brass making	52,000	26	57,000	25¼
Sheet zinc	34,000	17	36,000	16
Lead desilverization	2,400	1¼	2,500	1
Other purposes [a]	10,854	5¾	6,000	2¾
Total	199,254	100	225,500	100

[a] The apparent falling off in the consumption of zinc for "other purposes" in 1906 is explained by a more complete itemization of the consumption in 1906; in other words, there was probably more spelter used for brass making in 1905 than the above table shows.

World's consumption of spelter in 1906.[a]

	Short tons.
Austria-Hungary	31,746
Belgium	38,581
France	69,665
Germany	161,266
Great Britain	168,652
Holland	4,409
Italy	11,023
Russia	18,739
Spain	5,181
United States	220,781
Total	730,043
United States, percentage of world consumption	30

[a] Computed from statistics published by Metallgesellschaft and Metallurgische Gesellschaft A.-G., April, 1907, Frankfort-on-the-Main, p. 65-75.

PRICES.

The general rise in the price of spelter which began in 1900 continued through 1906. The average price in New York for 1906 was $0.061; in St. Louis, $0.060, the highest monthly price reached being $0.0659 in December, and the lowest, $0.0599, in May. This maximum monthly average of $0.0659 was the highest since May and June, 1899, and except that, the highest since February and March, 1880, that is, for sixteen years. As the average monthly price was much higher than the price in the high-record year, 1899, except during the abnormal and short-lived rise in the latter year, the price in 1906 may be said to have again reached the level at which it stood during the middle seventies and toward which it has been rising since the early eighties.

In detail it is to be noted that the opening price with the January average of $0.06487, gradually fell almost to the minimum in March, rose slightly in April, and descended on May 24 and 29 to the lowest point reached during the year, namely, $0.0590. After another false start, rising in June, only to fall nearly back to the lowest point in July, the price then moved actively upward, closing the year, December 28 and 31, with a maximum price of $0.0670.

The following table, giving highest and lowest prices of spelter in each month for the years 1902–1906, inclusive, is based from 1902–1905 on figures in the Iron Age; the 1906 figures are from daily quotations in Engineering and Mining Journal.

Price of common western spelter in New York City, 1902–1906, by months.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	4.30	4.25	4.25	4.00	4.35	4.20	4.45	4.40
1903	4.90	4.55	5.05	4.97	5.75	5.05	5.75	5.50
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
1906	6.70	6.00	6.15	6.05	6.35	6.10	6.15	6.05

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
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	6.00	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
1906	6.10	5.90	6.20	6.00	6.05	5.97	6.05	6.02

Year.	September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1902	5.50	5.30	5.50	5.40	5.35	5.10	5.00	4.50
1903	6.10	6.00	6.12	6.00	6.00	5.25	5.25	4.65
1904	5.15	5.07	5.37	5.15	5.80	5.37	6.12	5.80
1905	5.95	5.75	6.15	6.00	6.25	6.10	6.60	6.40
1906	6.35	6.05	6.30	6.15	6.45	6.25	6.65	6.45

FUTURE OF THE INDUSTRY.

In the immediate future, and until accumulated ores shall be exhausted, the production of zinc will readily meet all demand for consumption, and the market may be temporarily sated. Foreign ore production and cheap smelting tend to supply foreign consumption and to prevent export from this country and may possibly cause a slight falling off in prices. Following the present period of extraordinary activity, however, and in a relatively short time, normal conditions will obtain.

In the long run, continued increase in the use of zinc promises to outrun the present great increase in production, and as consumption thus presses upon production again it is believed that prices will gradually rise and render the zinc industry an increasingly profitable field for enterprise.

Summary of spelter statistics for 1906.

Production of spelter by United States	short tons..	224,770
Consumption of spelter by United States	do..	220,781
Excess of United States production over consumption	do..	3,989
Production of zinc by world	do..	775,871
Consumption of zinc by world	do..	731,043
Excess of world production over consumption	do..	44,828
United States percentage of world production	do..	28.9
United States percentage of world consumption	do..	30.0
Rank of United States among zinc-producing countries	do..	Second.
Rank of United States among zinc-consuming countries		First.

DIRECTORY OF SMELTING COMPANIES.

Many inquiries come to the writer from mine operators regarding treatment of ores and location of smelters. In the belief that it may thus be of mutual aid to ore producers, as well as to smelting companies, the following list is given. It includes the name of each company in this country at present engaged in smelting zinc ores, its office address, and location of works. In case both office and works are at same locality the address is not repeated.

American Zinc, Lead and Smelting Co., Boston, Mass.
  Works: Caney and Dearing, Kans.
Chanute Zinc Co., Chanute, Kans.
Cockerill Zinc Co., Nevada, Mo.
  Works: Altoona, Gas, La Harpe, and Pittsburg, Kans.; Rich Hill and Nevada, Mo.
Edgar Zinc Co., St. Louis, Mo.
  Works: Carondelet, Mo.; Cherryvale, Kans.
Granby Mining and Smelting Co., St. Louis, Mo.
  Works: Neodesha, Kans.
Grasselli Chemical Co., Cleveland, Ohio. Works: Clarksburg, W. Va.
Illinois Zinc Co., Peru, Ill.
Lanyon-Starr Smelting Co., Bartlesville, Okla. (Ind. T.)
Lanyon Zinc Co., Iola, Kans.
  Works: Iola and La Harpe, Kans.
Matthiesson & Hegeler Zinc Co., La Salle, Ill.
New Jersey Zinc Co., New York City.
  Works: Newark and Franklin, N. J.; South Bethlehem, Florence, and Palmerton, Pa.; Gas and Iola, Kans.; Mineral Point, Wis.; Depue and Waukegan, Ill.
Ozark Mining and Smelting Co., Cleveland, Ohio.
  Works: Joplin, Mo.; Coffeyville, Kans.
Pittsburg Zinc Co., Pittsburg, Kans.
Sandoval Zinc Co., Sandoval, Ill.

United States Smelting Co., Canyon City, Colo.
United States Zinc Co., Denver, Colo., and New York City.
Works: Pueblo, Colo.
United Zinc and Chemical Co., Kansas City, Mo.
Works: Iola and Argentine, Kans.; Springfield, Ill.

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QUICKSILVER.

By J. M. Boutwell.

CONDITION OF INDUSTRY.

The quicksilver industry in the United States was less active in 1906 than in 1905. The domestic production about satisfied domestic consumption, and exports fell off considerably. The decrease in domestic demand is due largely to the increasing adoption of other processes than amalgamation for the recovery of the precious metals. The decrease in exports may be ascribed to the fact that Mexico, which formerly imported considerable quantities from this country, at present not only supplies its own wants, but exports about 190 metric tons; also to the fact that the company which controls the industry in this country preferred not to accept bids of $30 a flask for exports to China. The production will hardly be measurably increased—though it is believed that domestic resources are equal to any reasonable tax on them—until the demand shall increase sufficiently to raise the price notably.

PRODUCTION.

The production of quicksilver in the United States in 1906 was 26,238 flasks of 75 pounds each, valued at $958,634, as compared with 30,451 flasks, valued at $1,103,120, in 1905, a decrease in quantity of 4,213 flasks and in value of $144,486. This decrease is due to the great falling off in the output of the California mines, as the Texas producers a little more than held their own, and Utah measurably increased its production. The domestic production of quicksilver in 1905 and 1906 and the value of same are shown in the following table, that for 1906 being based on direct confidential returns made to the Survey by all known producing quicksilver mines. The world's production is given in connection with a brief discussion of foreign resources and development.

Production of quicksilver in the United States in 1905 and 1906, in flasks of 75 pounds.

State.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
California	24,635	$886,081	20,310	$730,808
Oregon	43	1,677	3	109
Texas	4,723	173,362	4,761	178,829
Utah	1,050	42,000	1,164	48,888
Total	30,451	1,103,120	26,238	958,634

RESOURCES AND DEVELOPMENT.

CALIFORNIA.

California quicksilver mines yielded in 1906 a total of 20,310 flasks, valued at $730,808, or 77.4 per cent of the product of the United States. As compared with the State's production in the preceding year this is a decrease of 4,325 flasks, or 3.6 per cent.

Total production of quicksilver in California, 1850–1906, in flasks.[a]

1850	7,723	1870	30,077	1890	22,926
1851	27,779	1871	31,686	1891	22,904
1852	20,000	1872	31,621	1892	27,993
1853	22,284	1873	27,642	1893	30,164
1854	30,004	1874	27,756	1894	30,416
1855	33,000	1875	50,250	1895	36,067
1856	30,000	1876	72,716	1896	30,765
1857	28,204	1877	79,395	1897	26,691
1858	31,000	1878	63,880	1898	31,092
1859	13,000	1879	73,684	1899	29,454
1860	10,000	1880	59,926	1900	26,317
1861	35,000	1881	60,851	1901	26,720
1862	42,000	1882	52,732	1902	28,972
1863	40,531	1883	46,725	1903	30,526
1864	47,489	1884	31,913	1904	29,217
1865	53,000	1885	32,073	1905	24,635
1866	46,550	1886	29,981	1906	20,310
1867	47,000	1887	33,760		
1868	47,728	1888	33,250	Total	2,017,654
1869	33,811	1889	26,464		

San Benito County maintained its lead, but San Luis Obispo County passed Napa County. San Luis Obispo and Santa Clara counties made gains of 327 and 222 flasks, respectively, while the production of Napa County fell off 1,299 flasks and that of San Benito 564 flasks. The great producers which have afforded the bulk of this output are the New Idria in San Benito County, the New Almaden in Santa Clara County, the Cambria and Oceanic in San Luis Obispo County, and the Napa and Great Western in Napa County. The detailed production by the counties, with value of same according to actual direct returns from all known producers, is shown in the following table:

Production of quicksilver in California, by counties, during 1905 and 1906, in flasks of 75 pounds.

County.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Colusa	326	$12,321	13	$488
Lake	1,462	51,937	13	455
Mendocino	....	....	50	1,800
Napa	4,853	171,910	3,554	126,094
San Benito	7,967	286,959	7,203	254,813
San Luis Obispo	3,510	126,440	3,837	137,955
Santa Clara	2,693	95,968	2,915	109,318
Santa Barbara }	601	20,588	....	....
Solano }			528	20,120
Sonoma	2,584	97,041	2,031	73,789
Kings }	639	22,917	....	....
Trinity }			166	5,976
Total	24,635	886,081	20,310	730,808

[a] $76\frac{1}{2}$ pounds net; 75 pounds net since June 1, 1904.

In 1906 low prices and slack demand seriously interfered with the quicksilver mining industry of the State. The great diminution in production is made up of decreases by a few large mines and many small ones. Only a few mines increased their output in 1906. A few new properties were opened but many small mines closed down entirely, and some others operated only intermittently. The new Idria in San Benito County is reported to be the only quicksilver mine in the State now paying a dividend. On some properties the earthquake caused serious damage, and on others, as at the Socrates, in Sonoma County, salivation is stated to be troubling the miners.

The present situation is not believed to be due to lack of resources, as certain large producers are reliably reported to have excellent reserves, several medium-sized ones with good ore in sight closed down, and a number of new discoveries have been described. On the contrary, the situation is due, it is generally believed, to greatly decreased demand and the resulting low prices, under which mining operation at the present prices of material and labor can not be profitably conducted except on a large scale. The course of the industry during the present year, therefore, must depend particularly upon the demand.

TEXAS.

In 1906, Texas produced, according to direct returns to the Survey, 4,761 flasks of quicksilver, valued at $178,829, or 18.1 per cent of the total output of the entire country. The increase in quantity over that of the preceding year was 38 flasks, and the increase in its proportion of total domestic production was 2.6 per cent. The annual and total production of the State is shown in the following table:

Production of quicksilver in Texas, 1899–1906.

1899	Flasks[a]	1,000	1904	Flasks[a]	5,336
1900	do	1,800	1905	do	4,723
1901	do	2,932	1906	do	4,761
1902	do	5,319			
1903	do	5,029	Total	do	30,900

This production was contributed by the Marfa and Mariposa, Chisos, Terlingua, Texas-Almaden, and Lone Star companies, all located in Brewster County. The production was increased despite the fact that two former producers were idle during the year and a third operated only intermittently, and also despite extensive improvements, both surface and underground, that were made by most of the active companies. The increase was due to the fact that the largest producer, the Marfa and Mariposa, maintained its former large production, and other companies made noteworthy additions.

The most important development during the year in the industry in this State was the demonstration that ores of commercial value extend to considerably greater depths than those at which they are mined at present. The bulk of the mining up to 1906 was shallow, being at a depth of less than 50 feet. In 1906 shafts sunk to depths of 200 feet and 350 feet, respectively, proved an extension of good ore to at least those depths, and it is reliably stated that "ore may be profitably mined at much greater depth than has yet been reached."[b]

[a] Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.

[b] Phillips, W. B., Prospects of the quicksilver industry in Texas: Mining World, Oct. 13, 1906. Also, Proceedings of American Mining Congress, vol. 8, El Paso meeting. The writer has drawn freely from these articles, and further desires to acknowledge kind cooperation by their author.

Furthermore, prospecting with diamond drill is reported to have proved the existence of two new bodies, both in Brewster County, one east of the Lindsey and Dallas property, the other 100 miles distant and a few miles northeast of Cigar Springs Mountain. Important additions and improvements were also made in connection with reduction plants. These will be briefly described under "Reduction."

The development and operation of these quicksilver mines in Brewster County in the Big Bend of the Rio Grande, has been accomplished in spite of serious natural impediments, notably insufficient fuel, water, and transportation. The water problem can be met in the future, as it has been in the past, by utilizing rain water caught during the rainy season, and by hauling from a near-by stream. The fuel problem, however, for those companies that can not depend on streams for water sufficient for generating steam power, presses more seriously, as the supply of mesquite wood within reasonable distance is rapidly approaching exhaustion. Limited quantities of Cretaceous coal are known to occur in thin seams at several accessible points, and in 1906 these deposits were somewhat developed. In view of the successful utilization of similar coals elsewhere for making producer gas for operating gas engines, a like use of this coal is worthy of early and thorough consideration. If sufficient power can be satisfactorily obtained from this source, the proof of extent of ore in commercial value to much greater depth than hitherto known, and the solution of the fuel problem, should insure to the industry in this district a promising future.

UTAH.

The Sacramento Gold Mining Company, at Mercur, Tooele County, the sole producer in Utah, increased its output of quicksilver in 1906 over that for 1905 by 114 flasks, or 10.8 per cent, giving Utah the largest increase of any State over its production of the preceding year.

In this property quicksilver mining is incidental to gold mining, though the exploitation of this interesting deposit has proved profitable for several years. The ore is an earthy cinnabar with a siliceous gangue, and yields 6 per cent on an average and 80 per cent in picked samples. It occurs in bands in an altered cherty limestone adjacent to a dike and to a fracture zone. In general, the portion of this limestone which bears quicksilver constitutes a lenticular shoot measuring about 10 feet in thickness, 50 feet along the strike, and 140 feet on the dip. This lens is coincident with the bedding of the limestone along the middle and major portion of its dip, but at its upper edge it bends and cuts abruptly across the bedding; while at its lower edge, on approaching the dike and fracture on its dip, it drops sharply down across the bedding, pinching out at both its upper and lower terminations to thin edges. This main shoot of good ore is now approaching exhaustion, and though other bodies have been found on this property, they are of much lower grade. The ore is treated on the property in six retorts, each taking four pans, which afford a total capacity of 20,000 tons.

OREGON.

Oregon has been a small producer for several years, but in 1906 had it not been for a new producing property, its production would have been nothing. The main operator in 1906 was the Almaden Gold and Quicksilver Company, at Howard, Crook County. The most extensively developed property in the State, the Black Butte Mine, which also has a thorough equipment with a special furnace and retort, is understood to have remained idle. Considerable prospecting was carried on in Jackson, Josephine, and Douglas counties, and several occurrences of ore of good grade are reported. The greatest activity was in the Meadows District mines, in Jackson County, where a depth of 400 feet is stated to have been reached and a furnace and retort erected.

NEVADA.

Nevada has, from time to time, produced a few flasks of quicksilver, and during the last year or two several new deposits have been discovered. In Humboldt County new-found deposits are being developed in Eldorado and American canyons; two or three occurrences of cinnabar of good grade have been opened in the Goldfield district, and discoveries are reported from the South Bullfrog district in the Funeral Range. In Eldorado Canyon, Humboldt Range, a considerable tonnage of 2.4 per cent cinnabar ore is stated to have been opened. On the east slope of this range in American Canyon deposits of gold and cinnabar in intimate association are being developed. On the Dixie Group, in this locality, streaks of cinnabar of considerable size occur in a strong quartz vein, which traverses igneous country rock.[a]

ARIZONA.

A quicksilver deposit is being actively developed at Cinnabar, 14 miles from Ehrenberg, in Yuma county, Ariz., by the Colonial Mining Company. A shaft 180 feet deep is said to have been sunk on a body of cinnabar ore which is stated to yield 1.5 per cent. No shipments are reported. In this vicinity, another property, the Dangerfield-Beemer, is operating. Quicksilver prospects are also reported at a point about a dozen miles from Prescott.

WORLD'S PRODUCTION.

The world's production for the years 1902 to 1905, inclusive, (authentic figures for 1906 not yet being available), are shown in the following table. The figures for quantities produced by foreign countries in 1905 are based upon those compiled by the Metallgesellschaft and the Metallurgische Gesellschaft, and the values are compiled on the basis of a uniform price of $1,058 per metric ton. The figures for the United States are those published by the Survey.

World's production and value of quicksilver in 1902–1905, in metric tons. [b] [c]

Country.	1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	1,190	$1,467,848	1,237	$1,544,934	1,188	$1,503,795	1,036	$1,103,120
Austria	511	568,929	520	621,753	536	602,238	570	603,060
Italy	260	310,080	314	373,065	355	396,335	352	372,416
Russia	416	506,366	362	430,196	393	441,597	318	336,444
Spain	1,425	1,941,387	914	1,092,239	1,020	1,146,132	834	882,372
Total	3,802	4,794,610	3,347	4,062,187	3,492	4,090,097	3,110	3,297,412

[a] For information regarding the occurrences in Humboldt County the writer is indebted to Jas. F. McClelland, of Tonopah, and W. G. Adamson, of Winnemucca.

[b] Mexico exported 335 tons of quicksilver in 1901, and 190 tons in 1904 and 1905.

[c] A partial estimate of the world's production of quicksilver in 1906 by Mr. V. Spirek gives 3,237 metric tons, derived as follows: Almaden, Spain, 1,242 tons; California, 941 tons; Idria, Austria, 526 tons; Monte Amiata, Italy, 318 tons; and Nikitovak, Russia, 210 tons.

From this table it appears that the world's production of quicksilver is afforded by the United States, Spain, Austria, Italy, Russia, and Mexico, in the order mentioned.

Spain.—The greatest single quicksilver mine in the world is the famous Almaden, at Almaden, Spain. Its history dates back before its occupation by the Romans, and yet it is now yielding annually about 1,500,000 pounds of quicksilver. That quantity, augmented by a small amount afforded by a few other relatively minor producers in the provinces of Almeria, Granada, and Oviedo, gives Spain a production rank second to that of the United States.

Italy.—During 1906 a critical study of the quicksilver deposits of the Monte Amiata district in Italy, the sole producing section in that country, yielded valuable information.[a]

The deposits are all of cinnabar, and they occur in limestone of Eocene and Lias ages, overlain, in some instances, by trachyte. The conclusion was reached that the deposits were formed by the entrance of an acid solution of quicksilver, iron, and other metals into clayey limestones, resulting in a formation of sulphur compounds of calcium and the alkalies, which precipitated the mercury in solution as red crystallized mercury sulphide. The deposits have been opened through six mines and several prospects, while a number of outcrops yet remain unprospected. The rich ores, running 1.89 per cent mercury, have been practically worked out and only low-grade ores, running between 0.5 and 0.75 per cent, are now available. In 1904 60,403 tons of ore, averaging 0.58, yielded 352 tons of mercury.

Mexico.—In Mexico, quicksilver is in much demand for amalgamation. Despite the introduction of modern methods of metal recovery, native conservatism and costs lead to the continued use of quicksilver for the recovery of silver. The deposits are numerous, widely distributed, and, in many cases, historic. They are generally rather low grade, averaging about 1 per cent. The most important ones in the Republic are at Huitzuco, in the State of Guerrero, 67 miles south of Mexico City, where cinnabar occurs over an extensive area. At Guadalcazar, in San Luis Potosi, deposits occurring in limestone prove highly productive. Considerable deposits are known in Queretaro and Guanajuato, and limited deposits in the States of Morelos, Jalisco, Mexico, Hidalgo, Zacatecas, and Chihuahua, and others at various points are operated on a small scale.

Austria.—The Austrian mines maintain their output of about 550 metric tons with great regularity. The chief producers in that country are the Idria mines.

Russia.—The Russian deposits at Nikitovak afforded 75,181 tons of cinnabar ore in 1906, a decrease of 7,586 tons. This comprises practically the entire output from this country, as the Daghistan mine yielded only a small amount.

Japan.—Japan produced, in 1906, quicksilver valued at about $350.

China.—In China, in the province of Kweichow, the Wan Shan Chang mines, situated about 1,300 miles from Shanghai, contain isolated irregular deposits of cinnabar in magnesian limestone.[b]

These deposits are reported to have been extensively worked since the fourteenth century and to have yielded, until quite recently, about 4,000 pounds a month. This output has now been greatly

[a] Spirek, V , The Mercury mining district of Monte Amiata, Italy: Min. Mag., April, 1906.

[b] Brelich, Henry, Chinese methods of mining quicksilver: Abstract from paper read before Institute of Mining and Metallurgy, Min. Reporter June 8, 1905.

reduced, however, so that in 1905 it was only about 270 pounds a month. Methods of mining and reduction are very crude. The product is utilized for home consumption, entirely for the manufacture of vermilion.

Deposits are also regularly worked for a small production in Peru and Algeria, and recently some high-grade ore is reported to have been discovered in Vancouver Island.

TREATMENT.

The method employed for reducing quicksilver ore, as is shown by the practice in various quicksilver districts, depends mainly on the character of the ore and on the natural conditions. The processes comprise two main steps: (1) Volatilization—freeing the mercury from associated elements, and (2) condensation—reducing the mercurial vapors to liquid form and collecting this product. This treatment is accomplished either in closed retorts or in furnaces. Briefly stated, "retort reduction is essentially a simple distillation in which the mercury vapor is kept separate from the flame and smoke of the fire box," while in furnace reduction "all the gases enter the condensers together."[a]

Retorts are only suited for treating high-grade material, or for limited operations. In this country fine-ore furnaces, of the shaft type, are now most commonly used.

In California, where the ore is regarded as generally decreasing in grade, both retorts and furnaces are used. More than half a dozen properties, including the Cambria, Napa, Oceanic, and Socrates, operate 50-ton Scott furnaces, while other properties use smaller furnaces of the same type. The New Almaden operates six intermittent furnaces, and the Great Western a Litchfield furnace. The New Idria Mining Company, whose furnace and retort were somewhat damaged by the earthquake, though still running, has laid stone foundations for a new furnace and retort

In Texas, where the serious factor is scarcity of fuel, and, with one or two exceptions, scarcity of water also, the Scott furnace is in almost universal use. The Marfa and Mariposa use two Scott furnaces of 15-ton capacity each. The Chisos leases the 10-ton Scott furnace at the Colquitt-Tigner property, 6 miles distant, but is now building a 10-ton furnace of the same make on its own property. The 50-ton Scott furnace owned by the Big Bend Company was not operated during the year, and that of the same capacity and make owned by the Terlingua Company was operated only at intervals. In April the Texas-Almaden Company completed a 20-ton Scott furnace of special improved design. The condensers are constructed with close lining of brick of special quality to minimize the escape of quicksilver, and are maintained at a steady temperature by means of an 18-inch ventilator over each.

In Utah, at Mercur, on the property of the Sacramento Gold Mining Company, high-grade ore is treated at the mine in six retorts (each taking four pans) of a total capacity of 2,000 tons.

At the Black Butte quicksilver mine in Lane County, Oreg., an experimental furnace, designed by and named after the general manager of that property, and known as the Dennis roasting furnace, was built in 1905, but was not operated in 1906, as the mine was

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[a] Booth, Frank J., Reduction of quicksilver ore: Min. and Sci. Press, Nov. 10, 1906, p. 570-571.

not producing. It was constructed to secure, at minimum cost, perfect combustion for a large tonnage of low-grade ore. The small furnace comprised a series of primary and secondary combustion chambers and a number of other special devices, including one for preventing loss by the escape of raw ore dust. In test runs it is reported to have afforded a thorough roast of ore and volatilization of values in four hours, and to have eliminated practically all loss through flue dust.

In the Monte Amiata district, Italy, where the ores now mined are of very low grade, the treatment has been brought to a very high degree of refinement. The Czermak-Spirek continuous automatic reverberatory roasting furnace is almost universally used. The Spirek shaft furnace is also in operation at several plants. The largest mines use roasting furnaces which have a capacity of 24 tons of low-grade ore and 50 of high grade, while the medium-size furnace handles 12 tons and various smaller ones 6 to 3 tons. The Czermak-Spirek roasting furnace is also used in Idria, Austria; Almaden, Spain; Nikitovak, Russia; Vallalta, Tyrol; Taghit, Algiers, and Smyrna, in Asia Minor.

TRADE CONDITIONS.

The world's market for quicksilver in 1906 was weak. Although the prices of nearly all other metals rose actively during the year in response to strong demand the price of quicksilver remained about stationary and reacted at the close to the opening price of the year. The main cause of this weakening in world demand and the resulting stagnation in price is generally believed to be the extensive diminution in the use of quicksilver for recovering the precious metals by amalgamation. At present the leading consumers are understood to be China, which uses quicksilver for the manufacture of vermilion, and Japan, which is reported to utilize it for making high explosives.

The conditions which prevailed in the United States, as explained in the introductory statement on domestic conditions, although partaking of the general apathy, were fairly good.

IMPORTS AND EXPORTS.

The decreased domestic production about equaled domestic demand. Imports fell off greatly. Exports also decreased, largely owing to the fact that the California interests did not find it necessary to export surplus product to the Orient at cut prices as largely as in previous years. There were no exports of foreign quicksilver from this country in 1906.

The imports and exports of quicksilver are shown in the following tables, which are compiled from records of the Bureau of Statistics of the Department of Commerce and Labor.

Quicksilver imported and entered for consumption in the United States, 1900–1906, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	2,616	$1,051	1904	(a)	$1,405
1901	1,441	789	1905	2,690	1,710
1902	(a)	2,166	1906	84	[b] 327
1903	(a)	1,065			

[a] Not stated. [b] Including quicksilver valued at $277, quantity not given.

Exports of quicksilver from the United States, 1900–1906, in flasks.[a]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	10,172	$425,812	1904	21,064	$847,108
1901	11,219	475,609	1905	13,534	489,756
1902	13,247	575,099	1906	6,456	243,914
1903	17,577	719,119			

[a] Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.

Exports of domestic quicksilver from San Francisco in 1905 and 1906, by countries, in flasks.[a]

Country.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
China (Hongkong)	3,000	$104,831	503	$16,631
Mexico	5,572	201,310	1,639	61,132
Japan	3,283	121,372	602	22,688
Honduras	1,080	40,640	600	23,350
British Columbia	23	870		
Korea	24	876	37	1,347
Costa Rica	17	668	8	302
Salvador			18	684
Russia, Asiatic	3	115		
Nicaragua			2	82
Philippine Islands	7	274		
Canada	525	18,800	218	7,697
Total	13,534	489,756	3,627	133,913

[a] Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.

PRICES.

In January, 1906, the prices of quicksilver stood in New York at $40 a flask and in San Francisco at $39 for domestic and $37.50 for export. The price rose in February to $41 in New York and to $39.50 (domestic) and $38 (foreign) in San Francisco. At this level the prices were firmly maintained, chiefly by the pooling of the California output, until near the close of the year. In December, the price at New York fell to $40, but the San Francisco price of $39.50 was maintained.

The price in London started at £7 5s. in January, rose to £7 7s. 6d. in February, and stood at this point until August, when it declined to £7 5s. and to £7 and there remained.

In brief, the price of quicksilver through nearly the entire year was $40 at New York and $39.50 at San Francisco, with that for foreign shipments $1.50 lower until November, when it was $2 lower.

BAUXITE AND ALUMINUM.

By Ernest F. Burchard.

BAUXITE.

PRODUCTION.

The production of bauxite in the United States in 1906 amounted to 75,332 long tons, valued at $368,311. Compared with the production in 1905 of 48,129 long tons, valued at $240,292, the production in 1906 has increased 27,203 tons—nearly 57 per cent—while the average price per ton remains nearly the same. A reduction of perhaps 10 cents per ton is the average difference noted in the 1906 price as compared with that of 1905. The per cent of increase in tonnage from the Georgia-Alabama district is about even with that of Arkansas, the latter State still leading in production, as it has done since 1903.

The following table gives the production and value of bauxite from 1889 to 1906, inclusive:

Production of bauxite in the United States, 1889–1906, by States, in long tons.

Year.	Georgia.	Alabama.	Arkansas.	Total.	Value.
1889	728	....	....	728	$2,366
1890	1,844	....	....	1,844	6,012
1891	3,301	292	....	3,593	11,675
1892	5,110	5,408	....	10,518	34,183
1893	2,415	6,764	....	9,179	29,507
1894	2,050	9,016	....	11,066	35,818
1895	3,756	13,313	....	17,069	44,000
1896	7,313	11,051	....	18,364	47,338
1897	7,507	13,083	....	20,590	57,652
1898	....	....	....	25,149	75,437
1899	15,736	14,499	5,045	35,280	125,598
1900	19,739		3,445	23,184	89,676
1901	18,038		867	18,905	79,914
1902	22,677		4,645	27,322	120,366
1903	22,374		25,713	48,087	171,306
1904	21,913		25,748	47,661	235,704
1905	15,173		32,956	48,129	240,292
1906	25,065		[a] 50,267	75,332	368,311

[a] Includes a small quantity mined but not sold.

CONSUMPTION.

In order to show the annual consumption of bauxite and its value in the United States during the last five years, the following table has been compiled, which includes the annual production, imports, and consumption, together with the value of each, respectively:

Production, imports, and consumption of bauxite in United States, 1902–1906, in long tons.

Year.	Production.		Imports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	75,332	368,311	17,809	63,221	93,141	431,532

WORLD'S PRODUCTION.

The following table shows the world's production of bauxite in 1903, 1904, and 1905:

World's production of bauxite, 1903–1905, in long tons.

Country.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	48,087	$171,306	47,661	$235,704	48,129	$240,292
France	131,781	226,798	74,449	131,229	101,378	205,738
United Kingdom	6,128	7,368	8,700	8,340	7,300	8,880
Total	185,996	405,472	130,810	375,273	156,807	454,910

NOTES ON THE BAUXITE INDUSTRY.

DEPOSITS.

The principal deposits of bauxite in the United States have been found in Georgia, Alabama, and Arkansas. During 1906 bauxite was discovered in Tennessee, Virginia, and Pennsylvania, far north of the deposits previously known. It is noteworthy, however, that although these new discoveries extend the area known to contain bauxite, the general location, relations, and character of the deposits fulfill the conditions described by Survey geologists a decade ago—that is, the bauxite is invariably associated with Cambrian or Cambro-Ordovician rocks, such as the Knox or Shenandoah limestone of the valley regions, and in association with faults, so that the newly found ore bodies correspond closely to the type described by Dr. C. W. Hayes from Georgia and Alabama.

In Tennessee developments have already begun of deposits on Missionary Ridge, at East Lake and Sherman Heights, suburbs of Chattanooga. Bauxite has been noted in California,[a] in Shasta County, and also in Kentucky,[b] in Edmonson County. The use of low-grade bauxite for the manufacture of refractory brick and prospective new developments in the aluminum industry have stimulated interest in

[a] Mineral Industry for 1905, p. 46.
[b] Gardner, J. H., Some Kentucky clays: Kentucky Geol. Survey, Bull. No. 6, 1895, p. 51.

supplies of bauxite, so that it is probable that the promising districts will be well investigated in the near future.

Recent changes that have taken place in the bauxite trade are the acquisition of the properties of the General Bauxite Company by the Pittsburg Reduction Company and by the New National Bauxite Company. The latter company was organized by the leading interests in the former General Bauxite Company. On January 1, 1907, came the change of name of the Pittsburg Reduction Company to the Aluminum Company of America.

Georgia-Alabama district.—The Georgia-Alabama bauxite district extends along Coosa Valley from the vicinity of Summerville or Adairsville, Ga., to Jacksonville, Ala., and lies in Bartow and Floyd counties, Ga., and Cherokee County, Ala. Not the whole of the district is developed, however, nor even well prospected; so that from time to time the discovery of new deposits may be expected. Active mining is now carried on about three centers—Hermitage and Cave Spring, Ga., and Rock Run, Ala.[a] Near Hermitage two mines are operated by the Republic Mining and Milling Company of Philadelphia, viz, the Julia, 5 miles east, and the Ward mine, 2 miles south of Hermitage. The Aluminum Company of America, successor to the Pittsburg Reduction Company, is working the South Watters, one of a group of several mines 3 miles south of Hermitage, and J. H. Hawkins, of Rome, Ga., a pioneer in the bauxite business, maintains a steady output from his mine $5\frac{1}{2}$ miles southeast of Hermitage. There is a drier at the Hawkins mine, one at the Julia, and one at Hermitage, which takes care of the product from the Ward mine besides doing custom work on ore from other deposits in the vicinity. Near Cave Spring a mine is operated by the National Bauxite Company, and the Aluminum Company of America mines ore in the same vicinity. The latter company has a drier at Cave Spring, which is its principal shipping point for the district. The National Bauxite Company has recently completed a plant at Rome, where it treats the ore mined near Cave Spring and Adairsville. This plant comprises a crusher, log washer, mixer, tubular drier, elevators, and storage bins. This same company is also developing the deposits near Chattanooga, Tenn., referred to on page 6. Twelve miles south of Rome is a small mine, the Bigelow, owned by Harrison Brothers, of Philadelphia. Near Rock Run, Ala., the Republic Mining and Milling Company operates one mine and a drier.

Practically all the workings at present active in this district are included in the foregoing summary; but there are many other bodies of bauxite ore known to exist in the district, and some of these have been partly developed. One of these is at Summerville, Ga., where a pit has been opened northwest of the town, disclosing bauxite in pisolitic and cellular forms, also massive, associated with chert and limonite. A band of limonite forms the east wall of the deposit and a ridge of Knox chert bounds it on the west. A shaft about 25 feet deep has been sunk in the pit. Shipments amounting to 8 carloads of "donick" or ore in large lumps were made from this deposit some years ago. The greater part of this ore appears to need washing in order to render it salable.

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[a] Data on bauxite mining in the Georgia-Alabama district are partly according to E. K. Judd in Eng. and Min. Jour., Mar. 23, 1907, pp. 574-575, and partly from notes of the writer, who visited this district late in August, 1906.

In general it may be said that the ore bodies are easily found and quickly developed, and that many of them are speedily exhausted. The number of producing mines varies with the market.

The mining of bauxite is usually accomplished in open cuts, some of which have several benches, from which the ore is loaded down into cars moving on temporary tracks laid on the bottom of the cut. The chief problems are to obtain the ore as free as possible from clay, gravel, and soil, and to keep the pits free of water, in case they are not so situated that natural drainage can be secured. The proportion of material moved to ore yielded varies from 6:1 to 6:5. The percentage of alumina (Al_2O_3) in the crude ore commonly varies from 35 to 57, that of iron oxide (Fe_2O_3) from 0.4 to 5, and that of silica (SiO_2) from 5 to 30.

The preparation of the crude bauxite involves washing to remove the clay and drying in order to remove as much moisture as possible before the material is started on its long train haul to market. Log washers are used similar to those used for cleaning brown iron ores, with the exception that settling boxes are provided for the waste clay, by means of which a considerable saving of fine ore is effected. Some of the ore occurs so clean as to require no washing, and this, together with the washed ore, is run through a rotating cylindrical drier. Wood is regarded as the most satisfactory fuel for bauxite drying, because the smoke from soft coal blackens the ore, but, as an alternative, coke has been used. High-grade prepared ore from this district ranges between 56 and 58 per cent Al_2O_3 and about 8 per cent SiO_2. No. 2 ore averages about 50 per cent Al_2O_3 and 12 per cent SiO_2.

The Georgia-Alabama bauxite is of more uniform composition than the Arkansas ore, and consequently it is of greater value to the chemical trade for the production of alum and other aluminum salts. Some of this ore is used for lining basic open-hearth steel plants; some is used in the form of hard lumps in the manufacture of aluminum or artificial corundum, an abrasive material; and an increasing quantity is being demanded to supply the aluminum reduction plants.

Arkansas district.—The Arkansas bauxite has for two or three years been the main source of aluminum ore, but with the rapid increase in production of metallic aluminum the Arkansas field, notwithstanding its rapid development, can not fulfill this demand for the ore. The Arkansas product exhibits greater diversity in composition and is therefore suitable for a greater variety of uses than that from Georgia and Alabama.

The mining and treatment of bauxite in Arkansas is carried on in a manner very similar to that followed in Georgia and Alabama. The deposits attain a thickness as great as 10 to 12 feet and are mined from surface workings by blasting and by pick and shovel. If the ore is to be used in making alum it is merely crushed and dried. If a low silica ore is required, such as is needed in the manufacture of alundum, the bauxite is crushed and washed. By this operation the free silica is removed.

USES.

Bauxite has proved to be of great value as a basic refractory material in that it resists well the scouring action of metallic oxides in the furnace. Bauxite is used most conveniently in the form of bricks for this purpose. The Berger patent covers a process for making these bricks.[a] Natural high-alumina low-silica bauxite from Arkansas is used, bonded by a small percentage of plastic fire clay, sodium silicate, or lime. The bricks contain from 88 to 90 per cent of alumina and from 10 to 12 per cent of ferric oxide, silica, and titanic acid. The percentage of silica can be reduced to 6 or 8 per cent by the use of a bond free from silica, so that the brick is not appreciably detrimental to basicity. Bauxite brick seems to be especially adapted for the linings of basic open-hearth steel furnaces. The highest grade is used in the floor and walls up to the slag line, protected by a bed of calcined bauxite. Above the slag line cheaper brick with a lower percentage of bauxite can be used.

A severe test was made some time ago at one of the basic open-hearth furnaces of the Bethlehem Steel Works, in which a bauxite brick and a magnesite brick were placed side by side near the gas and air ports and thus were subjected to the highest temperature attainable in the furnace. The magnesite brick bent and showed viscosity after seven minutes, against fifteen minutes for the bauxite brick. A bauxite brick and a magnesite brick were then submerged in slag near the doors for some time, after which they were withdrawn and examined when cold. The magnesite brick was incorporated with slag, while the bauxite brick when broken showed that the slag had not penetrated to its center, but had remained as a coating over the outside.

In addition to its use for open hearths, bauxite brick has proved successful for other uses, two of which are as a lining for rotary Portland cement kilns and as a lining for lead-refining furnaces. Used as a lining for the hot zone (10 to 12 feet) of a 60-foot rotary cement kiln, 6-inch bauxite bricks have been found to give more than ten months' continuous night and day service. This indicates that the material is superior to fire brick, and that the saving of output that would otherwise be lost during frequent shut downs for the purpose of relining or patching a kiln in the hot zone will more than compensate for the increased cost of superior lining.

In lead refining it has been found that the scum composed of highly basic oxides readily attacks the free silica and silicates of alumina in a fire brick and rapidly decomposes the latter, whereas the basic bauxite lining, theoretically and in practice, is better adapted for use in such furnaces. Tests show that bauxite brick really lasts five or six times as long as the fire-brick lining.

Bauxite brick are manufactured by the Laclede Fire Brick Company, of St. Louis, for the American Bauxite Company, and their cost is considerably less than that of magnesite brick.

It is noteworthy that the attention of the public was first called to the Arkansas bauxite deposits in 1891 by Dr. J. C. Branner, then State geologist of Arkansas. In 1895 their commercial value began to be appreciated. In 1899 were reported the first statistics of production from this field, and reference to the table will show that the production of 1906 has exceeded the most sanguine predictions.

[a] Editorial, Eng. and Min. Jour., January 19, 1905, p. 154; also Aubrey, A. J., The refractory uses of bauxite: Eng. and Min. Jour., February 3, 1906, pp. 217-218.

ALUMINUM.

PRODUCTION AND CONSUMPTION.

The production of aluminum grew very rapidly from 1883 to 1897; its growth was slightly checked, though still vigorous, from 1897 to 1899. Then followed a period, from 1900 to 1903, during which the production was maintained at a high figure but with no real gain from year to year. From 1904 to the present, however, the production again increased, the proportion of annual increase being larger than since 1897.

The magnitude of the aluminum industry is shown by the following table, which gives the production of aluminum in the United States since the beginning of the industry in 1883:

Production, in pounds, of aluminum in the United States, 1883–1906.

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	1906	[a] 14,910,000
1894	550,000		
1895	920,000	Total	83,319,779

Aluminum and manufactures of aluminum of domestic production were exported valued at $166,876 in 1904, at $290,777 in 1905, and at $364,251 in 1906.

PROGRESS OF THE ALUMINUM INDUSTRY.

The manufacture of aluminum in America has been summarized recently in a brief article.[b] The growth of this industry in the United States coincides with the development of the Pittsburg Reduction Company, the name of which has recently been changed to the Aluminum Company of America. Operating under the patents of Charles M. Hall, the present vice-president of the company, the establishment and development of the aluminum industry have greatly reduced the price of aluminum to consumers, for prior to Mr. Hall's invention in 1886 the price of imported aluminum in our markets was about $15 per pound. Shortly after 1888, when the works of the Pittsburg Reduction Company were started, the price of imported aluminum dropped from $7 and $8 per pound to $4 per pound. The Pittsburg Reduction Company soon reduced the price of the metal to $2 per pound, and in 1893 the price ranged from 65 to 75 cents. From 1901 to 1905 the prices per pound of No. 1 aluminum ranged from 33 to 38 cents, according to the quantity purchased, and in 1906 the price averaged 36½ cents. In 1907 aluminum is only a little higher in price

[a] Consumption.
[b] The manufacture of aluminum: Bull. Am. Iron and Steel Association, April 1, 1907.

than it was a year or two ago, this metal having failed to increase materially in price with the marked increase in the price of copper, iron, tin, antimony, and other base metals. The reasons for this may perhaps be found in the great increase in production of the metal and in the improved methods of manufacture. On May 11, 1907, quotations of No. 1 ingots, 99 per cent, were 49 cents, and No. 2 ingots, 90 per cent, were 48 cents per pound.

Recent plans of the Aluminum Company of America include the erection of a model factory town, comprising 200 new houses for its employees at its factories in Massena, N. Y., and a continuous mill for rolling aluminum sheets at its New Kensington, Pa., plant. Ordinarily this company supplies its products in the form of ingots, the rolling and stamping and the production of aluminum utensils being distinct lines of industry carried on by independent manufacturing concerns, although the company has supplied one manufactured product in large quantities, viz, aluminum wire.

A fact of considerable significance to the aluminum industry at large concerns both the Hall and the Bradley patents, under which aluminum production in this country is now carried on. According to the United States Patent Office records, the Hall patent, No. 400766, was granted April 2, 1889, for a term of seventeen years, and it has neither been renewed nor extended. The Bradley patent, No. 468148, is due to expire February 2, 1909, it having been granted February 2, 1892, for a term of seventeen years. These patents cover the method of applying heat to the bauxite in the furnace and they so cheapened the cost of producing aluminum as compared with the cost of the old crucible method as to put the latter method out of competition.

Already there are projects under way which, if realized, will place in the field several competitors for the aluminum trade. One of these projects, it is reported,[a] will be located on Cumberland River, about 25 miles below Williamsburg, Ky., where there is a fall approximating 65 feet in the river. The enterprise involves the construction of a dam to back the water some miles and give a water storage ample to provide 20,000 horsepower at any season of the year. The utilization of this power in the form of electricity, coupled with good railway facilities, a fairly central location between the two developed bauxite fields, and proximity to new sources of supply would seem to afford unusual opportunities for the reported project, particularly at a time when the manufacturing field will be open to competitors.

The demand for aluminum is so active as to cause a continued shortage on the market. The rapidly increasing variety of uses for aluminum is probably responsible for this condition, for there has been no lack of preparation and effort on the part of manufacturers, both domestic and foreign, to supply the metal. The supply of aluminum can not be increased at will, as is the case with many commodities.

The many and widely diverse purposes for which aluminum has been found suitable have been summed up in previous volumes of Mineral Resources and in trade journals. Among the newer uses are in machine construction, as in crank cases and gear boxes for motor cars, for paneling insides of underground railway cars, for electric wire, and for new alloys, pigments, and metal plating; and the aluminum cell as a lightning arrester has proved to be a valuable addition to lightning-protecting devices.

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[a] New York Commercial, February 1, 1907.

During recent years the price of tin has been very high, and since adequate new supplies of ore have not been discovered, substitutes for tin must be used in manufactures. Mr. L. Parry[a] has summed up a number of possible substitutes. Aluminum he regards as probably the most available substitute for tin in the great majority of uses to which that metal is put, owing to the diminution in the price of aluminum, the practically limitless supply of the raw material, and the favorable physical properties of the metal.

The consumers of aluminum will doubtless welcome additional producers of the metal, who may in time relieve the pressure on the market, but it is difficult to imagine that even with active competition the output will gain much headway over the demand.

ALUMINUM SALTS.

PRODUCTION.

In the quantity of alum produced in the United States in 1906 there was an increase of 55 per cent, the value per ton remaining about the same as compared with corresponding totals for 1905. Both the production of aluminum sulphate and the importation of aluminum salts showed a slight decrease in quantity as compared with the report for 1905.

The following table shows the production and imports of alum and aluminum sulphate for the years 1902 to 1906:

Production and imports of aluminum salts into the United States, 1902–1906, in short tons.

Year.	Production.						Imports.[a]		
	Alum.			Aluminum sulphate.					
	Quantity.	Value.	Per ton.	Quantity.	Value.	Per ton.	Quantity.	Value.	Price per ton.
1902	8,539	$299,500	$27.00	80,075	$1,938,671	$24.25	1,267	$38,043	$30.03
1903	7,574	210,910	27.85	80,726	1,614,520	20.00	2,162	107,948	49.93
1904	11,563	319,189	27.60	74,481	1,417,867	19.04	896	19,991	22.31
1905	10,114	289,716	28.65	93,917	1,660,515	17.67	1,282	26,242	20.47
1906	15,613	450,125	28.83	89,246	1,613,050	18.07	1,183	23,193	19.61

[a] Includes alumina, aluminum hydrate, or refined bauxite, alum, alum cake, aluminum sulphate, aluminous cake, and alum in crystals or ground.

UNDEVELOPED DEPOSITS.

Messrs. C. W. Hayes and J. E. Spurr, of the United States Geological Survey, have recently called attention to undeveloped deposits of aluminum salts in the West.[b]

Regarding the deposits near Silver Peak, Nev., brief notes are given on its location, mode of occurrence, manner of formation, and commercial aspects. In this deposit both alum and sulphur occur closely associated in decomposed rhyolite. The sulphur coats thin cracks and crevices, while the alum forms veins, some of them several inches

[a] Parry, L., Substitutes for tin: Min. Jour. Rwy. and Com. Gaz., London, vol. 79, June 2, 1906, p. 728; see also Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906. p. 450.

[b] Hayes, C. W., The Gila River alum deposits: Bull. U. S. Geol. Survey No. 315, 1907, pp. 215–223; Spurr, J. E., Alum deposits near Silver Peak, Esmeralda County, Nev.: Bull. U. S. Geol. Survey No. 225, 1904, pp. 501–502.

thick, that split and ramify irregularly throughout the broken masses of altered rhyolite. The alum is present in far larger quantity than the sulphur, and from the character of its formation the deposit doubtless continues downward. The decomposed rhyolite is so friable that the material could easily be worked on a large scale. The alum and the sulphur would have to be worked together, and the latter could be collected as a by-product.

The report on the Gila River alum deposits of Grant County, N. Mex., is rather more detailed in the treatment of its subject. Topographic and geologic relations, as well as the distribution of the deposits and their relation to the adjacent basalt sheets, are discussed, and a topographic sketch map illustrates the article. The character of the alum rock and certain associated incrustations are carefully described and a considerable number of analyses given. The alum rock is extremely altered and leached, and consequently porous; analyses indicate that it is essentially the silicate of aluminum. The incrustations observed are of two classes, (a) alunogen, the hydrated sulphate of aluminum, and (b) halotrichite, the double sulphate of aluminum and iron. These materials have been derived from the alum rock by leaching followed by deposition from solution wherever conditions were favorable for their accumulation. The alum rock itself probably still contains an almost unlimited supply of soluble sulphates, and upon this fact depends the value of the deposit, although the present surface accumulations of alunogen probably amount to thousands of tons besides. No test has been made of the rock below drainage level, but it is probable that here, where leaching could hardly have taken place, will be found the largest quantity of soluble constituents.

In view of the rapidly growing demand for alum and aluminum sulphate in the arts, in sanitary engineering, and as a source of the metal, there is reason to believe that such deposits as these will in time be utilized. The essentials upon which the successful development of both the Nevada and the New Mexico deposits seem to depend are transportation facilities and skill in chemical engineering.

LITERATURE.

A great deal has been written about bauxite, particularly in French and German, although there is a fairly extensive list of papers on the subject in English. English and American writers, however, have devoted considerable attention to the metallurgy of aluminum, for the reason that in these countries the most rapid advances have been made in the extraction and uses of the metal. A few of the principal papers, mainly American, are listed below, together with a few shorter, but important, technological articles that have appeared recently in trade papers:

Aubrey, A. J. The refractory uses of bauxite: Eng. and Min. Jour., Feb. 3, 1906, pp. 217–218.

Berger, W. F. B. Bauxite in Arkansas: Eng. and Min. Jour., Apr. 14, 1904, pp. 606–607.

Branner, J. C. The bauxite deposits of Arkansas: Jour. Geol., vol. 5, 1897, pp. 263–289.

Engineering and Mining Journal. Bauxite brick: Issue for Jan. 19, 1905, p. 154.

Hayes, C. W. Bauxite: Mineral Resources U. S. for 1893, U. S. Geol. Survey, 1894, pp. 159–167.

Hayes, C. W. The geological relations of the southern Appalachian bauxite deposits. Trans. Am. Inst. Min. Eng., vol. 24, 1895, pp. 243–254.

——— Bauxite, its occurrence, geology, origin, economic value: Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1895, pp. 547–597.

——— The Arkansas bauxite deposits: Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 3, 1901, pp. 435–472.

——— Bauxite in Rome quadrangle, Georgia-Alabama: Geol. Atlas U. S., folio No. 78, U. S. Geol. Survey, 1902, p. 6.

——— The Gila River alum deposits: Bull. U. S. Geol. Survey No. 315, 1907, pp. 215–223.

Holland, T. H. The occurrence of bauxite in India: Records Geol. Surv. India, vol. 32, pt. 2, 1905, pp. 175–184.

Horton, J. The manufacture of aluminum: Trans. Eng. Soc. School of Prac. Sci., Toronto, No. 18, 1905, pp. 113–123.

Hunt, Alfred E. Aluminum (and bauxite): Mineral Resources U. S. for 1892, U. S. Geol. Survey, 1893, pp. 227–254.

——— Bauxite: Trans. Am. Inst. Min. Eng., vol. 24, 1895, pp. 855–861.

Institution of Mechanical Engineers, minutes of meeting, alloys of aluminum and copper: Engineering, Mar. 8, 1907, pp. 299–307.

Judd, Edward K. Aluminum: Mineral industry during 1905, pp. 11–22.

——— The bauxite industry of the South: Eng. and Min. Jour., Mar. 23, 1907, pp. 574–575.

McCalley, H. Bauxite, The valley regions of Alabama: Alabama Geol. Survey, pt. 2, 1897, pp. 79–84; also descriptions of Calhoun and Cherokee counties.

Metallurgie, Aluminum von der Weltausstellung in St. Louis: Nov. 22, 1904.

Packard, R. L. Aluminum (and bauxite): Mineral Resources U. S. for 1891, U. S. Geol. Survey, 1892, pp. 147–163.

——— Aluminum: Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1895, pp. 539–546.

Paint, Oil, and Drug Review, Aluminum paints: Aug. 15, 1906, p. 30.

Phillips, Wm. B., and Hancock, David. The commercial analysis of bauxite: Jour. Am. Chem. Soc., vol. 20, 1898, pp. 209–225.

Richards, Joseph W. Aluminum, its history, occurrence, properties, metallurgy, and applications, including its alloys: Baird & Co., Phila., 3d ed., 1896.

Schnatterbeck, C. C. Aluminum and bauxite: Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, pp. 285–294.

Spencer, J. W. Bauxite (the Paleozoic group): Georgia Geol. Survey, 1893, pp. 214–239.

Spurr, J. E. Alum deposits near Silver Peak, Esmeralda County, Nev.: Bull. U. S. Geol. Survey No. 225, 1904, pp. 501–502.

Struthers, Joseph. Aluminum and bauxite: Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, pp. 265–279.

Sutherland, James. The preparation of aluminum from bauxite: Eng. and Min. Jour., Oct. 3, 1896, pp. 320–322.

Watson, T. L. The Georgia bauxite deposits, their chemical constituents and genesis: Am. Geol., vol. 28, 1901, pp. 25–45.

——— Bauxite deposits of Georgia: Georgia Geol. Survey, Bul. No. 11, 1904.

ANTIMONY.

By Frank L. Hess.

INTRODUCTION.

Stibnite (Sb_2S_3), the sulphide of antimony, is widely distributed through the mineral-bearing regions of the world and forms the most important ore of antimony. Besides the sulphide there are a number of ores of less value. Senarmontite and valentinite, the oxides, contain theoretically 83.3 per cent of antimony, but, owing to the included impurities, from 30 to 65 per cent as found in nature. They are little used as ores. Kirmesite, antimony oxysulphide (SbS_2O), a cherry-red mineral carrying theoretically 75 per cent of antimony, is rare and but little known in this country. Antimony ochers, the hydrous-antimony oxides, such as stibiconite ($Sb_2O_4H_2O$), volgerite ($Sb_2O_5\,4H_2O$), stibianite ($Sb_2O_5H_2O$), and others are found at various places, but are unimportant as ores.

Up to the present time the United States has been but a small producer of antimony, owing to the low price of the metal, to the distance of the known domestic deposits from market, and to the low cost of production from extensive deposits in other countries. Hence it has been only in times of high prices that the deposits in the United States could be worked at a profit; and, although there is a constant increase in transportation facilities and the metallurgy of antimony is becoming better and more widely known, it does not seem likely that there will be much increase of domestic production in the near future.

The year 1906 witnessed a remarkable rise in the price of antimony, which had already begun during 1905 and had stimulated production greatly, so that the output of several countries was much increased. Toward the end of the year prices fell. This comparatively sudden rise and fall in prices has been a common phenomenon in the history of the antimony market.

PRODUCTION.

During 1906 Utah, Nevada, Idaho, and Washington produced small quantities of antimony. Stimulated by the active market, companies were formed to work deposits which had been neglected for years. Near Coyoto, Garfield County, Utah, two plants for the production of antimony were started; both are to use volatilization processes for the making of antimony oxide, and from this the metal is to be reduced. These deposits were described by Prof. W. P.

Blake in Mineral Resources for 1883-84.[a] During the current year a reconnaissance of these deposits has been made by a member of the United States Geological Survey.

The ore is stibnite and occurs, with some valentinite (orthorhombic Sb_2O_3) and senarmontite (isometric Sb_2O_3), formed by the oxidation of the sulphide, in masses following the stratification of a sandstone. The deposits occur in the lower part of the sandstone, directly above limestone and conglomerate, and are occasionally found in the conglomerate, forming the cementing material. The ore is very free from impurities and lies in masses from a fraction of an inch to 20 or 30 inches in thickness. Large masses are found also in the shape of bowlders, some of which weigh several tons. The sandstone is in places overlain by a lava, and the origin of the stibnite is probably in some way connected with this outflow.

In Idaho a few tons of antimony ore were shipped from Gorge Gulch, a mile from Burke.[b] Stibnite occurs in a quartz vein from 1 foot to 5 feet wide, which is said to be richly impregnated with the mineral. The vein also carries values in gold, including some native metal. A second ore shoot has been discovered on this vein 1,000 feet east of the first, and is reported to be from 1 foot to 18 inches wide. On the Northern Pacific Railroad, 15 miles west of Thompson Falls, Montana,[c] and about the same distance east of Wallace, Idaho, are other deposits of stibnite which have been worked to some extent. About 1897 a small furnace was erected,[d] and several carloads of antimony oxide were made and shipped. No work has been done since. Antimony deposits are also reported as occurring near Warren, Idaho County, and Ketchum, Blaine County.

In Washington antimony is being mined in Okanogan County, near Methow. Some ore was taken out during 1906, but none was shipped. The ore must be hauled in wagons 23 miles to Pateros, on the Columbia River, from which point it is transported 72 miles by steamboat to the railroad at Wenatchee. A small quantity of ore is reported to have been mined in Snohomish County and shipped during the year.

In Nevada there was a small output in the Bernice district, 75 miles east of Lovelocks. It is claimed that the ore carries a considerable amount of silver. Two hundred tons are said to have been shipped from Humboldt County, adjacent to Lovelocks.

At Eckley, Curry County, Oreg., a small quantity of ore was mined, but none was shipped owing to the distance from market. Samples of the ore assayed have shown high values in gold. The deposit is 30 miles from the railroad, and the roads are bad during most of the year.

Interest has been revived in the deposits of antimony near Antimony, Howard County, Ark., which have attracted attention periodically for years, and it is possible that there may be some output during 1907.

No production was reported from the California deposits, most of which are in rough country far from railroad facilities.

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[a] Blake, W. P., Mineral Resources U. S. for 1883-84: U. S. Geol. Survey, 1885, pp. 643-644.
[b] Bell, Robert M., Eighth Ann. Rept. of the Mining Industry of Idaho for the year 1906, pp. 158-159.
[c] O'Leary, J. J. The antimony belt in the Coeur d'Alenes: Eng. and Min. Jour., February 9, 1907, p. 284.
[d] Letter, Hon. Jos. M. Dixon, October 8, 1907.

By far the greatest quantity of antimony produced in the United States from domestic ores is that contained in antimonial lead. During the year a production of 10,546 tons of antimonial lead containing 1,362 tons of antimony was reported by the refineries of the country. It is estimated that about one-fourth of this was from foreign ores, so that the production from domestic ores was about 1,021 tons. Most of this antimonial lead was used in making antifriction metals. This quantity is about one-half that produced during any year for the preceding five years, and was less than the trade requirements, so that metallic antimony was melted with lead to supply the demand. The production during the last six years has been as follows:

Production of metallic antimony from domestic and foreign ores and that contained in antimonial lead in the United States, 1902–1906, in short tons.

Year.	Contained in antimonial lead. [a]		Produced from foreign and domestic ores.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	1,362	[c] 544,800	404	58,149	1,766	602,949

[a] Antimony estimated at 25 per cent of the total quantity of hard lead produced from both foreign and domestic ores, except for the year 1902, when an average of 27 per cent was taken, and the year 1906, when the actual content of antimony was determined by the smelters.
[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.

In 1905 the imports for consumption of antimony and antimony ore reached the highest point in the record dating back to the fiscal year ending June 30, 1867. They were valued at $484,254. In 1906 this value was exceeded by more than $1,000,000, as is shown in the following table:

Antimony and antimony ore imported and entered for consumption in the United States, 1902–1906, in pounds.

Year.	Metal and regulus.		Crude antimony and ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1902	5,388,739	$333,601	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
1906	10,305,734	1,391,289	1,972,658	125,841	1,517,130

The imports of salts of antimony for the last four years have been as follows:

Salts of antimony imported and entered for consumption, 1903–1906.

1903	pounds..	916,468	$66,469
1904	do....	981,026	70,668
1905	do....	1,010,228	80,130
1906	do....	764,070	99,251

FOREIGN PRODUCTION OF ANTIMONY.

The figures of production in foreign countries are quite unsatisfactory, for, as obtained, they generally include ore, regulus, antimony, and sometimes oxides or other compounds. The principal producing countries and their outputs are as follows: China[a] (1905), 6,288 tons of metal and regulus, valued at $210,802, and in 1906, 8,216 tons of metal and regulus, valued at $384,340. These are the figures obtained by the customs officers and probably do not include much of the junk trade or antimony produced and used in the country. France (1905), 14,826 tons of ore, valued at $200,381. The only returns available for 1906 are exports of metal from St. Étienne, valued at $34,351.[b] Italy (1905), 5,601 tons of ore, valued at $42,590. Bohemia (1905), 833 tons regulus and refined antimony, valued at $103,733, and 1,046 tons of ore, valued at $29,029. Austria (1905), 1,844 tons of ore, valued at $22,542. Japan, Turkey,[c] and New South Wales[d] (1905), ores or metals, less than 500 tons each. Portugal, Servia, Spain, Victoria, Queensland,[e] and Germany (1905), less than 100 tons each of metal or ore, in the order named. Mexico[f] (1906), 2,665 tons of metal and 197 tons of ore, valued at $566,690. Canada[g] (1906), 1,876 tons auriferous ore. Turkey,[c] Corsica,[h] and Queensland[e] (1906), between 500 and 1,000 tons of ore each. Peru,[i] South Africa, and Sweden[j] (1906), 100 tons or less, metal or ore.

USES.

The larger part of the output of antimonial lead in the United States, which contains most of the domestic production of antimony, goes into the manufacture of babbitt and other antifriction metals. According to the requirements of the railroads, babbitt metal consists of 88.9 per cent tin, 7.4 per cent antimony, and 3.7 per cent copper, but in most babbitt and other antifriction metals the tin is largely replaced by lead.

Antimony has the property of hardening lead when melted with it, and in the smelting of antimonial ores much hard lead is produced. This lead is not sufficiently malleable for rolling and pressing, and until the recent rise in the price of antimony hard lead sold for a less price than soft lead. In order to dispose of it profitably, a considerable amount of antimonial lead was formerly placed upon the market as shot, for which it is well adapted, while other quantities were used in solder. In the latter case the antimony replaces lead and is purely an adulterant. Alloys of antimony and lead expand upon solidifying and make excellent metal from which to cast type, since it will fill the corners of the mold. Type metal contains varying quantities of antimony, generally less than 40 per cent, alloyed

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[a] Returns of Trade and Trade Reports, Imperial Maritime Customs, China, for 1906, Shanghai, 1907, p. 29.
[b] Brunot, Hilary S. Daily Cons. and Trade Repts., April 6, 1907.
[c] Harris, Ernest L. Daily Cons. and Trade Repts., July 19, 1907.
[d] Ann. Rept. Department of Mines, New South Wales, Sydney, 1906–7.
[e] Ann. Rept. of the Under Secretary for Mines, Queensland, for 1906, Brisbane, 1907, p. 23.
[f] Figures furnished by Departmento de Fomento, Mexico.
[g] Figures furnished by Canadian Department of Mines.
[h] Corsica's Minerals: Min. Jour. (London), May 18, 1907, p. 665. Quoted from report of British Vice-Consul Southwell.
[i] Klinge, German. Estadistica minera del Perú en 1906, Bul. 54, Cuerpo de Ingenieros de Minas del Perú, Lima, 1907, pp. 12, 28.
[j] Sveriges Officiella Statistik, Bergshandteringen, for 1906, 1907, p. 17. Part of the figures, for which authority has not been specifically given, are from the British Mines and Quarries; 1905, pt. 4, Colonial and Foreign Statistics.

with lead, tin, and sometimes copper, zinc, bismuth, and nickel. 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. Pewter and britannia were formerly much used for tableware. A use of antimony which shows at present some degree of growth is its use as a pigment. It is now used in France, Germany, and Italy, and its use is stated by current trade papers to be encouraged by the Governments of France and Germany. The oxide makes a white and the sulphide a red paint. It is claimed that it is not poisonous, as is lead when used in paints, and to be more permanent and sunproof than zinc paint. The largest dealers in antimony in this country, however, after investigation of the use of antimony pigments, did not find it desirable to enter into this branch of the business, and such pigments remain practically unknown upon the American market, with the exception of the chromate which under the name of "Naples yellow" is used as a fine artist's color. Naples yellow and some of the oxides are used as ceramic colors.

Antimony in the form of metal and oxide is used in making flint glass. About 1¼ pounds of each per ton of "batch" is used.

Antimonial lead is used for storage batteries, for lining lead chambers in making sulphuric acid, and in making coffin trimmings and toys. Antimony combines readily with many metals, from some of which it may be easily volatilized under the heat of the blowpipe. Such an alloy of antimony and gold is used as a solder in jewelry. Considerable quantities of antimony sulphide are used in vulcanizing rubber.

PRICES.

Antimony metal prices vary considerably with the brand, the brand ordinarily indicating a difference in the purity of the metal. The year opened with Cookson's and Hallett's at 15 cents per pound; other brands at 14.50 cents per pound. The lowest price reached during January was 13.75 cents per pound and 13.25 cents per pound, respectively. By May Cookson's and Hallett's rose to 28 cents per pound, with other brands reaching 27.50 cents per pound. In December the price was 25 to 25.50 cents per pound for Cookson's, 24.50 to 25 cents per pound for Hallett's, and 23.50 to 24.50 cents per pound for other brands. Antimonial lead commanded a premium over soft lead during the year, which made it sell as an antimony-lead alloy whose value was based almost directly upon the value of the component metals. Thus, with lead at 6 cents and antimony at 25 cents per pound, hard lead carrying 25 per cent of antimony would be worth 10.75 cents per pound. The market price would probably be one-fourth to one-half of a cent below this figure.

As to the value of antimonial ores, the following may be quoted from an article by F. T. Havard, in the Engineering and Mining Journal of December 1, 1906. Prices refer to the English market:

Discussing now the question of the scarcity of ore, and particularly of high-grade ore, and the suggested consequent diminution of the supply of antimony, we find that the argument does not bear examination, because, although the ore on the market is of low grade, it is coming forward in much larger quantities now than at any other time, so that the actual quantity of antimony going to metallurgical works is increased rather than diminished. As to the question of speculation, buying in and "cornering" of the supply, it is true that dealers and brokers have attempted to coerce the market with some degree of success. It is reported, for instance, that one French dealer in Lyon bought in large quantities in the early part of the year, and he is supposed to have realized at a great advantage to himself. We may, however, assume that any stocks now held by dealers have been bought in at such a price as precludes selling out at less than 80 or 90 pounds (sterling), so that unless fresh and large sources of supply should drown the market with ore, the prices will probably be maintained for some time to come.

With regard to the price paid per unit of antimony in ore:

In 1904, 4s. and 5s. per unit was expected for 50 per cent sulphide ore, when regulus was worth 25 and 35 pounds (sterling).

In 1905, 6s. and 8s., when regulus was being sold at 35 and 60 pounds (sterling).

In 1906 prices have ranged from 8s. to 15s., and in some cases above 15s., when the price of regulus rose from 60 to 120 pounds (sterling). In fact, in May dealers were still offering ores to smelters on the old formula $0.9\ T\ (P-330) = V$, c. i. f., in which T represents the content of antimony in percentage, P the market price of the regulus, and V the value in francs, c. i. f., Havre, Marseille, Antwerp, or Hamburg. Of course the price for low-grade, mixed, and refractory ores was considerably less per unit of antimony.

For the purposes of discussing the prices paid for antimony-carrying materials, and also with a view to describing the various processes used for extracting the metal, I shall classify the different kinds of ore now appearing on the market under the following heads:

(*a*) Auriferous, with 40 to 70 per cent of antimony in the form of sulphide, several ounces of gold, together with, in some cases, payable silver. The chief sources of these ores for European markets are Australia, France, Italy, and Hungary. The value per unit of antimony is 13s. and 17s.; gold is generally paid for at 75s. per ounce. Sometimes, however, no pay is given for the precious metals.

(*b*) The same class of auriferous ore, but with less than 40 per cent of antimony; sometimes with payable silver. At the present time this is worth from 8s. to 13s. per unit of antimony. Pay is given for precious metals as under (*a*).

(*c*) Antimony ore, both sulphide and oxide, free from precious metals, with from 40 to 70 per cent antimony. Sources, Austria-Hungary, Australia, Iberian Peninsula.

(*d*) The same class of ore with under 40 per cent antimony, from the same sources.

(*e*) Mixed copper, antimony, and zinc ores, nearly always carrying some lead and silver, in which antimony is paid for at prices varying from the price of lead to 7s. per unit.

(*f*) Lead concentrate and high-class lead ore, with 40 to 60 per cent lead, 3 to 10 per cent antimony, and generally carrying some silver. Antimony is generally sold at lead price by the mines, and also sometimes by dealers on the consideration that they receive the resulting hard lead at an advantage on the market price.

Of these ores the antimony smelters using what is known as the English process can treat only (*a*) and (*c*); pigment makers and smelters using the French process (*a*), (*b*), (*c*), and (*d*); only general metallurgical works will touch (*e*), while (*f*) is eagerly sought by lead smelters. The ores (*b*) and (*d*) are relatively cheaper than any other class.

BISMUTH.

By Frank L. Hess.

The United States has been but a small producer of bismuth ores, and these have been shipped abroad for refining. Meanwhile this country has imported refined bismuth to a much greater value than its exports of the raw material.

The refining of bismuth does not appear to be attended by any particular inherent difficulty, but the large smelting companies do not care for so small a business, while the smaller firms apparently do not wish to antagonize the foreign firms who now control the business.

The only bismuth production known to have been made in this country during 1906 was from two mines at Leadville, Colo., whose output was 8,334 pounds, for which a value of $12,500 was given.[a]

Bismuth was imported during 1906 to the amount of 254,733 pounds, valued at $318,452, but no record was kept of the importation of bismuth compounds.

Besides the occurrence noted at Leadville, Colo., bismuth ores are known at other localities in that State; in southeastern New Mexico; in southern California; on Charlie Creek, 35 miles north of Nome, Alaska; at Hailey, Idaho; on Reese River, Nevada; and west of Salt Lake, Utah. None of these localities are known to have produced ore during 1906.

Some lead ores carry bismuth, and when lead is refined electrolytically the bismuth remains in the residual mud. It is thought that the lead refineries using this process may turn out some bismuth in the future.

Bolivia produces by far the largest quantity of bismuth, and during 1906 exported bismuth to the value of $722,978.[b]

Other countries, either actual or potential producers of bismuth, are Bohemia, Mexico, New South Wales, Norway, Peru, Portugal, Queensland, Saxony, Spain, and Tasmania.

Most of the bismuth produced is used in pharmaceutical preparations, such as the subnitrate, the combinations with the haloids, the tannate, and others. It is also used in low-fusing alloys or cliché metal, and to a small extent in glass.

The price during 1906, wholesale, ranged around $1.25 per pound, a much lower price than has often held. This lower price is generally supposed to have been due to a desire of the controlling firms to crush out competition, a new refinery having started in Germany.

[a] Personal letter from Smith, John T., mining editor of Rocky Mountain News, Denver, Colo.
[b] Sorsby, W. B. Daily Cons. and Trade Repts., April 9. 1907, p. 12.

NICKEL, COBALT, TUNGSTEN, VANADIUM, MOLYBDENUM, TITANIUM, URANIUM, AND TANTALUM.

By Frank L. Hess.

INTRODUCTION.

The great activity during recent years both in purely scientific and in commercial research, especially along the line of electro-metallurgy, has made possible the reduction of metals before almost unknown. As their properties are determined they suggest new uses for the metals, with the result that there is a growing demand for ores which but a few years ago were useful only as mineralogical curiosities.

Two branches of industry are making this demand, steel manufacture and electric lighting. It has been found that a number of metals when added in small quantities to steel give so remarkable an increase to some of the valuable qualities of steel that the added metals are often referred to as the steel-hardening metals. The best known and most important of these metals are manganese, chromium, tungsten, nickel, vanadium, molybdenum, and titanium. Of these all but manganese and chromium will be treated briefly in this paper. Cobalt, uranium, and tantalum have also been used as alloys for steel, but so far apparently without sufficient success to warrant the continuation of manufacture. In electric lighting tungsten, titanium, and tantalum are occupying a new field, with a promise of increasing importance.

The salts of a number of the metals are used for dyeing, disinfectants, ceramic coloring, and in various other ways. Of the metals mentioned cobalt is the only one of which no use is known to be made in the metallic state, either alone or as an alloy. Owing to their association in nature, nickel and cobalt will be treated together.

NICKEL AND COBALT.

Although the United States is rich in almost all of the useful metals, it does not produce nearly enough nickel, cobalt, or tin for its own consumption, and there seems to be scant promise that it will do so from any of the deposits now known. During 1906, as for a number of years past, this country imported much more nickel, mostly in the form of matte, than it consumed, so that large quantities of the refined metal were exported. The supplies continue to come from Sudbury, Ontario. Only a small quantity of nickel ores was imported from New Caledonia during the year. Considerable quantities of cobalt are produced at Cobalt, Ontario, as a constituent of the rich silver ores. Only one company of the three principal buyers, the Orford Copper

Company, is known to pay for, or even to save, the cobalt contents of the ore. The ore is smelted at Copper Cliff, Ontario, and gives a partial silver recovery and a highly silver-bearing speiss, which is shipped to Camden, N. J., for further treatment. The ore is paid for at the rate of $30 per ton for ore containing 12 per cent of cobalt and over, $20 per ton for 10 per cent ore, and $10 per ton for 6 per cent ore. A large smelter for the treatment of these ores is being erected at Trout Lake, near North Bay, Ontario, which is intended to have a capacity of 3,000 tons of ore a day.

The quantity of nickel in the cobalt ores is comparatively small and is not paid for.

There was no production of nickel or cobalt metal or matte during 1906 from mines in the United States, but a small quantity of concentrates containing an unknown percentage of nickel and cobalt was produced at Comer, Oreg.

During the year Mr. J. S. Diller, assisted by Mr. George F. Kay, made a detailed examination of the nickel deposits near Riddles, Oreg. A report on this deposit by Mr. Kay appears in Contributions to Economic Geology for 1906.[a]

The uses of nickel are well known. Very large quantities are used in nickel plating; large quantities are consumed also in making armor plate, nickel imparting toughness and hardness to the steel. Considerable quantities are used in coinage, though the ordinary "nickel" of the United States coinage contains only 25 per cent nickel, the other 75 per cent being copper. Efforts, thus far unsuccessful, have been made to induce this Government to make a coin of pure nickel.

Much interest was aroused in the southern Appalachian States during the year by the apparently authoritative statement that deposits of cobalt were to be found in these States. Veinlets of titaniferous iron, carrying some cobalt, have been found at a number of places, but so far no considerable deposits have been developed.

Cobalt is used mostly in the form of the oxide, largely for coloring purposes; but this use does not create a large demand.

During the year it was announced that Mr. Thomas A. Edison had perfected a new storage battery, much lighter and more efficient than the older forms, which was in part made of cobalt. In a letter from the Edison laboratory it is stated that the manufacture of this battery had been given up, owing to the high price of cobalt.

Items have been published stating that the cobalt output, for which the demand is at present not very heavy, might be used to advantage in steel. Experiments have been made with cobalt as an alloy for steels, but none of them seem to have been successful enough to call for the manufacture of cobalt steel. Various experiments are quoted by M. Léon Guillet,[b] who sums them up as follows:

Cobalt steel.—The great likeness which exists between nickel and cobalt would lead one to suppose that they would have the same action upon iron, but such is not found to be the case.

Steels have been examined which contained as high as 30 per cent of cobalt with 0.800 per cent of carbon. Several other specimens were made and examined which contained 50 to 60 per cent of cobalt. All these specimens were of perlitic structure. Although the mechanical tests indicate a higher tensile strength, they do not show any sudden great increase.

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[a] Kay, G. F., Nickel deposits of Nickel Mountain, Oregon: Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, pp. 120-127.

[b] Guillet, Léon, Aciers Speciaux, Paris, 1905, vol. 2,

Interesting results obtained by M. Dumas are given in the following table:[a]

Composition.		Tests for tensile strength.			
Carbon.	Cobalt.	Tensile strength (R.).	Elastic limit (E.).	Percentage of elongation (A. per cent).	Reduction of area (Σ.).
0.250	5.42	46.7	33.5	32	68
0.267	10.80	60.6	44.1	27.5	53
0.287	15.40	66.7	49.7	25.5	55
0.160	19.76	73.8	59.8	18.5	42
0.183	25.16	74.2	56.3	18.5	39
0.117	29.24	76.8	54.9	18	34

In will be observed that there is a slow rise in the tensile strength and elastic limit, and an equally slow diminution in the elongation and reduction in area of cross section.

The results given by Mr. Hadfield appear to lead to the same conclusions. He gives a series of tests as follows:

Composition.		Tests for tensile strength.			
Carbon.	Cobalt.	Tensile strength (R.).	Elastic limit (E.).	Percentage of elongation (A. per cent).	Reduction of area(E.).
0.16	0.53	59.7	42.5	29	43
0.25	1.80	64.5	39.3	19	24
0.38	2.50	82.	59.7	15	15
0.55	4.46	89.5	58	15	17
0.52	6.91	86.5	?	14	13

We have obtained the following results upon steels with about 0.800 per cent carbon:

Composition.		Tests for tensile strength.				Tests.	
Carbon.	Cobalt.	Tensile strength (R.).	Elastic limit (E.).	Percentage of elongation (A. per cent).	Reduction of area (Σ.).	Under blow.	For hardness.
0.886	4.45	121.8	46.6	6	10.6	3	248
0.740	6.72	102.3	51.1	7	14.4	4	241
0.813	9.76	122.6	44.0	5	6.8	3	248
0.750	29.30	118.5	50.5	6	11.5	3	241

M. Guillet concludes from these results that the cobalt steels show no properties that are of industrial interest, and states that "they appear odd a priori from not recalling at all the nickel steels."

Besides the work done on deposits of nickel and cobalt already mentioned, more or less work has been done on deposits near Keller, Ferry County, Wash.; Blackbird, Idaho; Mine La Motte, Mo., and Lovelocks, Nev. So far as known, no work was done at the Gap Mine in Pennsylvania, nor in North Carolina.

[a] In the tables the tensile strength and the elastic limit are given in kilograms per square millimeter and the elongation in a bar whose length is 8 times its diameter.

TUNGSTEN.

The rise in the price of tungsten, which had been noticeable during 1905, continued during 1906, and the production was stimulated accordingly. There was, however, a very great discrepancy in the prices paid for ores in various places, as there is almost sure to be when an article is spasmodically produced in widely separated and often little known localities, while at the same time the market is limited and the isolated small producers have little chance to become acquainted with buyers and market conditions. The isolation of the producers and the small quantities of ore produced by many of the mines make it difficult also for the manufacturer and the miner to get into close touch.

Prices ranged during the year from $5 to $9 per unit for the contained tungsten tri-oxide, or, as it is often erroneously called, "tungstic acid."

As is often the case in mining, much secrecy is sometimes maintained about the mines, with the result that men who consider themselves well informed about the affairs of the camp in which they reside make estimates on the output of the camp that are far from correct. On the other hand, buyers who feel sure they know the output of the different camps are apt to find that ores of which they knew nothing have been bought by others from the same camp.

Several firms had buyers in the field visiting the known producing localities during the year, who gathered up small lots of ore and combined them into car lots for shipment to the factories.

The market for tungsten ores is expanding, and seems now to be almost as sure as the market for copper or other staple ores. Firms wishing to use large quantities of tungsten have had difficulty in obtaining sufficient supplies that could be depended upon for future deliveries.

During the year experiments that have been under way for a long time produced a remarkable incandescent lamp, the filament of which is made of metallic tungsten. As is well known, the ordinary carbon incandescent lamp uses a large amount of electricity, averaging about 3.5 watts per candlepower, while the profitable life of the lamp is comparatively short—little over 500 hours—and the loss of efficiency after burning such a length of time is great, owing to the blackening of the bulb through the dissipation of the carbon filament. This is especially true if the lamp is used on a voltage high enough to give a light approaching whiteness.

Constant endeavors have been made to construct a lamp which would give a better light with less power, and while the best carbon lamps may give somewhat better results than those cited above, there is still much to be desired. Filament lamps have therefore been made from osmium, tantalum, silicon, tungsten, and other substances with this end in view. The Nernst lamp, using a glower made of oxides of the rare earths with a cementing paste, the Cooper-Hewitt mercury-vapor lamp and the Moore gas lamp are the results of efforts at greater efficiency. Of these the tungsten lamp gives promise of being as useful as any, if not the most useful of all. Up to the beginning of 1907 but a few had been put on the market, owing to the necessity of working out a number of details connected with their manufacture.

A writer in the Engineer (Cleveland and New York) for December, 1906,[a] gives the following table comparing various forms of incandescent lamps:

Comparison of various kinds of incandescent lamps.

Kind.	Highest voltage.	Watts per candlepower.	Profitable life.	Lowest candlepower lamps made.
			Hours.	
Cooper-Hewitt	220	0.15-0.33	7,000+	200
Nernst	220	1.5 -2.00	800	25
Osmium	47	1.5	700	Not given.
Tantalum	110	1.5	600	Not given.
Zirconium	110	1.0	500	Not given.
Tungsten	110	1.05	1,000+	40
Carbon	220	3.5	800	3

This table is, however, evidently not very reliable, as it exceeds the claims of the dealers and manufacturers as to the efficiency of several of the lamps. Thus a claim of 2 watts per candle is made in the circular of the American dealers in the tantalum lamp; and a life of only about five hundred hours is claimed for both the tantalum and the carbon lamps in a letter to the present writer from one of the largest factories.

Of the lamps tabulated the Cooper-Hewitt mercury-vapor lamp is the only one giving a noticeably greater efficiency than the tungsten lamp, but its blue-green color precludes its use in any but restricted fields. The zirconium lamp gives, according to this author, a very slightly greater efficiency than the tungsten lamp, but its profitable life is given as only five hundred hours. He gives the profitable life of the tungsten lamp as over one thousand hours. Tungsten lamps seen in the Tetter-Heany Development Company's laboratory at York, Pa., were said to have been burning over three thousand hours and showed no noticeable depreciation to the ordinary observer. The light is nearly white, and a carbon lamp looks decidedly yellow beside it. Some manufacturers claim a much higher efficiency for the tungsten lamp than that given in the table quoted, saying that lamps are run on one-tenth of 1 watt per candlepower; but it is probable that the life of a lamp giving such efficiency would be greatly shortened, owing to the high temperature at which it must be burned. It is difficult to make tungsten lamps which can work well on a voltage of 110, and it has been proposed to introduce small transformers on each service wire that will reduce the voltage to 20 or 40.

The high efficiency of these lamps is due to the fact that tungsten has a high temperature coefficient, its resistance increasing with increasing temperature, while the resistance of carbon lessens with high temperature.

As stated, the tungsten lamp gives a brilliant white light which is of very pleasing quality, but most persons will probably prefer to use it with frosted globes for reading, writing, or similar purposes. A 110-volt lamp, having a claimed candlepower of 150, has a filament about 12 inches long by about 0.0018 inch in thickness.

One great advantage of the tungsten filament over the carbon filament is that the former, if properly made, does not blacken the globe

[a] Engineer (Cleveland and New York), December, 1906, pp. 569, 593, 633.

with use, while carbon, especially if the voltage is a little high, soon blackens its globe so that a large amount of light is lost. The osmium lamp requires a long filament which is fragile and does not stand shipping well. The tantalum lamp also requires a long filament, but owing to its peculiar construction it stands shipping and handling, and is a great improvement over the carbon lamp; but with age it, too, blackens its globe, and its life is no longer than that of a carbon lamp.

The metals whose melting points are high enough to be used in the manufacture of filaments for incandescent lamps are few. The determination of the melting point of osmium is old and probably not very reliable, but has been given as 2,500° C. The melting points of tantalum as 2,910° C. and of tungsten as 3,080° C. have recently been determined by Dr. C. W. Waidner and Dr. G. K. Burgess, of the Bureau of Standards, Washington, D. C.[a]

During the year a patent was issued to Mr. G. Allen Heany for a tungsten-titanium alloy lamp, whose melting point and efficiency are said to be higher than for tungsten. A titanium lamp introduced during the year will be mentioned under Titanium.

Tungsten alloyed with zirconium is said to form the filament of a recent German incandescent lamp capable of standing 220 volts and having an efficiency of 1.2 to 1.3 watts per candlepower per hour; but as the lamp has not appeared on the market, there may be serious drawbacks to it.

The manufacture of pure tungsten is a difficult matter owing to its affinity for carbon, oxygen, and other impurities, which greatly lower its melting point. Much secrecy is maintained about the manufacture of tungsten by the different firms converting it; but in a general way it may be said that the common practice is to fuse wolframite, if that ore is used, with sodium carbonate, reducing the tungsten to a sodium tungstate. This is then treated with a strong mineral acid, forming tungstic oxide (WO_3), a yellow powder. If scheelite is used, it may be treated directly with a mineral acid and the tungstic oxide obtained. Wolframite is too slowly soluble to be treated cheaply in this more direct way. The tungstic oxide is mixed with carbon in some form and strongly heated in crucibles, and the tungsten is obtained as a metallic powder which contains more or less carbon. The tungstic oxide is also reduced electrically, but again contains carbon.

One method of manufacturing filaments from tungsten is said to be by taking as pure a tungsten powder as can be obtained and amalgamating it with cadmium and mercury. This amalgam is squeezed through a die into filaments which are heated by an electric current in vacuo; although the cadmium and mercury are thus expelled, traces of them still remain in the filament and are possibly the cause of blackening the globe somewhat, which sometimes occurs under high voltage or long use.

Another process is the preparation of a tungstic colloid by dialysis. This colloid is "squirted" into a filament and then reduced to metal by passing an electric current through it in an atmosphere of hydrogen.

Metallic tungsten has been made into an electrode for use in the arc lamp, and is said to give a flaming arc with a high lighting capacity.

The very high melting point of tungsten has suggested its use for crucibles, and for certain inert substances these might have a definite use.

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[a] Communicated by Dr. G. K. Burgess.

Large quantities of sodium tungstate are manufactured, much of which is said to be used in fireproofing cloth for curtains, drapery, etc., and as a mordant in dyeing. Other tungsten salts are used in weighting silks. When the silks are dyed, tungsten salts, owing to their high specific gravity, are introduced to give more apparent weight to the fabric.

Colorado.—During 1906 Boulder County, Colo., was the greatest producing locality. Some work was done in this field during the year by Mr. Waldemar Lindgren, of the United States Geological Survey, who has written a short description of the deposits, for publication in the current volume of Economic Geology. Mining has been carried down to a depth of between 200 and 300 feet, and the ores are apparently of about the same grade as nearer the surface. The ore is wolframite.

California.—There was considerable activity in tungsten mining in California during the year, and there will probably be still more in 1907. There is a good deal of work being done in the neighborhood of Randsburg, along the Kern–San Bernardino County line, where scheelite (calcium tungstate) occurs in the gold mines and also in quartz veins unaccompanied by gold. At the Sidney mine, in the Stringer district, 5 to 6 miles southwest of Randsburg, scheelite occurs in thin veins, up to 4 inches in thickness, to a depth of over 200 feet.

The most important known tungsten vein of the vicinity is on the Papoose claim, at Atolia, 4½ miles southeast of Johannesburg, on which large improvements were made and much work was done during 1906.

A small quantity of scheelite was also produced in the Amalie district during the year. This district is about 35 miles east and a trifle south of Bakersfield, and is reached by a stage ride of about 15 miles from Caliente on the Southern Pacific Railroad; it has produced scheelite at irregular intervals for a number of years.

Scheelite has been reported from Manvel, San Bernardino County, a number of times, but the rocks taken for that mineral have so far proved to be something else. Scheelite is also reported from Kelso, on the Salt Lake Railroad.

A small quantity of wolframite has been found about 12 miles northeast of Raymond, Madera County.

Arizona.—The output from Arizona for the year was small. A few tons of wolframite were shipped from Kingman, Mohave County, that had been obtained at points within a radius of about 50 miles. The deposits at Dragoon, Cochise County, were worked in a small way during the year; and at Benson, a few miles west of Dragoon, a small quantity was obtained. The deposits at Arivaca, 60 miles south of Tucson, were not worked during the year.

Montana, *New Mexico*, *Washington.*—A few tons of tungsten ore were shipped during the year from Lordsburg, N. Mex., Loomis, Wash., and Jardine, Park County, Mont. The ore from the two former places was wolframite, and from the latter scheelite. About 60 tons of scheelite were put on the market from Park County, Mont.

Alaska, *Connecticut*, *Idaho*, *Nevada*, *Oregon.*—There was no known production from the deposits in Alaska, Connecticut, Oregon, Nevada, or Idaho, though considerable development work was reported from Osceola, Nev. More scheelite is reported to have been found in the

Golden Chest mine at Murray, Idaho, where it has been known for several years, and it is hoped that production will begin soon.

Foreign localities.—Tungsten ores are mined in Norway, Spain, Queensland, New South Wales, Tasmania, Federated Malay States, Peru, Bolivia, Rhodesia, and Argentina. Smaller quantities occur in France, Finland, England, New Zealand, Japan, Canada, and other places where old crystalline rocks occur.

VANADIUM.

During 1906 the actual production of vanadium from its ores was begun in Colorado, and a small output was made. A reduction plant was established by the Vanadium Alloys Company, at Newmire, and another plant, at which some vanadium concentrates were made, was put up on Dolores River, 4 miles below the mouth of Disappointment Creek and 20 miles from Cedar post-office, by the Dolores Refining Company. It is 65 miles from Dolores and 90 miles from Placerville. Vanadium is obtained as a by-product in the concentration of carnotite ores, about 20 per cent of the concentrates being V_2O_5. This will be referred to under the heading "Uranium."

At Newmire roscoelite, occurring in a sandstone to which it gives a dull-green color, is roasted with salt, converting the vanadium to a chloride which is soluble in water. The roasted material is then leached and a ferric salt added, which precipitates the vanadium in the form of an iron vanadium compound. This is shipped to Niagara Falls and smelted, by electricity, to a ferrovanadium running about 25 to 27 per cent vanadium and guaranteed to contain not over 2 per cent impurities. It sells for $5 per pound for the contained vanadium.

The following analyses of the ferrovanadium were furnished by the company:

Partial analyses of ferrovanadium.

	1.	2.
Vanadium	27.47	25.65
Carbon	1.78	75
Silicon	.44	.44
Sulphur	Trace.	.044
Phosphorus	.067	.067

Another company is erecting a factory at Pittsburg, Pa., for the manufacture of ferrovanadium from ores imported from near Cerro de Pasco, Peru. The ore is a remarkable new sulphide of vanadium, called patronite, containing about 15 per cent of vanadium. The deposits are said to be large.

No production of vanadinite or allied minerals is known to have been made during the year. These minerals generally occur as thin coatings along joint planes in rocks, and no extensive deposits are known to occur in the United States.

The principal use for vanadium is in steel, especially in connection with chromium. Very small quantities of vanadium give such steel a remarkable rise in tensile strength, while both elastic limit and elongation are good.

The following record of tests, made upon a 2-inch bar of experimental steel, was furnished by one of the large steel companies:

Elastic limit	pounds per square inch..	222,200
Tensile strength	do....	227,300
Elongation	per cent..	11.5
Reduction of cross section	do....	42

The partial analysis of this steel was as follows:

Carbon	per cent..	0.34	Manganese	per cent..	0.40
Sulphur	do....	.025	Chromium	do....	1.00
Phosphorus	do....	.027	Vanadium	do....	.17

Still more remarkable tests have been reported. One company claimed to have made vanadium steel having a tensile strength of 400,000 pounds per square inch, but other details were not given.

The use of vanadium steel in axles and other parts of automobiles is familiar, and a large proportion of the higher-priced machines are said to use it.

Besides its use in steel, Dr. Fritz Ephraim quotes the following uses:[a]

With aniline as a black dye; as V_2O_5 it has been used in place of platinum in the contact process for the manufacture of sulphuric acid (though it is said to be less effective than platinum); as a photographic developer. In medicine salts with potassium chlorate have been used under the name of "Vanadin." Vanadium salts are said to be favorable to the growth of plants; vanadyl phosphate acts physiologically like potassium permanganate; from vanadates and tannic acid a water-proof black ink is made; vanadium salts are used in coloring glass; vanadic acid is used to determine hydroxylamin and hydrazin in the presence of ammonia.

The use of vanadic acid as a pigment has also been advised.

Vanadic acid has properties which commend it as a substitute for true gold bronze With the necessary foresight a handsome color and durable luster can be produced which are little or not at all inferior to true gold bronze. It is unchangeable in the atmosphere, covers well, and according to described methods can be obtained as a very light, fine powder that is easily mixed with gums or varnishes. Attempts to employ metavanadic acid as gold bronze are recommended.[b]

At present the only occurrences of vanadium ores in the United States which seem large enough for commercial exploitation are those in southwestern Colorado, where the vanadium occurs as roscoelite, the vanadium mica, in a sandstone. These deposits are said to be traceable into Utah. This ore rarely runs above 2 per cent in vanadium, and more often less than that. There is a possibility that vanadinite, lead vanadate, may also be found in sufficient quantities in Arizona to become of importance. Vanadinite or related minerals, dechenite, descloizite, etc., occur in small quantities in many parts of the country, especially in the Southwestern States.

MOLYBDENUM.

The occurrences of molybdenum ores in the United States are numerous, being frequent associates of the old crystalline and metamorphic rocks. In the lead-bearing regions the molybdenum ore is apt to be wulfenite (lead molybdate) in the oxidized zone, and molybdenite (molybdenum sulphide) below that zone. The occurrence of molybdenite is, however, much the more common. It is often found

[a] Ephraim, Fritz, Das Vanadin und seine Verbindungen: Sammlung chemischer und chemisch technischer Vorträge, vol. 9, pts. 3-5, Stuttgart, 1904, pp. 83-84.
[b] Gerland, B. W., Ueber einige Verbindungen des Vanadins: Ber. Deutsch. chem. Gesell., Berlin 1876, pp. 874-875.

in metamorphosed limestones in small flakes, sometimes so minute as to be hardly recognizable with a hand lens. In quartz veins the flakes are generally larger, and are sometimes several inches across.

Where molybdenite occurs in small flakes it is very hard to save. Several firms have recently undertaken the working of deposits of this character and have met with failure, although a number of companies advertise their ability successfully to perform the operation by means of oil or water flotation, static electricity, or secret processes. One of the recent failures was said to be a process by which the fine flakes were to be separated from the gangue by an air blast. The ore was a gneiss, throughout which the molybdenite was thinly distributed. With such a process the molybdenite could not be separated from the mica, which occurred in much larger quantity.

Finely flaked molybdenite is being separated by a Denver firm with apparent success. A California firm has experimentally run molybdenite ores through a static electrical machine, with satisfactory results, but it is said that "because of the principle involved in the separation, namely, static electricity, it is impossible to state that this process will treat any particular ore until that particular ore has been treated upon the machine. So far as the readily discernible physical properties of two ores are considered, they may be practically identical, and yet the machine will work one and fail upon the other, by reason of the peculiarities in the conductivity of minerals."[a]

Most molybdenite deposits are too small to justify expensive machinery, and it is doubtful if the market is at present able to take any very great increase in the output. On the other hand, were a constant supply available at prices within the reach of manufacturers, it is probable that the demand would soon increase considerably, for the uncertainty of being able to obtain a regular supply of ore seems to have been one factor in preventing the extensive use of molybdenum in steel, in which it is said to have practically the same effect as tungsten, with the use of a much smaller quantity. It is probable, however, that this statement needs modification, as some steel makers doubt the efficacy of molybdenum in steel.

Wulfenite, the lead molybdate, is more easily saved than molybdenite, and can be separated on ordinary concentrating tables. It is not of so common occurrence as the sulphide, but has been produced in a few localities in small quantities. Wulfenite often carries so many impurities that it is almost impossible to use it.

Besides its use in steel, molybdenum in the form of ammonium molybdate is used to determine phosphorus in iron. In the United States alone its use for this purpose amounts to several tons per year. In Europe ammonium molybdate is used as a fire-proofing material and as a disinfectant for cloth used in railway passenger coaches and for similar uses. It is said to be a strong germicide. Molybdenum salts are said to give a fine blue color in pottery glazes. Efforts have been made to use metallic molybdenum as a filament for incandescent electric lights, but so far these have not proved successful owing to its comparatively low melting point.

Montana.—The only production reported for 1906 was from Homestake, Mont. Deposits at Dillon, Sheridan, Ophir, and other places in the same State are being prospected.

[a] Letter from Mr. H. L. Haehl, April 1, 1907.

Maine.—Molybdenite occurs widely over Maine, but in most places it is sparsely distributed through the rocks, and so far mining ventures have not been successful, though others are projected which may solve the problems presented.

Other States.—California and Colorado have many deposits, none of which are known to have made an output during 1906. There are also a number of nonproducing mines in Washington, Oregon, and Arizona. Excellent specimens have been received from near Vail, Ariz., where the molybdenite occurs with copper ores—a frequent association.

Wulfenite was not reported as a commercial production during the year. It occurs in various places in Utah, Arizona, Nevada, and New Mexico. Wulfenite has been known to exist in the Alta district, Utah, for a long time, but the quantity in sight is not large. It has been reported to the Survey by one firm that the wulfenite of this district contains too many impurities for it to be readily used.

Foreign countries.—The chief sources of supply of molybdenum are Norway, New South Wales, and Japan, all of which export it as molybdenite.

TITANIUM.

Although it has generally been considered as an objectionable admixture, preventing the exploitation of many otherwise good iron ores, titanium seems to be coming into various uses which give promise of making it a valuable element. While generally spoken of as one of the rare elements, it is really one of the more common ones. According to Dr. F. W. Clarke's[a] estimate, it forms 0.43 per cent of the surface rocks of the globe, being much more plentiful than lead, zinc, copper, and other metals classed as "common." It is a component of all the basic and most of the acidic rocks, entering especially into the darker minerals. Schists and gneisses often carry titanium, and it is almost always found in clays in appreciable quantities. This is not only true of surface clays, but it was found in those dredged from the deep parts of the ocean by the *Challenger* expedition.[b]

Many deposits of iron ore carry varying percentages of titanium, such as the iron ores of the Adirondacks and those of Iron Mountain, Wyoming. The iron ores of New Jersey and of the Appalachians also often carry several per cent of titanium. In these ores titanium either replaces iron in the magnetite, or more commonly occurs as ilmenite or rutile. Iron ores containing quantities of titanium approaching 1 per cent or more have generally been avoided, owing to a reported difficulty with thick, pasty slags. It is claimed, however, that when properly handled the slagging of titaniferous ores gives no more trouble than other iron ores,[c] and companies have acquired various deposits of these ores with the intention of working them for iron.

Steel and iron made from iron ore smelted in a blast furnace running on the titaniferous Adirondack ores are said to have taken a prize medal at the London Exhibition of 1851.[d]

Experiments with titanium in cast iron show that it adds greatly to the strength, and ferrotitanium is now being manufactured at a num-

[a] Clarke, F. W., Analyses of rocks from the laboratory of the U. S. Geological Survey, 1880–1903: Bull. U. S. Geol. Survey No. 228, 1904, p. 19.

[b] Communicated by Dr. Eugene V. Sullivan and Mr. George Steiger, of the U. S. Geological Survey chemical laboratory, who have analyzed portions of these clays.

[c] Rossi, A. J., Titaniferous iron ores in the blast-furnace: Trans. Am. Inst. Min. Eng., vol. 21, 1893, pp. 832–867.

[d] Idem., p. 840.

ber of places in this country and in Europe for this purpose. It is said to add also greatly to the tensile strength and elastic limit of steel, and though much secrecy is maintained, it is known that titanium is used by various firms; and it seems probable that some steels, imported as containing vanadium, are really titanium steels.

If titanium will add to the good qualities of steel and cast iron, as its advocates claim, there would seem to be a large future for it, owing to its plentifulness and cheapness, in sharp contrast with the comparative rarity and high price of other metals used for the same purpose, such as vanadium, molybdenum, and tungsten.

Experiments are now being conducted by several firms in an effort to make incandescent electric lamps with titanium filaments. The problems connected with the reduction of titanium to a metal are so difficult, however, that the lamps have not yet been extensively placed on the market. One firm is said to have placed about 1,000 lamps during 1906. The melting point of titanium is very high; private experiments are said to have shown it to be about 200° C. higher than tungsten, with a higher electrical resistance than that metal, so that its efficiency in an incandescent electric lamp is considerably higher.

Titanium as a component of rutile (TiO_2) and titaniferous magnetite is used in the electrodes of arc lamps, and titanium carbide is now coming into use for the same purpose. When one electrode is made of these substances, a block of carbon is used for the other.

Titanous chloride ($TiCl_3$) has been used to some extent in dyeing, as a mordant, but is said to have little, if any, advantage over stannous chloride for the purpose. Titanous sulphate ($Ti_2(SO_4)_3$) is now being used as a stripper and mordant, and titanous potassium oxalate is used as a yellow dye and mordant in the dyeing of leather.

A new use for titanium as a detector of minute quantities of fluorine has been worked out by Mr. George Steiger,[a] of the United States Geological Survey chemical laboratory. A solution of titanium sulphate ($Ti(SO_4)_2$) is oxidized by hydrogen peroxide, and the degree of decolorization of the resulting straw-colored liquid by fluorine is used to determine the quantity of fluorine present. Very small quantities of fluorine can be determined in this way.

In porcelain tile, rutile is used to give a soft, beautiful yellow color. It is also used to color artificial teeth. For this last use, however, only the purer grades of rutile can be employed. The entire demand for titanium ore is still small.

Virginia, North Carolina, Pennsylvania.—During 1906 rutile (TiO_2) was produced at Roseland, Nelson County, Va., where are the best deposits now known in this country. A small deposit was produced in North Carolina in washing for monazite, and a few pounds were produced in Chester County, Pa. The Chester County product is said to be very pure, and in comparative large crystals. They are mostly picked up while fields are being cultivated, and are used by dentists in the coloring of artificial teeth, as mentioned above.

North of Lenoir, N. C., is a deposit of titaniferous iron, a sample from which is composed of menaccanite, magnetite, and rutile. It is said to carry 37 to 41 per cent TiO_2, and to be in large quantity. One firm that has used the ore reports that it is readily converted to ferrotitanium which contains 35 to 40 per cent titanium, and which, by a second process, can be made to contain 65 per cent titanium.

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[a] Communicated by Mr. Steiger.

Wyoming.—At Iron Mountain, Wyo., 40 miles northwest of Cheyenne, is an immense deposit of titaniferous iron ore, carrying over 20 per cent TiO_2, which has recently been described by Mr. Sydney H. Ball.[a]

Other large deposits of titaniferous iron ore occur in the Adirondacks, as stated, and at various other places in the United States and in Canada.

URANIUM.

Uranium ores are of rare occurrence, and so far but few uses have been found for them, though it is likely that more use will be made of them as the metal and its salts become better known.

Experiments have been made with uranium as a steel-hardening metal, but, although they have not been as complete as those carried on with the somewhat commoner metals, tungsten, vanadium, and chromium, they do not so far show that any particularly valuable properties are added to the steel through the use of uranium that are not given by the use of other elements which are at present cheaper.

In the form of an acetate, uranium is used as an indicator in the determination of zinc and in various determinations in organic chemistry. Other salts are used in iridescent glass and pottery glazes. The popular idea of uranium ores is often that they obtain their value from the quantity of radium they contain. This idea is obtained from the fabulous value given to radium in many publications, but up to the present this value is almost negligible, as the uses of radium are yet to be proved other than as a chemical and physical curiosity.

Colorado.—In Colorado there are many occurrences of uranium, principally in the western tier of counties, where it is known at present only in the form of carnotite. During 1906 discoveries of carnotite were made near Meeker, in Rio Blanco County, and have been described by Mr. Hoyt S. Gale, of this Survey.[b] Like those farther south, the deposits occur in sandstones, though of different age. Carnotite occurs, but in less quantity, in Utah also.

Uraninite or pitch blende occurs in the Kirk, Wood, and German mines in Gilpin County. It is said that a fair quantity can be produced from this locality.

A reduction plant using the Haynes process was operated near Cedar, San Miguel County, upon carnotite ores running 2 per cent or less in uranium. Mr. Justin H. Haynes, who is the inventor of the process and is in control of the mill, gives the following description of the process, which is patented:

The ore is crushed to 20-mesh and roasted in an ordinary reverberatory furnace. This is to coagulate the clay, which otherwise forms very troublesome slimes. The roasted pulp is then agitated for approximately one hour in a revolving barrel in a boiling (or hot) solution of sodium carbonate. This extracts the vanadium in the form of Na_3VO_4 and the uranium as $2Na_2CO_3VO_2CO_3$, both of which compounds are soluble and are, of course, the only soluble compounds of the ore formed, that is, iron, lime, etc., remain with the silica. This solution is then filtered with vacuum filters, and sodium hydroxide added to the filtrate to precipitate the uranium, which it does as sodium uranate. This is filtered off and forms our uranium product. The vanadium in the filtrate is then precipitated as calcium vanadate on the addition of water-slacked lime. This forms our vanadium product, but is contaminated by a quantity of calcium carbonate which also forms. The final filtrate consists now of

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[a] Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, pp. 206–212.

[b] Gale, Hoyt S., Carnotite in Rio Blanco County, Colo.: Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, pp. 110–117.

nothing but sodium hydroxide, which, after saving a portion for precipitating more uranium, is recarbonated to sodium carbonate by passing down the flue of the roasting furnace, which is filled with coke and broken stone. It is then ready to use over again. In this way our chemical bill is very small, as we only buy sodium carbonate to supply the sodium in the uranium product and to cover mechanical losses.

The product is shipped to Germany.

Several hundred tons of carnotite-bearing rock were reported as mined and left on the dump at various places. As the demand is small and the ore low grade, it does not pay to ship it far for working. One lot of over 10 short tons of carnotite was shipped to Germany, but the ore was of too low grade to pay.

No production of uraninite (pitch blende) is known to have been made during the year, but there is said to have been a production amounting to over $20,000 during 1905.

Other States.—Besides the Colorado occurrences, small quantities of uranium are said to be found in the Black Hills as uranium phosphate (autunite). Other small quantities, of mineralogical interest only, are occasionally found in Connecticut; in Franklin and Mitchell counties, N. C.; at Barringer Hill, Llano County, Tex.; and in California.

TANTALUM.

Owing to its rarity, tantalum and its qualities are comparatively little known; but, as in the case of the other metals treated in this paper, constant investigations in its metallurgy and properties are being carried on.

The one principal use to which the metal is now put is as a filament in incandescent lamps. These lamps were put on the market in Germany in 1905 and on the American market in 1906. There is a considerable saving in current in their use, as they consume but 2 watts per candlepower, as compared with 3.1 watts per candlepower at the best for the ordinary carbon filament lamp.

An excellent article by W. von Bolton and O. Feuerlein, who developed the tantalum lamp for the Siemens & Halske Actien-Gesellschaft, was published early in 1905, which gives the results of their investigations of the metal.[a]

A portion of this article relating to the tantalum incandescent lamp was quoted by Dr. J. H. Pratt in the Mineral Resources of the United States for 1904.[b]

Some of the properties of this remarkable metal are given in the following condensed translation of a portion of the article cited:

In the cold the metal is extraordinarily inert. The metal is not attacked by hot hydrochloric, nitric, or sulphuric acids, aqua regia, or alkaline solutions, but it is attacked by hydrofluoric acid.

Heated in the air at 400° C. it becomes yellow, like steel, and, like this, when heated to 600° C., or for a longer time at 500° C., it becomes blue. In fine threads heated in the air it burns with little intensity and small flame. It eagerly combines with hydrogen and nitrogen at the beginning of the red glow, forming metallic-looking but brittle compounds. It combines easily with carbon, forming several carbides, which so far as known appear metallic and are very hard, but brittle. From the high atomic weight of tantalum (181) it can be seen that a very small percentage of carbon (atomic weight 12) is sufficient to carbonize a relatively large amount of tantalum.

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[a] Von Bolton, W., and Feuerlein, O., Die Tantallampe, eine neue Glühlampe der firma Siemens & Halske A.-G.: Electrotech. Zeitschr., Berlin, January 26, 1905, pp. 107-109.

[b] Pratt, Joseph Hyde, Production of monazite, zircon, gadolinite, and columbite or tantalum minerals: Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, pp. 1222-1223.

Melted and drawn tantalum has a specific gravity of 16.8. In powder, with oxygen and hydrogen still present, it has a specific gravity of 14. It is a little darker than platinum and of about the hardness of soft steel, with a greater tensile strength. It can be hammered into plates, though individual blows show little effect. It can be rolled and drawn into fine wire, having a tensile strength that is remarkably high, amounting to 93 kilograms per square millimeter, while that of good steel is 70 to 80 kilograms. If a lump of tantalum heated to a red glow is placed under a steam hammer, it may at once be beaten into a plate, which after being heated and hammered several times attains a hardness equal to diamond.

An attempt to perforate such a sheet 1 millimeter thick with a diamond drill running continuously at 5,000 revolutions per minute for three days penetrated but one-fourth of a millimeter, while the drill was much worn. A complete perforation could not be made. Despite this, the plate could still be rolled thinner, a remarkable union of toughness and hardness. If it were only a cheap metal it would be ideal for armor plates. Siemens & Halske A.-G. hope to employ it for dies, drills, bearings, journals, etc.

At 110 volts, for a 32-candlepower lamp, a filament 700 millimeters (about 27.6 inches) long, and for a 25-candlepower lamp a filament 650 millimeters (about 25.7 inches) and 0.05 millimeter in diameter is used. As the filament softens when highly heated, it can not be used in a loop like a carbon filament, so that the arrangement was finally hit upon of looping it back and forth upon metal supports held by a central glass rod.

For 220 volts a filament 1,350 millimeters (about 48.2 inches) long is necessary and becomes impracticable. A filament 650 millimeters long by 0.05 millimeter thick weighs 0.022 gram, so that about 45,000 filaments will weigh a kilogram (about 20,600 filaments per pound). A 0.05 millimeter wire will support 400 grams.

The lamp gives a comparatively white light, and after it has been used for about five hours it gives 15 to 20 per cent more light, owing to the filament changing to the form of a series of semiglobular masses. There is afterwards a diminution of light, but the lamp's life is somewhat longer than that of the carbon lamp. When it burns out, its ends will weld if brought in contact under current, and the lamp will go on burning. It will stand a much greater overload than a carbon lamp, and with 50 per cent overload shows much less blackening of the bulb for the same time. With rising temperature the resistance increases, while with carbon it decreases. It gives a steadier light than a carbon lamp, because it is less sensitive to current changes.

These lamps are now on the market in very small forms to be used on low voltages (2 to 5). The light of all the forms is excellent, approaching the tungsten lamp in whiteness.

Since perfecting the tantalum lamp the Siemens & Halske A.-G. has obtained a British patent (No. 3691-B, 1905) for the making of pens from tantalum. The patent specifications are in part as follows:

Steel pens have the advantage of great hardness and elasticity, but they do not resist the action of chemicals and, in particular, of that of the atmosphere and of ink. Gold pens, on the other hand, offer great resistance to chemical action, but their mechanical properties are relatively inferior. According to the present invention pens are made of metallic tantalum, a metal that is exceedingly resisting against chemical action and that at the same time possesses a high degree of elasticity and hardness. On account of the great hardness of pens made of this metal, they have also a much greater resistance to wear than steel.

The pens can be made either of pure metallic tantalum or of alloys thereof with other metals, and the tantalum can also contain small quantities of other substances, such as carbon, silicon, boron, serving to impart greater hardness thereto.

For the sake of economy, parts of the pens may be made of other materials, such as steel, and only the points, or parts subject to wear or strain, be made of tantalum.

In order to be able to work the tatalum metal satisfactorily it must be previously well fused. By the fusing process it is at the same time freed from impurities and brought to the state of a homogeneous body. The fusing is effected best in vacuo and by means of the electric current. When being mechanically worked, the metal (in particular when it contains a small quantity of carbon or other hardening medium) readily assumes so great a degree of hardness that the further working is rendered impossible, and it must then be carefully reheated or annealed in order to be rendered soft again. In this annealing process care must be taken that the temperature does not rise too high, as otherwise the material is more easily attacked by the oxygen of the atmosphere. In order to prevent too great a heating it is preferable to effect the heating indirectly by bringing large plates or drums to the temperature to which the parts required to be heated are required to be brought, and then to bring the objects of tantalum to be heated in contact with these plates or drums; if, on the other hand, it is desired to raise the tantalum to higher temperatures without being materially affected on its surface, it is of advantage to effect the heating in vacuo, as at very high temperatures the metallic tantalum combines with most substances. The heating in vacuo is preferably effected by electrical means, such as by means of electrical resistances, or directly by passing an electric current through the object to be heated.

In carrying out the manufacture of pens from tantalum metal, the metal having been smelted so as to obtain in the first instance a lump of metal of irregular form, which is in a soft condition, it is worked by rolling, or otherwise, in any suitable known manner into the form of thin sheets, from which the pens are produced by the same means as those employed for the manufacture of pens of other metals. By the said process of rolling the tantalum metal assumes, as before stated, a much greater degree of hardness than before, and it may therefore require to be repeatedly annealed between the several stages of rolling.

After the final stage of rolling, the thin sheets of tantalum metal may be found to be of the right hardness for forming the pens therefrom; if too hard they may be again annealed to a certain extent, or if the pens are required to have a greater degree of hardness than can be attained by merely working the metal, the tantalum may have a small quantity of the before-mentioned hardening substances, such as carbon, added to it. This may either be effected in the first instance when the metal is smelted, a very small quantity, such as 0.1 per cent, of carbon being sufficient for the purpose, or the prepared sheets of tantalum metal may be packed in carbon powder and subjected to a considerable heat for some time.

If an alloy of tantalum with another metal is to be employed, the most suitable metals for this purpose are wolfram and iron, either of these metals being simply added to the tantalum metal when in the fused condition. Care must in this case be taken to protect the tantalum against chemical change, for which purpose the melting is preferably effected in vacuo. The composition of such alloys may vary very considerably, but very suitable alloys for the purpose consist of from 95 to 98 per cent of tantalum and from 2 to 5 per cent of wolfram or iron.

Tantalite, in at least a majority of the cases, occurs in pegmatites or coarse granites.

South Dakota, Colorado, North Carolina, and Texas.—In the United States tantalum ores occur probably in the greatest quantity in the Black Hills of South Dakota. During the year one mass weighing 600 pounds was found; but it generally occurs in much smaller pieces. Dana mentions one mass weighing 2,000 pounds.[a] A smaller lot was shipped from Canyon, Colo., to Germany during 1906. It is found in small lots in Mitchell County, N. C., and a few hundred pounds have been shipped at one time. Prices have ranged from 25 cents to $2.40 per pound.

Texas.—Tantalum occurs in fergusonite (a metaniobate and tantalate of yttrium with other rare earths and uranium) at Barringer Hill, Llano County, Tex.

Other States.—Tantalum has also been found in Alabama, California, Connecticut, Maine, New Hampshire, New York, Maryland, and Virginia, but the occurrences have a mineralogical rather than an economic interest.

Foreign countries.—As stibiotantalite (tantalate of antimony) tantalum occurs in considerable quantity in the Greenbushes District of Western Australia, in the tin placers, where, before its value was known, stream tin had been washed to what seemed to be almost pure cassiterite, but upon analysis, to the great disappointment of the miners, it proved to be largely stibiotantalite.[b]

Tantalite and manganotantalite (tantalate of manganese), manganocolumbite (niobate and tantalate of manganese), and calciotantalate

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[a] Dana, J. D., A System of Mineralogy, 6th ed., 1892, p. 735.

[b] Simpson, Edward S., Greenbushes tin ore. Ann. Prog. Rept., Geol. Survey Western Australia for 1899, 1900, p. 53.

(tantalate of calcium and iron) are found in the Wodgina tin field, Pilbara District, Western Australia.[a] They occur in pegmatite dikes and the detritus from them.

As high as 80s. per pound was paid in the early part of 1905 for ore carrying 80 per cent Ta_2O_5, but the price soon dropped to one-sixth of that sum. About 81 short tons of tantalum ores, valued at $51,173, were reported sold during the year. A considerable amount mined during 1906 is said to remain in the field unsold, owing to lack of demand.

PRODUCTION.

In line with the policy of the United States Geological Survey not to publish figures of production of individual persons or firms unless with their specific consent, the values of the outputs of nickel, cobalt, molybdenum, tantalum, titanium, uranium, and vanadium in 1906 have been combined, although the total is but a small sum, amounting to $34,800, as against $19,785 in 1905 and $73,775 in 1904. The production of concentrated tungsten ores was 928 short tons, valued at $348,867.

The following table shows the production of the concentrated ores of these metals from 1904 to 1906, inclusive:

Production (short tons) of concentrated ores of molybdenum, nickel, cobalt, tantalum, titanium, tungsten, uranium, and vanadium in the United States, 1904–1906.

Mineral.	1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Molybdenum	14	$2,175				
Nickel and cobalt	23	54,000	90	$19,410	....	....
Titanium	44	7,000				
Tungsten	740	184,000	803	268,676	928	$348,867
Uranium and vanadium	45	10,600	4	375	....	[a] 35,800
Total	866	257,775	897	288,461	....	384,667

[a] Includes value of nickel, cobalt, molybdenum, tantalum, and titanium.

PRODUCTION OF NICKEL AND COBALT.

But one small production of nickel and cobalt ores, at Comer, Oreg., was reported for 1906. In the following table is shown the production and value of nickel obtained from domestic ores from 1876 to 1906, inclusive:

Production (pounds) of nickel from domestic ores in the United States, 1876–1906.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1876	201,367	$523,554	1892	92,252	$50,739
1877	188,211	301,138	1893	49,399	22,197
1878	150,890	165,979	1894	9,616	3,269
1879	145,120	162,534	1895	10,302	3,091
1880	233,893	257,282	1896	17,170	4,464
1881	265,668	292,235	1897	23,707	7,823
1882	281,616	309,777	1898	11,145	3,956
1883	58,800	52,920	1899	22,541	8,566
1884	64,550	48,412	1900	9,715	3,886
1885	277,904	179,975	1901	6,700	3,551
1886	214,992	127,157	1902	5,748	2,701
1887	205,566	133,200	1903	114,200	45,900
1888	204,328	127,632	1904	24,000	11,400
1889	252,663	151,598	1905	(b)	(b)
1890	223,488	134,093	1906	(b)	(b)
1891	118,498	71,099			

[a] Rept. Department of Mines for 1905 (Western Australia), 1906, pp. 126–128, 138.
[b] 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 1906, inclusive, is given in the following table:

Production (pounds) of cobalt oxide in the United States, 1869–1906.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1869	811	1882	11,653	1895	14,458
1870	3,854	1883	1,096	1896	10,700
1871	5,086	1884	2,000	1897	19,520
1872	5,749	1885	8,423	1898	6,247
1873	5,128	1886	8,689	1899	10,230
1874	4,145	1887	a 18,340	1900	6,471
1875	3,441	1888	8,491	1901	13,360
1876	5,162	1889	13,955	1902	3,730
1877	7,328	1890	6,788	1903	a 120,000
1878	4,508	1891	7,200	1904	a 22,000
1879	4,376	1892	7,869	1905	(b)
1880	7,251	1893	8,422	1906	(b)
1881	8,280	1894	6,763		

[a] Including cobalt oxide in ore and matte.
[b] Ore mined included under total production of steel-hardening metals.

PRODUCTION IN FOREIGN COUNTRIES.

CANADA.

As usual, much more nickel was imported into the United States during 1906 than was consumed, the greater part of the matte produced in Ontario being shipped to this country for refining. These Canadian exports, as reported by the geological survey of Canada,[a] amounted to 21,252,444 pounds of nickel in matte. This matte contains from 78 to 80 per cent of the combined metals, nickel and copper, in the proportion of about 2 parts of nickel to 1 of copper.

The production of nickel in Canada, as taken from the same publication, since 1902 has been as follows:

Production of nickel in Canada, 1902–1906.

Year.	Ore mined.	Ore smelted.	Matte produced.	Nickel in matte.
	Short tons.	*Short tons.*	*Short tons.*	*Pounds.*
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
1906	343,814	340,059	20,364	a 21,490,955

[a] Nickel contents of ore, matte, etc., at 41.64 cents per pound.

NEW CALEDONIA.

The production of nickel and cobalt ores in New Caledonia, which has hitherto been credited to France, Germany, and England in this publication, is given for the last four years by British Acting-Consul Manning,[b] as follows:

Production (short tons) of nickel and cobalt ores in New Caledonia, 1903–1906.

Year.	Nickel.		Cobalt.	
	Quantity.	Value.	Quantity.	Value.
1903	80,865	....	9,140	....
1904	108,747	....	9,881	$354,940
1905	138,106	$1,097,606	8,729	185,000
1906	144,057	763,738	3,070	48,745

[a] Summary of the Mineral Production of Canada for 1906, pp. 11 and 12.
[b] Min. Jour. (London), vol. 81, April 27, 1907, pp. 560-561.

The average metallic content of ores exported from New Caledonia during 1906 is said to have been 6 per cent, against 7¼ per cent for 1905.

OTHER COUNTRIES.

The production in Norway and from other European deposits is not available at the time of writing. There were 110 short tons of nickel-cobalt ores, valued at $3,000, produced in Mexico in 1906.[a]

IMPORTS OF NICKEL AND COBALT OXIDE.

The imports of nickel for consumption in 1906, as reported by the Bureau of Statistics, were 34,082,040 pounds of ore, matte, and oxide, valued at $1,876,531, which sum includes also $8,963 worth of manufactured nickel.

Fifty tons of nickel ore were imported from New Caledonia during the year.

The imports of nickel for consumption for the last five years have been as follows:

Nickel imported and entered for consumption in the United States, 1902–1906.

Year.	Nickel, nickel ore and matte, nickel oxide, alloys of nickel with copper, etc.		Value of manufactures.	Total value.
	Quantity (pounds).	Value.		
1902	33,942,710	$1,407,521	$30,128	$1,437,649
1903	36,217,985	1,456,605	37,284	1,493,889
1904	19,739,315	1,118,541	2,950	1,121,491
1905	31,072,206	1,958,840	3,291	1,962,131
1906	34,082,042	1,867,568	8,963	1,876,531

In the figures of the Bureau of Statistics the nickel content of the imported ore and matte is given only for the period from July 1 to December 31, 1906, during which time it was 10,123,750 pounds.

During the year the price of nickel, in large lots, varied from 40 to 50 cents per pound. In smaller lots the price ranged from 50 to 65 cents per pound.

The imports of cobalt into the United States during 1906 were considerably less than during 1905—53,934 pounds for 1906, as compared with 70,048 pounds for 1905. In the importations for 1906 were included 12,850 pounds of ore and zaffer. Zaffer is the roasted ore and is used as a blue pigment in painting and enameling.

The following table gives the imports for consumption of cobalt since 1902:

Cobalt oxide imported and entered for consumption in the United States, 1902–1906.

1902	pounds	79,984	$151,115
1903	do	73,350	145,264
1904	do	42,354	86,925
1905	do	70,048	139,377
1906	do	41,084	83,167

The wholesale price for cobalt oxide as given by the trade papers during the year varied from $2.50 to $2.60 per pound.

[a] Letter from Mr. O. Matina, sec. ministerio de Fomento, August 19, 1907.

EXPORTS OF NICKEL.

In 1906 the nickel exported amounted to 10,620,410 pounds, valued at $3,493,643, as against 9,550,918 pounds, valued at $2,894,700, in 1905. The following table shows the nickel exports since 1902:

Exports of nickel, nickel oxide, and matte from the United States, 1902–1906.

1902	pounds..	3,228,607	$924,579
1903	do....	2,414,499	703,550
1904	do....	7,519,206	2,130,933
1905	do....	9,550,918	2,894,700
1906	do....	10,620,410	3,493,643

PRODUCTION OF TUNGSTEN.

During 1906 there were produced 928 short tons of tungsten ores, worth, as nearly as could be learned, $348,867. In this estimate all ores have been reduced to a basis of 60 per cent WO_3. It is thought that these figures are approximately correct, as every effort has been made not only to obtain figures of production, but to check them wherever and whenever possible. The output for the year is a gain of 125 tons, or 15.56 per cent, in quantity and of $80,191, or 29 per cent, in value over the known production of 1905. Boulder County, Colo., produced 565 tons—more than 64 per cent of the total output—valued at $221,627. The output of Boulder County is probably habitually overestimated, and it is likely that these figures will be questioned; but both buyers and producers have been very obliging with figures, and it is believed that the output given is practically correct.

The production of tungsten ores in the United States for the last seven years has been as follows:

Production of concentrated tungsten ores in the United States, 1900–1906.

1900	short tons..	46	$11,040
1901	do....	179	27,720
1902	do....	184	34,040
1903	do....	292	43,639
1904	do....	740	184,000
1905	do....	803	268,676
1906	do....	928	348,867

The price averaged about $376 per ton for 60 per cent WO_3, but varied from $3.50 to $7 per unit. The only imports of tungsten reported are 26 tons of ferrotungsten, valued at $28,289. The percentage of tungsten contained is unknown.

WORLD'S PRODUCTION OF TUNGSTEN ORES IN 1905.

With very few exceptions the latest available figures for the production of tungsten ores, chiefly wolframite, are for 1905. These are given in the following table:

World's production of tungsten ores in 1905.[a]

Great Britain	short tons	193	$55,271
New South Wales	do	[b]251	85,090
Queensland	do	[b c]1,582	487,688
South Australia	do	71	16,446
Tasmania	do	36	11,540
New Zealand	do	64	[d]22,400
Austria	do	65	20,418
Bolivia	do	75	[d]26,250
France	do	28	11,448
Germany	do	[e]42	16,184
Saxony	do	37	12,437
Portugal	do	320	99,413
Spain	do	413	32,111
United States	do	803	268,676
Other countries	do	20	[d]7,000
Total	do	4,000	1,172,372

In round numbers the world's production of tungsten ores during 1905 was 4,000 short tons, worth $1,200,000; and, although but few figures are available (July, 1907), it is probable that the production for 1906 was approximately the same. The production in Queensland in 1906—892[f] short tons, valued at $322,400—showed a very marked decrease from that of 1905, which was in turn a decrease from the output (1,725 short tons) of 1904, but it is thought that this was probably made up in other quarters. New South Wales produced 148 short tons of wolframite, valued at $44,108, and 123 tons of scheelite, valued at $37,241, a fair increase over 1905. In 1906 Tasmania produced 22 short tons, valued at $7,130. There was an estimated production of about 95 tons, valued at $33,977, in the northern territory of Australia,[g] and the output of the United States increased to 928 tons, valued at $348,867. Rhodesia produced 17 tons of wolframite, valued at $7,339, in 1906.[h] The Federated Malay States are known to have made some output during 1906, though figures are not available, and there was probably an increase in the Spanish output. It is thought that there was also an output from Peru. Peru, Bolivia, Argentina, and Mexico are factors of almost unknown possibilities in the tungsten market.

PRODUCTION OF VANADIUM.

In addition to the vanadium ores used at the two mills already described, about 600 tons of ore were reported as mined in Colorado, but unsold. The contents are unknown.

PRODUCTION OF MOLYBDENUM.

One lot of crude molybdenum ore was reported as mined and sold at Homestake, Mont. Small lots were mined at a few places in Colorado, but were not marketed. A small quantity of comparatively pure molybdenite was reported as shipped from Lucerne, Wash.

[a] Figures for foreign countries are taken chiefly from the British official publication Mines and Quarries for 1905, pt. 4, 1907; see also official reports of Queensland and Tasmania for 1906 and of New Zealand, Germany, Saxony, Austria, and France for 1905.
[b] Contains scheelite, 155 tons from New South Wales and 5 tons from Queensland.
[c] Contains small quantity of bismuth ore.
[d] Value estimated at $350 per ton of 2,000 pounds.
[e] Contains unknown quantity of uranium ore.
[f] Contains some scheelite and bismuth ore.
[g] Min. Jour. (London), February 16, 1907, p. 213.
[h] Rept. Exec. Com. Rhodesia Chamber of mines, March, 1907. Bulawayo, 1907.

Australia.—New South Wales produced 37 short tons of molybdenite valued at $23,366,[a] and Queensland produced 145 short tons, valued at $82,956, during 1906.[b]

PRODUCTION OF TITANIUM.

The titanium output amounted to almost nothing outside of the rutile produced at Roseland, Nelson County, Va., the remainder consisting of a few pounds from Chester County, Pa., and a small quantity from South Carolina.

PRODUCTION OF URANIUM.

Besides the quantities mentioned as having been utilized in the Haynes mill and shipped to Germany, 200 tons of uranium ore of unknown value were reported mined in 1906 and on the dumps in Colorado and Utah.

The exports of uranium ore, as given by the Bureau of Statistics, amounted to $6,870, and this figure is used also for the production. Uranium oxide and salts were imported to the value of $11,828.

PRODUCTION OF TANTALUM.

The bulk of the tantalum ore was produced in the Black Hills of South Dakota, with a smaller quantity from Canyon, Colo., and it all went to Germany. The production in North Carolina during 1906, so far as can be learned, amounted to but a few pounds.

The large quantities of tantalum available in Western Australia practically control the market, which is easily supplied.

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[a] Ann. Rept. Dept. Mines, 1906, Sydney, 1907, p. 59.
[b] Ann. Rept. under sec. for mines, 1906, Brisbane, p. 23.

CHROMITE OR CHROMIC IRON ORE.

By Arthur J. Collier.

INTRODUCTION.

The mineral chromite is widely distributed both in the southeastern and the western parts of the United States, where it is usually associated with certain basic igneous rocks, but there are few localities where it occurs in sufficient quantities to constitute an ore of chromium. In the States along the Atlantic slope no deposits of chrome ore are worked on a commercial scale, though it is probable that with the extension of railroad transportation some of the deposits will be exploited. The only active chromite mines in the United States are in California, where there has been a small production for many years.

Chrome ore is used principally in making ferrochrome alloys and for hardening steel, usually in combination with nickel in the manufacture of armor plates. It is also used extensively in the manufacture of chromium salts for pigments. All the product of the California mines for several years has been used in the crude state for linings of copper furnaces.

The principal American markets for chromite are in the manufacturing States along the Atlantic slope, and these are supplied by importation, the chief sources of supply being Asiatic Turkey and in recent years New Caledonia. Smaller quantities are produced in Russia, India, Australia, Greece, Canada, and Newfoundland.

PRODUCTION.

The total production of chromite in the United States during 1906 amounted to 107 long tons, valued at $1,800. The whole quantity was mined by two operators in California and was used in furnace linings. The production of chromite in the years from 1885 to 1906 is shown in the following table, from which it will be seen that the maximum production in the United States for any one year was 3,680 long tons, valued at $53,231, in 1894:

Production of chromite, 1885–1906.

1885	long tons..	2,700	$40,000	1896	long tons..	786	$6,667
1886	do....	2,000	30,000	1897	do....		....
1887	do....	3,000	40,000	1898	do....		....
1888	do....	1,500	20,000	1899	do....		....
1889	do....	2,000	30,000	1900	do....	140	1,400
1890	do....	3,599	53,985	1901	do....	368	5,790
1891	do....	1,372	20,580	1902	do....	315	4,567
1892	do....	1,500	25,000	1903	do....	150	2,250
1893	do....	1,450	21,750	1904	do....	123	1,845
1894	do....	3,680	53,231	1905	do....	22	375
1895	do....	1,740	16,795	1906	do....	107	1,800

IMPORTS.

Chromium is imported into the United States both as crude ore and in various manufactured products. The quantities and values of the different forms of chromium imported during the years from 1901 to 1906, inclusive, are shown in the following table:

Chromate and bichromate of potash, chromic acid, and chrome ore imported and entered for consumption in the United States, 1901–1906.

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
1906	30,098	2,124	[d] 144,666	21,505	43,441	557,594	581,223

[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.
[d] Includes 143,359 pounds of chrome yellow, valued at $21,174.

CANADIAN CHROMITE.

The production of chromite in Canada has increased rapidly in the last few years, though the prices reported are somewhat lower than those in the United States. The following table gives the quantity and value of the chrome ores mined in Canada in the years from 1902 to 1906, inclusive:

Production of chromite in Canada, 1902–1906.

Year	Unit	Quantity	Value
1902	short tons	900	$13,000
1903	do	3,383	33,830
1904	do	6,074	67,146
1905	short tons	8,575	$93,301
1906	do	8,750	92,100

TIN.

By Frank L. Hess.

PRODUCTION.

During the year 1906 the only actual output of metallic tin in the United States was 2,500 pounds produced from 3,750 pounds of concentrates at the Gertie Mine, in the Black Hills of South Dakota. This mine is now 500 feet deep. Buck Creek, Alaska, produced 45 short tons of stream tin, and the Bartels Tin Mining Company, at Cape Prince of Wales, produced about 10 short tons of concentrates, carrying 64 per cent metallic tin, which were shipped to England. About 14 short tons of concentrates were produced in the North Carolina-South Carolina tin field. The estimated value of the total output, including metallic tin and concentrated ores, was $35,600.

Alaska.—Prospecting was actively carried on along the streams flowing to the Arctic Ocean from the hills surrounding Buck Creek and on the streams farther to the east. Much prospecting was also done on the lodes discovered on Potato Mountain and the adjoining hills at the head of Buck Creek; and on Cape Mountain several hundred feet of tunnel were driven and a good deal of drilling was done in the granite with a chilled steel-shot core-drill. Prospecting along creeks between the head of Buck Creek and Cape Mountain is said to have shown the presence of workable values in many of the gravels. Two parties sluiced the tin-bearing gravels of Buck Creek, and it is reported that 400 pounds of cassiterite per cubic yard was found in small areas. The gold content of the gravels, formerly considered as about 40 cents per cubic yard, is said to have been found to be higher since the bed rock is well stripped.

One lot of 30 tons of stream tin averaged 64.3 per cent metallic tin. It was sold in Hamburg, Germany, and brought a good price on account of its purity. Prospecting was also carried on in the Ears Mountain region, and encouraging results are said to have been obtained, though there has been no production of tin from this place. Prospecting was continued on the Lost River deposits, and is said to have shown the bodies of tin ore to be of good size.

Articles have appeared in several periodicals stating that large dredges were to be placed in some of the creeks flowing into Lopps Lagoon, or the Arctic Ocean, to mine stream tin. This is an undertaking which will require very careful preliminary prospecting, and it is more than likely that the gravels will be found to be frozen in much of the region, in which case a dredge would be unable to work. There is some talk of erecting a tin smelter in Seattle to smelt Alaskan ores, but this proposition has not yet taken definite form.

Mr. Adolph Knopf will study the Seward Peninsula tin deposits for the United States Geological Survey during the season of 1907.

South Dakota.—In the Black Hills interest in tin mining has been greatly revived by the high price of the metal, and a number of tin deposits have been reexamined with a view to beginning mining operations. There seems to be little doubt that there are a number of claims having lodes that will yield from 0.5 per cent to 1.75 per cent metallic tin.

North Carolina.—In North Carolina placer deposits have been developed about 2½ miles southwest of Kings Mountain in connection with the veins on the noted Le Doux property. Prospecting in the lode mines has been prosecuted in the various properties of the region.

Texas.—Fifteen miles north of El Paso, Tex., in the Franklin Mountains, a considerable amount of prospecting has been done on the veins which have been known for several years, and five veins have been uncovered through distances varying from 300 to 600 feet; two smaller outcrops have also been uncovered. Cassiterite occurs both as a replacement and as a vein filling fissures in the granite country rock. The feldspar of the granite is frequently impregnated by cassiterite along cracks in such a way that replacement of the feldspar can not be doubted. It is probable that there are placer deposits accompanying these veins, but should they exist it will be difficult to work them because of the scarcity of water, which, however, in quantity probably sufficient for lode mining occurs at a depth of perhaps 45 feet.

California.—During the year an attempt was made to smelt some of the old concentrates at the Cajalco mines near Corona, Cal., but the furnace "froze" with the tin distributed through the slag in the form of shot, and the effort was given up. Prospecting has been continued in Trabuco Canyon, in southern California, and a small quantity of ore was produced, but none has been concentrated.

Idaho.—No new occurrences were reported from Idaho during the year, but some interest has been shown in the little-known stream-tin deposits near Salmon.

PRODUCTION IN FOREIGN COUNTRIES.

From many of the producing countries it is almost impossible to obtain accurate figures as to the output; hence they can be stated only in a general way.

Federated Malay States.—Owing to the very high price of tin during the year 1906, prospecting for the ore was greatly encouraged all over the world, but in spite of this the output of the Federated Malay States, the principal producer, was somewhat less than that for 1905, as that had been less than the production of 1904, because of the impoverishment of many of the shallower and richer placers. The high price, however, allowed the working of ground which would have been much too poor to work under the prices existing in previous years. During the year the British Government, with a view to retaining the smelting of tin in the Federated Malay States, increased the export tariff upon tin.

The production of tin in the Federated Malay States in 1906 was 54,584 short tons as against 57,178 short tons in 1905, a decrease of 2,594 short tons.[a]

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[a] Min. Jour. (London), vol. 81, April 20, 1907, p. 527.

During the year the imports of tin into the Federated Malay States amounted to 8,904 short tons, mostly from Siam and the Dutch East Indies, but including also a considerable quantity of tin from Western Australia, sent to Singapore for smelting.

The exports for 1905 and 1906, in which the United States is given credit only for that tin which was shipped directly to it and not by way of England, were as follows:

Exports of tin from Federated Malay States in 1905 and 1906, in short tons.[a]

Country.	1905.	1906.
United States	18,606	16,543
England	34,736	37,957
Continent of Europe	9,361	8,198
China	532	477
India	1,118	944
Japan	728	618
Dutch East Indies	105	176
Philippines		1
Siam	1	8
Total	65,187	64,922

[a] Wilber, D. F., quoted in Industrial World, March 30, 1907, p. 391.

As a matter of fact, the quantity of Straits tin consumed by the United States was very much larger, but it came to this country by way of England.

The total exports of the Federated Malay States for 1906, according to the figures quoted, exceeded the output and imports by 1,434 short tons. This is accounted for by the fact that the ore is figured as running 70 per cent tin, while it is claimed that a large part of it will run over 75 per cent. The hold-over stock from 1905 may, however, account in large part for this apparent excess of exports. There is no way of ascertaining the quantity of tin left in stock at the close of 1906.

It is probable that the Federated Malay States will have to depend more and more upon the mining of lode tin. At present no large lodes are known, but there are many comparatively narrow veins and stockworks which it will pay to develop.

Siam.—Much prospecting has been carried on in Siam during the year, and tin is being worked in 21 provinces. The annual production is estimated to be about 5,000 short tons, valued at about $2,900,000.

Burma.—Some tin mining is carried on in Burma, and it is claimed that the future output will be large, but so far it is but a small factor in the world's production. No figures are at hand at present for the production of 1906, but 92 short tons of ore were reported as produced during 1905.[a]

China.—The Imperial Maritime Customs reports that during 1906 China exported 4,538 short tons of tin, against 5,020 short tons for 1905 and 3,359 short tons for 1904. Only high prices bring the Chinese tin into the open market. The mines are said to be largely alluvial, only the upper and softer parts of veins being worked.

Banka and Billiton.—Under the influence of the high prices the output was increased over that of 1905. A total quantity of 2,158

[a] Mines and Quarries, Gen. Rept. and Statistics for 1905, pt. 9, 1907, p. 359.

short tons was sold by private tender at Batavia during 1906, and 269,324 slabs, equal to 10,055 short tons, of Banka tin were sold in Holland during the year. The production of Billiton for the year 1905–6 was 4,997 short tons. There has been a gradual decrease in the tin mined in these two islands during the last ten years, except for the considerable recovery within the last two years, owing to the rise in price.

Australia.—As in other countries, tin mining received a great impetus during the year in Australia, with the result that there was a considerable increase in the output, especially in Queensland, where the increase came largely from the lode mines. The production for the year was 5,402 short tons, valued at $2,385,962, the largest output for any year since 1874, being an increase of almost 1,000 tons of ore over the production of 1905, which was 4,418 short tons. The output of tin ore in Queensland since the beginning of tin mining in that country in 1872 to the end of the year 1906 amounted to 121,932 short tons.[a] The percentage of the ores is unknown, but they are supposed to run about 65 per cent.

The feature of tin mining in New South Wales is the operation of dredges, working in the Tingha and Inverell districts. Fifteen dredges are at work, with a number of others planned or under construction. The dredges are some of them working on very low-grade gravel, said to contain but about 2½ pounds of tin per cubic yard. Complete figures for the New South Wales output are not at hand.

The Mount Bischoff mine in Tasmania remains one of the greatest lode tin mines of the world, although its output for the year was exceeded by that of the Briseis-New Brothers Home No. 1 placer mine. During 1906 the former mine produced a total of 1,182 short tons of concentrates. At the Briseis-New Brothers Home No. 1 mine 57,700 cubic yards of gravel, yielding only 111.1 short tons of tin concentrates, were sluiced at a profit. In the Pioneer mine 439,400 cubic yards of gravel gave a yield of 2.156 pounds of concentrates per cubic yard. The total yield of tin ore for Tasmania was 5,010 short tons, valued at $2,711,937.

Tin mining was carried on in the Greenbushes and Wodgina fields of Western Australia, but the quantity produced is not at hand. A large part of the ore is shipped to Singapore for reduction. For several years tantalite has been mined with the tin ore at a profit, but owing to the reduced demand it is now being piled up at the mines waiting for a market.

Bolivia.—The bulk of the output of Bolivian tin is derived from lode mining, although there are workable placers which at times give a small output. The Bolivian tin ore is comparatively impure ore, containing much sulphur, bismuth, arsenic, and antimony. However, the output has become so great that it is playing a considerable part in the world's markets, and there was substantial increase during 1906 over the output of 1905. Only a small part of the Bolivian output is smelted in Bolivia, most of it going to Germany or to England for reduction.

The Bolivian Government has made arrangements for a large increase in the railroad mileage of the country, and when this work is completed it may be expected that there will be a considerable

[a] Ann. Rept. Under-Secretary for Mines, 1906, Brisbane, 1907, p. 23.

increase in the output of tin. Owing to the fact that most of the tin ore of Bolivia is shipped as barilla, or concentrates, the figures of production are quite uncertain, varying greatly as given by different authorities. According to Mr. William B. Sorsby, American minister at La Paz,[a] the Bolivian tin production (exports) in 1906 was 32,375 short tons of barilla, or 19,425 short tons of metallic tin; according to the New York Metal Exchange it was 18,346 short tons of metallic tin. The difference in the figures is striking and not easily explained. It seems probable that the barilla often runs considerably over 60 per cent metallic tin, and that the Metal Exchange figures are too low. As all of the figures given are based on exports, they take no account of the tin produced and used in the country, which would increase the total output somewhat. Some of the mines are large producers. The Chorolque mine is said to be able to put out 200 tons of barilla per month,[b] which would make it the largest known producer.

During the year new deposits of tin are said to have been discovered, in the province of Cochabamba, east of the deposits worked at present.

England.—The high price of tin has caused the reopening of a number of old mines in Cornwall, and this rejuvenation is still going on. In the mines already in operation the present price of tin allows ores hitherto impossible of working to be taken out at a profit.

The ticketings (fortnightly offerings of ore for sale) for tin during the year in Cornwall, in which county are all of the producing English tin mines but one (whose output was 8½ tons of ore), amounted to 6,690[c] short tons, valued at $3,050,230, against 6,493 short tons for 1905. These are estimated quantities, but they are probably not far from correct, and afford a fair comparison for the outputs of the two years. They do not include tin ore obtained by "streaming" in the Red River, nor tin ore sold by private tender.

The exact output of Cornish mines is unknown, but it was probably in the neighborhood of 5,000 tons of metallic tin. Much tin ore is shipped into Cornwall from foreign countries for smelting.

Other countries.—Small quantities of tin are produced in Austria, Finland, France, Germany, Portugal, Spain, Transvaal, Swaziland, Congo Free State, and Nigeria. Prospecting has been carried on during the year in Mexico, New Zealand, Nova Scotia, and Siberia, but without production, except 4½ tons in Mexico.

MARKET CONDITIONS.

The year 1906 has been one of the most remarkable years ever known in the tin market. On January 2, 1906, tin sold for 35.825 cents per pound on the New York market. On the 15th of May it rose to 48.5 cents per pound, dropping by the end of the week to 44 cents, and by the end of the next week to 40 cents. On July 12 the market dropped to 36 cents, but rose again, and the year closed with tin at 42.72 cents per pound. The London market reached its highest point on May 14, at which time tin commanded £215 sterling ($1,046) per long ton, the highest price known in the history of the tin market. This extreme high price was very likely due largely to

[a] Daily Cons. and Trade Rept., No. 2854, April 26, 1907, p. 12.
[b] Mining in Bolivia, Min. Jour. (London), April 20, 1907, p. 543.
[c] Min. Jour. (London), January 12, 1907, pp. 50–51.

speculative conditions, for it seems probable that consumption is keeping pace with production so evenly that the market is easily manipulated and will probably continue to show periodic high prices until production is enlarged or until some substitute for tin is found.

IMPORTS.

As reported by the Bureau of Statistics of the Department of Commerce and Labor the imports for consumption of tin into the United States for the calendar years from 1901 to 1906, inclusive, have been as follows:

Tin imported and entered for consumption in the United States, 1901 to 1906.

1901	short tons	37,280	$19,024,761
1902	do	42,522	21,263,337
1903	do	41,567	22,265,336
1904	do	41,472	22,356,895
1905	do	44,188	26,316,023
1906	do	50,477	37,447,315

The report of the New York Metal Exchange[a] accounted for importations amounting to but 42,794 short tons in 1905 and to 47,571 short tons in 1906, about 90 per cent of the total in each year being from the Malay States, the remainder in 1906 being distributed among the following countries: Australia, 854 tons; Banka and Billiton, 474 tons; China, 949 tons; England, 2,073 tons, and 1,632 tons from various sources.

WORLD'S PRODUCTION AND CONSUMPTION.

German statistics give the approximate world's production of tin for 1906, based upon estimates of the production by various tin smelters and upon exports for the years 1905–6, as follows:[b]

World's production of tin in 1906, in short tons.

Malay States (exports)	65,500
England, production from English ores	5,500
England, production from foreign ores (Bolivian, Australian, Spanish, African, etc.)	10,300
Banka (sold in Holland)	10,400
Germany (largely Bolivian ores)	6,900
Australia	7,700
Billiton (sold in Holland and Java)	2,200
Total	108,500

There appear to be considerable errors or omissions in this table. The quantity of Bolivian tin produced (exported) in 1906, as already shown, was 19,425 tons. The table does not seem to account for several thousand tons of this output. As a matter of fact, over 3,800 short tons of foreign tin ores in addition to the Bolivian ore were imported into England during 1906,[c] while the Bolivian ore should

[a] Ann. Statist. Rept. New York Metal Exchange for 1906, p. 11.
[b] Statistische Zusammenstellungen, etc., von der Metallgesellschaft und der metallurgischen Gesellschaft A.-G., Frankfurt, Germany, 1907, p. 14.
[c] United Kingdom imports of tin ores: Min. Jour. (London), January 12, 1907, p. 48.

alone have produced a larger quantity of tin than that given in this table as produced in England from foreign ores. Furthermore, the production (exports) of China, as already stated, was about 4,538 tons. These items, combined with the lesser productions of Europe, Africa, and Alaska, and a few tons from Mexico, would probably make the total world's production in 1906 between 115,000 and 120,000 short tons.

The German publication quoted gives the world's consumption of tin during 1906 as follows:

World's consumption of tin in 1906, in short tons.

England	20, 282	Netherlands	276
Germany	17, 086	Other European countries	882
France	7, 496	United States	48, 170
Austria-Hungary	4, 079	Other American countries	1, 433
Belgium	3, 086	Australia (estimated)	661
Russia	2, 756	Africa	220
Italy	2, 756	Asia	496
Switzerland	1, 543	Other countries	551
Spain	1, 433		
Norway, Sweden, and Denmark	992	Total	114, 198

The world's production for 1905, as estimated by the United States Geological Survey,[a] was as follows:

Approximate tin production of the world in 1905, in short tons.

Australia	5, 028	Cornwall	5, 040
Banka	11, 155	Malay States	65, 565
Billiton	2, 715		
Bolivia	13, 646	Total	103, 149

To this should have been added the Chinese output of about 5,000 short tons. Probably enough tin was mined in smaller lots in various countries to raise the total for 1905 to 109,000 short tons. From the figures given, the increase in production during 1906 seems, therefore, to have been from 6,000 to 8,000 short tons over the production of 1905. The important point apparently shown by this analysis and comparison is that the production for 1906 not only fully covered but was somewhat in excess of the consumption for the year.

[a] Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, p. 448.

PLATINUM.

By David T. Day.

INTRODUCTION.

PRICES.

The principal feature of interest in the platinum industry during the year 1906 was the phenomenal rise in prices for ingot platinum. The Engineering and Mining Journal shows that on January 6, 1906, the market price for ingot platinum was $20.50 per troy ounce. In one month this had risen to $25 per troy ounce, and the market continued stationary at this figure until the last of June, when a further rise to $26 was noted on June 23. Continuing at this figure until the end of August, the price advanced to $28.50 on September 1. A week later it had risen to $33, and it continued at this price until November 17, when it was quoted at $38 per ounce, remaining at this figure until the end of the year, after which it rose slightly higher. In February, 1907, for the first time a distinction was made between ordinary platinum and hard platinum; that is, platinum rich in iridium and osmium, considerable iridium being allowed to remain alloyed in the platinum of the ingots. Such hard platinum was quoted at $41 per ounce on February 23, and this price continued until April 6, 1907, when the placing on the market of more than 100 pounds of platinum by a new producer interested in American developments checked the advance, and on May 4, 1907, ordinary platinum was quoted at $32 and hard platinum at $35. Then a gradual decline set in, $26 being the price for ordinary and $28.50 for hard platinum, which prices continued almost up to the time of this article (August, 1907). The marked effect of this rise in price in stimulating the interest in the search for platinum all over the world makes it advisable to give a résumé of the prices of platinum with such statements as have been put forth as to the reasons offered for this remarkable advance. These are best summarized in an article by Mr. S. I. Gulishambarov, of the Russian ministry of finance, which has been translated in the Mining Journal (London), as follows:

Mr. Gulishambarov expressed his opinion that the rise in price of crude platinum was brought about by the fact that whilst the demand for this product on the foreign markets has remained steady and even shows signs of increasing, the supply of it has diminished lately. The Paris firm, under the title of the Compagnie Industrielle du Platine, which is the largest producer of crude platinum in the Urals and is also the owner of large platinum-refining works in Paris, forms at the same time the connecting link between the remaining independent platinum producers and the combine of platinum buyers, headed by the London firm Johnson, Matthey & Co. This French company can gain nothing by lowering prices, but on the contrary is making every possible effort to keep the prices at the highest level possible. With a view to this the company, in 1905, offered the following terms to everyone who would be willing to sell platinum to it: On delivery of the platinum the company pays as an advance 12,000 rubles ($6,180) per pood (36.112 pounds) of crude platinum containing 83 per cent of pure metal. After the platinum has been refined and sold the whole of the difference between the amount advanced and the sum realized is handed over to the seller. The company's profit is represented by an interest at the rate of 5 per cent per annum on the money advanced before the platinum is sold and one-fourth per cent commission for every three months, and also 1.70 francs for every lot of platinum delivered, irrespective of the quantity. All of the valuable metals of the platinum group which are found in the crude platinum, such as palladium, rhodium, iridium, osmium, and ruthenium, become the property of the company as compensation to it for the cost of refining, etc.

The combine of platinum users, in their turn, pay to the company 3 francs per gram of refined platinum, which is equal to 18,400 francs ($3,551.20) per pood, the company also receiving 50 per cent of the profits derived by the sale of the articles made out of the platinum. This price of 3 francs per gram fluctuates in accordance with the conditions of demand and supply of this product on the world's market. In 1905, for instance, when the largest platinum producers reduced their output, and disposed of their product in one way or another, it was found possible to pay 3.30 francs per gram; that is, about 20,250 rubles ($10,428.75) per pood, with the same 50 per cent participation in the profits. Since then the French company further reduced their output, and in consequence of this the demand became greater still and the price went up to 28,000 rubles ($14,420) per pood. It is therefore clear that the present high price of platinum can be quite easily explained by the natural conditions of supply and demand without reference to any rumors about intended Government action (such as an export duty).

In the history of the platinum industry there was a time when the metal could scarcely find any use at all. Thus, in the twenties of the last century, after the discovery of platinum in the Ural Mountains, the world's output of this metal, according to data collected by the Russian minister of finance, amounted to 40 poods per annum. The demand for it, however, was so small that the Government had to take steps to find a sale for it and began buying it on its own account for coinage purposes. In the sixties of the same century the development of the chemical industries in western Europe, and later on the springing up of electrical engineering and of the dental manufacturing business, increased the uses of platinum, but in spite of this the supply was still in excess of the demand, which latter was not of a permanent character, and the prices, which were then comparatively low, were ruled by the action of speculators more than by the condition of supply and demand.

All this has since changed. The demand for platinum has become permanent, the platinum producers have become able to fight the speculators, and they are making good use of their chance. Statistics show that Great Britain, France, the United States, Germany, and Russia together require annually as much as 23,292 pounds of platinum. Of this quantity the United States takes approximately 7,200 pounds, Great Britain 6,696 pounds, Germany 4,752 pounds, France 4,356 pounds, and Russia 288 pounds. If we admit, according to the experience gained in America, that in the total quantity of platinum used there is contained 35 per cent of old metal worked up again, we find that the markets of the above-mentioned five countries alone require every year a supply of 15,084 pounds of fresh platinum, while the available output is only about 10,800 pounds. Russia being the only source from which the world's market is supplied with platinum, and as a considerable part of the platinum output in Russia is concentrated in the hands of the French Platinum Company, mentioned above, the latter is at present absolute master of the market and can regulate prices at will. There is therefore no need whatever to look for the cause of the high price in the rumor of an export duty.

In regard to the question of the imposition of the export duty on platinum, Mr. Gulishambarov declares that no such duty will be imposed. It is true that at the first and second conferences of Russian gold producers, when speaking of the needs of the platinum industry, views were expressed in favor of the establishment of a stricter control over the export of crude platinum abroad, and the conference petitioned the Government for the imposition of an export duty. This petition was, however, refused by the Government, as it was found exceedingly inconvenient and difficult to demand that platinum, which is usually exported from Russia in the form of postal packets, shall be declared in the consignment notes and to establish a custom inspection of postal packets containing platinum. In 1904 the committee of the conference again made representations to the Government to the same effect, but without success, and the question of an export duty on platinum can now be considered as finally decided in the negative. Apart from the difficulties which the carrying out of such an export would have encountered from the technical side, the measure in itself would have proved quite useless.

The amount of duty proposed was 5 rubles per pound, or 200 rubles ($103) per pood, which of course can have no influence whatever on an article the price of which is 28,000 rubles ($14,420) per pood (36.112 pounds).

PLATINUM IN FOREIGN COUNTRIES.

RUSSIA.

The platinum conditions in Russia are also well summarized in an article in the Mining Journal[a] (London), by Mr. E. de Haupick, of the Imperial Russian Engineers. In this article Mr. de Haupick gives the prices of crude platinum and of platinum ingots, and the production of the last few years, as shown in the following tables:

Prices of crude platinum of 82 per cent in the Ural Mountains.

Year.	Rubles per pood.	Per troy ounce.	Year.	Rubles per pood.	Per troy ounce.
1874	4,800	$4.62	1903	18,500	$18.36
1888	6,000	5.84	1904	21,000	20.36
1890	6,200	6.00	1905	22,000	21.45
1893	6,500	6.29	1906 January	22,000	21.45
1895	6,600	6.47	1906 October	34,000	33.01
1898	6,800	6.57	1907 January	30,000	28.93
1899	7,000	6.73	1907 February	29,000	28.14
1901	16,200	15.51	1907 March	28,000	27.25
1902	17,300	17.60	1907 April	27,000	26.28

Average price per troy ounce for platinum ingots.

1874	$6.12	1903	$20.94
1888	8.19	1904	21.43
1890	8.67	1905	21.97
1893	9.19	1906 January	23.16
1895	10.22	1906 October	38.85
1898	17.88	1907 January	34.07
1900	19.41	1907 February	33.94
1901	19.93	1907 March	33.82
1902	20.44	1907 April	33.74

Production of platinum in the Ural Mountains in the last few years, in troy ounces.

1894	203,250	1903	226,000
1896	200,000	1904	190,120
1898	203,100	1905	200,450
1900	212,500	1906	210,318

COLOMBIA.

The International Bureau of the American Republics has received so many inquiries in regard to the deposits of platinum in Colombia and the possibilities of that South American Republic as a future source for the supply of this extremely rare and useful metal, that the Bureau has been at especial pains to obtain the fullest, most recent, and most accurate information available on the subject. Mr. Isaac A. Manning, the United States consul at Cartagena, and Mr. P. P. Demers, the United States consul at Barranquilla, the two principal seaports of Colombia, have courteously forwarded to the Bureau exceedingly valuable data on the platinum resources of the Republic. Their com-

[a] Min. Jour. (London), May 4, 1907.

munications, together with facts gathered from the most authentic Spanish, British, and French literature relating to this metal, form the basis of the following contribution:

The long isolation of Colombia, from which she is now fortunately rapidly emerging, has hitherto operated to prevent the American public from knowing much about the wonderful mineral wealth of that naturally highly endowed Latin-American country. The Hon. John Barrett, Director of the International Bureau of the American Republics, submitted a special report to the State Department on the resources of Colombia at the time that he was United States minister to that Republic, and alluding to her extraordinary wealth of minerals, declared that "silver is found in Antioquia, Cauca, and Tolima; copper in Boyaca; platinum in Cauca; petroleum in Tolima; while lime, alum, chalk, magnesia, sulphur, marble, asphalt, cinnabar, lead, quicksilver ore, are found in large deposits in many parts of the country."

The mineral resources of Colombia, especially in precious metals, early attracted the attention of the Spanish conquerors, discoverers, and rulers. Indeed, during the Spanish régime of three hundred years the Colombian gold fields were admittedly the richest in the world, and down to 1848, when those of California were discovered, they furnished fully one-third of the whole supply of American gold, in spite of the extremely primitive methods employed by the Spaniards. It was while engaged, through their thousands of Indian slaves, in extracting gold and silver from the alluvial beds of the streams and rivers of western and southern Colombia that the first traces of platinum were discovered. The new metal came to be so highly prized that, in 1804, Don Ventra Salzas Malibran, lieutenant-governor of the Province of Atara, submitted a curious report to the viceroy, Don Antonio Amar, in which the author adduces arguments to prove that platinum is really a kind of white gold. Whether it be true or not that platinum was first discovered as far back as 1720, it is recorded that 4,202 pounds of it were shipped to the Spanish King in 1788. According to Dr. Don Vicente Restrepo, in his admirable work on the gold and silver mines of Colombia,[a] platinum first began to attract attention in Europe in 1748. It had previously been observed by miners in the Choco and Barbacoas, but it was thrown aside as useless. As far back as 1720, it is said, the method of separating it from gold by means of quicksilver was known in Popoyan, Cauca. The Spanish Government, in 1778, ordered all platinum to be sent to the royal treasury, but without offering any remuneration. Ten years later $2 a pound was offered for it in the name of the King, and at the end of 1788 about 3,820 pounds of platinum had been collected in the Choco. The mines then producing most platinum were those of the Opagado, a tributary of the Atrato. The low price paid by the Government led to its being sold to foreigners, who gave as much as $12 per pound for it and made fortunes by reselling it in Europe.

The value of Colombian platinum was recognized, at the beginning of the nineteenth century, by the great German explorer and scientist Baron von Humboldt, who wrote:

Platina in grains is only found in two places in the known world, viz, in the Choco and Barbacoas. It is peculiar to certain sedimentary lands that cover surfaces of 600

[a] Restrepo, Vincente. Estudio sobre las minas de oro y plata de Colombia, Bogota, 1888.

square leagues. The price of this metal on the spot is \$8, or 40 francs, per pound, while in Paris it generally costs 130 francs to 150 francs.

The Choco platinum is the purest and best sold in foreign markets, as it contains from 80 to 85 per cent of pure metal. Its price had already risen in 1894 to 900 francs, or £36 (\$180), per pound. In spite of the high price it commands in the world's markets, the exploitation of the potentially rich platinum deposits of Colombia has been so slight that, as stated by Mr. P. P. Demers, the American consul at Barranquilla, only 661 pounds of it were produced in the Choco in 1905.

The region in which native Colombian platinum is found in greatest abundance is in the western department of Cauca, more especially in the south central and southern districts of the Choco, Barbacoas, and Supia, between the western foothills of the Cordillera of the Andes and the Pacific. The entire territory of this Cauca department has been renowned, from the earliest days of the Spanish conquest, as the richest of all the mineral-bearing sections of Colombia. From 1654 up to 1890 the department yielded \$137,000,000 in gold of which the Choco region alone produced \$115,000,000, or 84 per cent.

The most profitable field for the extraction of platinum is on the divide between the heads of the Atrato and the San Juan rivers, in the Choco region, around Tado, the San Juan, Condoto, and Iro. This territory is comprised between latitude 1°, 30′ N. and latitude 6° N.—that is, in the southern and equatorial portion of Colombia. The platinum lies hidden in the auriferous sands and alluvial deposits of streams fed by the melting snows of the Andes and flowing westward into the Pacific. In these districts one finds a zone or layer of gravel, sand, stone, and various clays, parallel with the horizon and lying within very narrow limits. The lowest part of this layer lies at about 80 or 100 yards above sea level and the highest at about 800 or 820 yards, and its thickness is about 720 yards. Higher up or lower down not one grain of platinum has been found. The farther from the sea the more difficult the extraction. The breadth of the zone is from 10 to 12 leagues. The work of many thousands of negroes since their discovery has not sufficed to exhaust these deposits (superficial). Their wealth is not invariable; there are rich and poor spots in the zone. From latitude 1° 30′ N. the wealth of the deposits gradually falls off; in latitude 1° N. they are scarcely worked, and on the equator there is no trace of them left. South of the equator the expressions, "gold or platinum veins, mines," etc., are never heard.

The platinum deposits of Colombia are comparatively easily accessible for international exportation. Most of the platinum extracted is exported from the Pacific port of Buenaventura, on the Bay of Choco, which is conveniently reached in a few days by steamers sailing southward from Panama city. To proceed thence inland to the alluvial deposits bearing native platinum is not difficult. An alternate route, recommended by Consul Manning, is to proceed, first, to Cartagena, on the Gulf of Darien, in northern Colombia, thence south to the head of that gulf and up the historic Atrato River 400 miles to its source, where it is separated from the San Juan by such a low and narrow divide that this route has been regarded as an available one for an interoceanic canal connecting the Atlantic and the Pacific. The trip may be made in four or five days from Cartagena, allowing for touching at way stations and other detentions.

Properly managed, there appears to be a broad field for American capital and enterprise in the mining districts of Colombia. The inhabitants of those districts have merely gathered from the surface of the soil an infinitesimal fraction of the mineral wealth of the Republic. The alluvial placer deposits are in the hands of small miners, who spend a portion of the week in washing the gold-platinum sands and clay, another part in their corn and garden patches, and the rest of the week in placid enjoyment of life. It is said that no effort has ever been made to discover platinum in ore bodies or vein deposits nor, so far as can be learned, has it ever been found in quartz, even in the shape of float.

Concerning the location of the best platinum mines of Colombia, Mr. Lucindo Posso, of Cartagena, an exporter of the metal, gave Consul Manning the following information:

The richest mines are on the Condoto, the Opagado, and the Tamanal, all branches of the San Juan River. In the province of Atrato there is only one small district, Negua, from which platinum is taken. Some new mines have lately been discovered in Nobitu which promise to be very rich, and a company of French capitalists has recently made very large purchases in the platinum district. This company is headed by Albert L. De Lantreppe, of London, England, and it is soon to send competent engineers to make a careful study of the region and especially of the properties which have fallen into its hands. Gen. Ramon Buendia, a Colombian, has bought a great quantity of mineral lands in Condoto and Nobitu. There is yet a great expanse of country there rich in minerals of all kinds where platinum must exist in goodly quantities yet unprospected and virgin. There is certainly a great field for the prospector and miner there.

Judging by the statements of various exporters in Cartagena, there is reason to believe that a great deal of the platinum and gold of the Cauca is shipped out through Buenaventura and via Panama, and that it is divided between France and the United States. It seems that France and other European countries received the larger portion up to a short time since, but now there seems to be a tendency to forward the bulk of the output to the United States, where the demand has increased wonderfully and where the price is satisfactory.

Through the courtesy of Señor Don Washington Méndez, of Cartagena, Mr. Manning has been enabled to make public the following extract from a report made by the former in January last to a firm in Paris, which report is very valuable as giving essential information regarding the character of the country in which the mines are located, its healthfulness (or unhealthfulness), etc.:

Platinum is found in its greatest abundance in the region of Choco, Barbacoas, and San Juan, and especially in the latter. The district is easily accesslbie by steamboats to Quibdo by way of Cartagena in four and five days of travel, including in this time the detentions in the ports. The principal places are Quibdo and San Pablo, especially Quibdo, which is the capital of the province of this name.

There are no mines in exploitation. The mineral which they export from here is that encountered in the bottom of the canyons of the rivers in the form of powder (dust) and in the exploitation of the bars which contain it. The work is of a very primitive mode, like that in practice in ancient times. Up to the present the indolence of the people has been so great that they have not discovered the first ledge which would carry platinum, because they have made no serious study or scientific exploration. Labor is abundant.

It is not possible to find anyone willing to contract a certain quantity of platinum, no one having, as I have said, made serious explorations and there being no acquired rights. In order to understand the situation properly, it would be necessary at the beginning to send a mining engineer to study the ground. However, the enormous riches that the region contains are nearly virgin, unexplored, owing in part to the lack of capital and to the unhealthfulness of the climate, it raining there ten months in the year, and the district being very swampy. The annual production is principally exported through the port of Buenaventura, and it would be venturous to fix the quantity of the export, because the Government has placed an export duty on metals, and above all in regions where the action of the Government is weak it is presumed that 90 per cent of that which goes out will be contraband.

Propositions have been made to the Government that it should declare the platinum deposits national property, but they are so extensive and variable that the Government has done nothing in this particular. Scientific investigations will be necessary for the discovery of the ledges from which the platinum comes, which is now taken from the beds of the rivers.

According to Mr. P. P. Demers, the American consul at Barranquilla, the Colombian Government a few months ago monopolized the platinum industry in the same way as the emerald, with the result that at the present time nothing is being done to develop these mines. There is now an export duty on platinum of 1 per cent ad valorem.

In a comprehensive report on mining in Colombia just submitted to the State Department, Consul Demers gives the following additional information concerning the platinum districts of that South American country:

The low Atrato is unhealthful, swampy, and devoid of all communication, except water, and is navigable from its delta to Lloro, the mouth of the Andagueda, almost 150 leagues. But lately some mule roads or paths have been opened, to wit: From Medellin to Quibdo, from Andes to Andagueda, and from Urrao to Islita, thus permitting the introduction of cattle, mining material, and provisions for enterprises not at proximity to navigation. Besides its water communication, Quibdo is also connected with Medellin by telegraph.

On the divide between the heads of the Atrato and the San Juan is found the "Tado" group, which produces platinum, until lately exploited by a few isolated Indians only, but recently made a Government monopoly.

The Choco presents a good future for hydraulic enterprises. Labor is still scarce and dear, averaging $1 a day with food, but Antioquia is not very far off, and laborers could be imported from that source.

Although it is true that the platinum industry in Colombia has been retarded by the unhealthy nature of some of the localities in which the deposits are found, there are excellent platinum-bearing sections, such as Supia, in latitude 5° 21′ N. and longitude 1° 40′ W. from Bogota, at an elevation of 4,144 feet above the sea, which are quite salubrious. It should, moreover, be borne in mind that, with due regard to strict sanitary measures, proper dieting, regulation of the habits of life to meet the requirements of a tropical climate, and the wearing of suitable clothing, the most unsanitary of the mineral regions of Colombia may be robbed of their terrors.

In closing this contribution it is fitting to give a few admonitions gathered from the bitter experience of American and European companies whose enterprises have too frequently gone to complete wreck, owing to the unwise methods and procedure which they have adopted.

It should be remembered, in the first place, that, although conditions are steadily improving under the present enlightened administration, Colombia is a new, virgin country, largely unexplored and unexploited, like the great West of the United States fifty years ago. The Republic is a tropical land, touching the equator along its southern border. Its topography is composed in large part of the lofty Cordillera of the Andes, between whose western slopes and the Pacific there stretches, from north to south, a narrow, long belt of lowlands, in the southern portion of which are found the principal deposits of native platinum. Between important points good roads are frequently lacking, and difficult trails over mountains and through valleys, plains, and jungles have to be followed. Hence until means of communication are vastly improved it is highly impolitic to ship heavy, complicated, and expensive machinery over the towering Andes and through the tropical wilderness. "The companies," says the eminent Colombian mining expert, Dr. Manuel Restrepo, "do not consider that our roads are narrow, broken up, and everywhere difficult to traverse, and that only light loads can pass over them; but they send out heavy machinery whose massive pieces are doomed to lie rusting on the banks of our rivers. Such masses of iron, mute witnesses of disasters due to want of foresight, are frequently met with."

Some companies in the past have tried the costly experiment of putting up fine buildings regardless of all expense. It is recorded, for example, of one foreigner that he arrived with a store of wines and preserved food and built himself a house full of conveniences in a desert region; when his foreign provisions came to an end, he took his departure.

Were it not for the disastrous experiences of the past it would be unnecessary to advise capitalists intending to exploit the platinum districts of Colombia that they should first dispatch the most competent engineers to make a careful survey of the territory in which it is proposed to commence operations, and to make an exhaustive and careful report on all local conditions. It has too frequently happened that engineers have been sent out who could not handle a prismatic compass nor distinguish ores one from another, much less assay them. In this way millions of dollars have been squandered by foreigners on mining undertakings which, managed with judgment and economy, would have turned out well.

Mining companies which are planning to establish themselves in the Republic can not be too strongly urged to avoid engaging American or European workmen for operations in Colombia. Not only must the cost of transporting the men to their destination be incurred, but they must be paid high wages and be maintained in comfort. Strangers in a foreign tropical land, and unable to speak the language of the country, the men grow discontented, become demoralized, and too often take to hard drinking. "It is easy," declares Señor Restrepo, "to find in Colombia workmen satisfied with moderate salaries, who are docile, strong, and intelligent. Those foreign mine owners who have met with most success have employed native labor even for the most difficult work. * * * To make a fortune in a new country, it is necessary to put up with some privations. * * * Finally, nothing more is necessary than to begin by a careful study of the conditions of the country and of the special circumstances of the undertaking. There must be no question of bringing out machinery until everything has been thoroughly gone into."

For the convenience of those who may desire further information in regard to the platinum deposits of Colombia and the present state of the industry, there is appended the following list, furnished by the courtesy of Mr. Isaac A. Manning, American consul at Cartagena, of the names and addresses of Colombian gentlemen who are exceptionally competent to write with authority concerning the platinum resources of their native country:

David Delgado, Tado.
C. Copeland, Quibdo.
J. María Lozano, Istmina.
Camilo E. Lopez, Istmina or Novitas.
Victor M. Calderon, Novitas.
Tiverino Posso, Istmina.
José C. Leon Castillo, Istmina.
Lucindo Posso, Istmina.
Lucindo Posso, Quibdo.
Lucindo Posso, Novitas.
Francisco de V. Carrasco, Istmina de Lozano.
Victor M. Lozano, Istmina de Choco.
Manuel Posso, Podo.
Alejandro Ferrer, Quibdo.
Tracey Brothers, Medellin.

In communicating with these gentlemen, it will be advisable to write letters of inquiry in Spanish.

Exports.—The following statement of the exports of platinum from South America has been kindly furnished by Mr. E. Schlesinger, subdirector of the General Bureau of Statistics of the Republic of Colombia, through the United States Department of State.

Exportation of platinum from Colombia, South America, during the year 1906, in troy ounces.

Port of export.	Destination.			Total.	Value declared by the exporter.	Duties charged.
	United States.	France.	Great Britain.			
Buenaventura	584.02	1,213.99	322.07	2,120.08	$24,763.20	$251.40
Cartagena	3,343.17	1,350.13	....	4,693.30	97,456.20	974.56
Total	3,927.19	2,564.12	322.07	6,813.38	122,219.40	1,225.96
PLATINUM AND GOLD.						
Cartagena	546.48	....	....	546.48	7,895.00	$78.95

NOTE.—From the custom-house at Buenaventura there are no data for the month of March; and as to the remainder of the custom-houses, there is no record that there had been any exportations of platinum.

SOUTH AFRICA.

A new locality is reported at Spring Grove, in the Albany district of Cape Colony, 15 or 20 miles from Grahamtown, South Africa, although the conditions of occurrence have not been stated with accuracy nor is the practical value of the find substantiated.

CANADA.

According to the annual statistical report of the Canadian geological survey for 1906 only $500 worth of platinum was saved, chiefly from Granite Creek, British Columbia. Mr. Hobson, the enterprising manager of the placer interests near Cariboo, British Columbia, introduced modern concentrating apparatus during the year to utilize the black sands. He predicts a considerable yield in 1907.

The metal palladium has recently been recovered from the Sudbury ores as follows: 1902, 4,411 ounces, valued at $86,014; 1903, 3,177 ounces, valued at $61,952; 1904, 952 ounces, valued at $18,564.

PLATINUM IN THE UNITED STATES.

The report on platinum in the volume of Mineral Resources of the United States for 1905 [a] summarized the conditions of occurrence of platinum in the United States and elsewhere, the method of its extraction, its physical properties, and its uses in a way which leaves little to be added in this supplementary report.

In spite of the interest aroused in the study of platinum resources in the United States, the changes in price have not been effective in developing any greater confidence among the placer miners in platinum localities in the stability of platinum prices in the future.

This has delayed the natural effect of stimulating a much greater production from American localities. Nevertheless, two or three new purchasing companies have had their representatives throughout various placer camps known to contain platinum with the gold, for the purpose of making definite arrangements to concentrate the waste black sands left after extraction of the gold with quicksilver. The effect of this campaign is naturally slow, but one considerable shipment of heavy black sand was made from the Oroville district to Denver, with the result of a somewhat larger yield of platinum than would ordinarily have been expected from these residues. Meantime, the high price of platinum has had another beneficial effect upon production, in that platiniferous gold dust has been received with more favor in the United States mints so that the quantity of platinum recovered in gold refining has exceeded all previous records. A greatly increased production may be expected from California and Oregon.

NEVADA.

Reliable reports have been sent in to this office, and even reliable assays made, showing the occurrence of platinum in certain copper-nickel ores in southwestern Utah and in eastern Nevada, and within the last year two companies have developed in the Bunkerville district, in the northeastern part of Lincoln County, Nev., considerable supplies of low-grade copper-nickel ores somewhat similar to the Sudbury ores and in what is claimed to be a similar geologic condition. Development work to the extent of several thousand feet of drifts and cross-cuts have been made in the claims of the two companies, where it is said that the average grade of the ore is 4 per cent copper, 2½ per cent nickel, and one-third of an ounce of platinum. This station is reached by a good wagon road 45 miles from Moapa station, on the San Pedro, Los Angeles and Salt Lake Railroad.

PRODUCTION.

The production of platinum in 1904 was 200 ounces, valued at \$4,160; this increased to 318 ounces in 1905, valued at \$5,320, and to 1,439 ounces in 1906, valued at \$45,189, the increase in 1906 over 1905 being more than fourfold in quantity and more than eightfold in value.

It is impossible to divide accurately the platinum production of 1906 between California, Oregon, and Washington, inasmuch as by

[a] Mineral Resources U. S. for 1905: U. S. Geol. Survey, 1906, pp. 423-434.

far the greater part of the product was obtained from miscellaneous assignments of gold dust from the Western assay office to the New York assay office. The total product, however, aggregated 1,439 ounces, valued at $45,189.

The following table shows the production of platinum in the United States since 1880:

Production of crude platinum in the United States, 1880–1900, and of refined metal from domestic ores in 1901–1906, in troy ounces.

Year.	Quantity.	Value.[a]	Year.	Quantity.	Value.[a]
1880	100	$400	1894	100	$600
1881	100	400	1895	150	900
1882	200	600	1896	163	944
1883	200	600	1897	150	900
1884	150	450	1898	225	3,375
1885	250	187	1899	300	1,800
1886	50	100	1900	400	2,500
1887	448	1,838	1901	1,408	27,526
1888	500	2,000	1902	94	1,874
1889	500	2,000	1903	110	2,080
1890	600	2,500	1904	200	4,160
1891	100	500	1905	318	5,320
1892	80	550	1906	1,439	45,189
1893	75	517			

[a] The chief variations in price up to 1901 have been due to the quality of the crude grains. Since 1901, however, the average price for the refined metal has been given.

IMPORTS.

It is interesting to note that the imports for consumption of platinum during the calendar year 1906 were valued at $3,788,759, as against $2,173,623 in 1905, $1,879,155 in 1904, $2,055,933 in 1903, and $1,987,980 in 1902.

The imports in 1906 were distributed as follows: Unmanufactured, 1,267 pounds, valued at $390,989; ingots, bars, sheets, and wire, 10,227 pounds, valued at $3,210,131; vases, retorts, and other apparatus, vessels, and parts thereof for chemical uses, $186,398; manufactures of, not specially provided for, $1,241.

PRICES.

In the following table are given the weekly prices of platinum on the New York market from January 6, 1906, to August 3, 1907, inclusive:

Prices of platinum on the New York market, 1906–7, by weeks.

1906.

January 6	20.50	April 14	25.00
January 13	20.50	April 21	25.00
January 20	20.50	April 28	25.00
January 27	20.50	May 5	25.00
February 3	25.00	May 12	25.00
February 10	25.00	May 19	25.00
February 17	25.00	May 26	25.00
February 24	25.00	June 2	25.00
March 3	25.00	June 9	25.00
March 10	25.00	June 16	25.00
March 17	25.00	June 23	26.00
March 24	25.00	June 30	26.00
March 31	25.00	July 7	26.00
April 7	25.00	July 14	26.00

1906—Continued.

July 21	26.00
July 28	26.00
August 4	26.00
August 11	26.00
August 18	26.00
August 25	26.00
September 1	28.50
September 8	33.00
September 15	33.00
September 22	33.00
September 29	33.00
October 6	33.00
October 13	33.00
October 20	33.00
October 27	33.00
November 3	33.00
November 10	33.00
November 17	38.00
November 24	38.00
December 1	38.00
December 8	38.00
December 15	38.00
December 22	38.00
December 29	38.00

1907.

January 5	not given.
January 12	38.00
January 19	38.00
January 26	38.00
February 2	38.00
February 9	38.00
February 16	38.00
February 23:	
Ordinary	38.00
Hard	41.00
March 2:	
Ordinary	38.00
Hard	41.00
March 9:	
Ordinary	38.00
Hard	41.00
March 16:	
Ordinary	38.00
Hard	41.00
March 23:	
Ordinary	38.00
Hard	41.00
March 30:	
Ordinary	38.00
Hard	41.00
April 6	33.00
April 23	33.50
April 20	32.00–32.50
April 27	32.00–32.50
May 4:	
Ordinary	32.00
Hard	35.00
May 11:	
Ordinary	32.00
Hard	35.00
May 18:	
Ordinary	31.00
Hard	33.50
May 25:	
Ordinary	28.00
Hard	31.00
June 1:	
Ordinary	27.00
Hard	30.00
June 8:	
Ordinary	27.00
Hard	29.50
June 15:	
Ordinary	26.00
Hard	28.50
June 22:	
Ordinary	26.00
Hard	28.50
June 29:	
Ordinary	26.00
Hard	28.50
July 6:	
Ordinary	26.00
Hard	28.50
July 13:	
Ordinary	26.00
Hard	28.50
July 20:	
Ordinary	26.00
Hard	28.50
July 27:	
Ordinary	27.00
Hard	29.00
August 3:	
Ordinary	28.00
Hard	29.50

COAL.

By Edward W. Parker.

INTRODUCTION.

The most notable feature connected with the coal-mining industry of the United States in 1906 was the suspension of mining operations which followed the termination, on March 31, of the wage-scale agreements in the bituminous fields and of the awards of the strike commission in the anthracite field of Pennsylvania. The cessation of work was general in the anthracite region and also in those bituminous districts where the mine workers are well organized and operate under agreements with the mine owners. The bituminous States most seriously affected were Pennsylvania, Ohio, Indiana, Illinois, Missouri, Kansas, and Arkansas, and Indian Territory, in all of which mining operations were almost entirely suspended from April 1 to June 18. In some respects the suspension possessed characteristics which inclined toward humor. In the first place, there was no officially called strike. The miners were advised simply to "suspend" work pending the adjustment of the differences with the employers. In the second place, both sides were fully aware several months in advance that mining operations would be stopped, and both prepared for it by pushing work to the utmost capacity for several months prior to April 1—the operators to provide a supply of coal to carry consumers through the emergency, and the miners to provide a fund which would supply their needs during their voluntary idleness. In this way each side, while providing for itself, helped the other. Another humorous point in the situation was that in some States, in Illinois particularly, the operators formulated "demands" upon the miners, thus reversing the usual order. The principal "demands" made by the operators were for the repeal of the "shot-firers'" law and for the payment of mining upon the screened-coal basis. Thanks to the supplies of coal laid by in anticipation of the "suspension" and to the fact that it came at a time when the severe winter weather had passed, the public was not seriously inconvenienced, and, considering the large number of men idle, acts of lawlessness were few.

In the anthracite region the miners made demands for certain changes in rates of wage and in conditions of mining. These were met by a proposition on the part of the operators to renew for another term of three years the award of the Anthracite Coal Strike Commission. The anthracite miners finally accepted this proposition, and, after ten or eleven weeks of idleness in the bituminous districts, differences were finally adjusted, but not without a disruption of the interstate agreement which had been in existence for several years. The details of the suspension in the several States are discussed in the portion of this report devoted to labor troubles and under the statistics of production by States. As a result of the suspension there was a decrease of 6,000,000 short tons as compared with 1905 in the production of anthracite, but the total output of bituminous coal exhibited a normal increase notwithstanding the lost time.

The statistics presented in the following pages, which exhibit primarily the details of quantity and value of coal produced in 1906, 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.

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 to other local authorities for contributions to the portion of this report included under the caption of "Coal trade review." Recognition of these by name is given in connection with their contributions. The report on the production of Pennsylvania anthracite has been, as for several years past, prepared by Mr. William W. Ruley, chief of the bureau of anthracite statistics, in Philadelphia.

UNIT OF MEASUREMENT.

The standard unit of measurement adopted for this report is the short ton of 2,000 pounds, although it is necessary in a few instances to use the long ton. All of the anthracite product is mined and sold on 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.

PRODUCTION.

Total production in 1906, 414,157,278 short tons; spot value, $513,079,809.

Pennsylvania anthracite.—Total production in 1906, 63,645,010 long tons (equivalent to 71,282,411 short tons); spot value, $131,917,694.

Bituminous and lignite.—Total production in 1906, 342,874,867 short tons; spot value, $381,162,115.

In spite of the fact that from April 1 to June 18 coal-mining operations in Pennsylvania, Illinois, Indiana, Ohio, Kansas, Missouri, Arkansas, and Indian Territory were almost entirely suspended, and that the idleness thus created represented 12.3 per cent of the total time made by all the coal-mine workers of the United States, the total production of coal in 1906 showed a normal increase over that of the preceding year and exceeded all previous records in the history of the industry. Compared with 1905, when the total production amounted to 392,722,635 short tons, valued at $476,537,294, the largest previous quantity, the output in 1906 shows an increase of 21,434,643 short tons, or 5.5 per cent in quantity, and of $36,542,515, or 7.7 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 1906 shows an increase of 56,800,862 short tons and of $9,355,428.

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. Prices returned to a normal standard in 1904, were depressed by a production in excess of market requirements in 1905, and were somewhat advanced by conditions resulting from the labor troubles in the spring of 1906.

The increased production in 1906 was confined almost entirely to the States producing bituminous coal east of the Mississippi River and in the Rocky Mountains, Texas and Washington being exceptions. A considerable part of the supplies of anthracite laid by in anticipation of what promised to be a prolonged period of idleness was mined in 1905, and the production for that year exhibited a substantial increase over 1904 (4,503,141 short tons), but the practically complete shut-down for seven weeks, from April 1 to May 18, 1906, resulted in a loss of about one month's normal tonnage, the total production for the year being 5,694,142 long tons, or 6,377,439 short tons, less than that of 1905. The legal qualifications required of men permitted to mine coal in the anthracite regions were probably in part responsible for the failure of the anthracite mines to recover from the effects of the suspension. There are practically no such restrictions on the bituminous miners, and this branch of the industry was able to overcome the loss of tonnage during the idleness, and the output shows an increase for the year of 27,812,082 short tons. Deducting from this the 6,377,439 tons of decrease in the anthracite region of Pennsylvania, the net increase is found to have been 21,434,643 short tons. The total production for the year was 414,157,278 short tons, which was 47 per cent larger than the coal production of Great Britain, until 1899 the leading coal-producing country of the world; it was 1.85 times that of Germany and represented 37 per cent of the total production of the world.

In addition to the increased production in 1906 over 1905, in spite of the suspension during the spring, there was, because of this suspension, a general advance in prices throughout the United States. The average price of all the bituminous and lignite produced and sold in 1906 was $1.11 per short ton, against $1.06 per short ton in 1905. The average price of anthracite at the mines in Pennsylvania advanced from \$2.25 to \$2.30 per long ton. 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 tons, 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 amounted to 2,832,402,746 short tons, and the grand total from the beginning of coal mining amounted to 5,970,576,865 short tons. The average annual production from 1896 to 1905 was 283,240,275 short tons, compared with which the production of 414,157,278 short tons in 1906 shows an increase of 130,917,003 short tons, or 46 per cent.

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 16,139,736 tons, or an average of 0.514 ton per person. At the census of 1870 the population of the United States amounted to 38,558,371; the coal production in that year amounted to 36,806,560 short tons, a per capita average of 0.96 ton. Ten years later, when the population was 50,189,209, the coal output amounted to 76,157,944 short tons, or 1.52 tons per capita. In 1890 the population had grown to 63,069,756, 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 2.52 tons. At the taking of the Twelfth Census, in 1900, the increase in population amounted to 22 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 1906 at 84,000,000 persons, the per capita production for that year is found to have been 4.93 tons.

The statistics relating to the use of machines for the mining of bituminous coal in the United States, the details of which are to be found in subsequent pages of this report, show that in 1906 the total quantity of coal mined by the use of machines was 118,847,527 short tons, or 35.10 per cent of the total production in the States where mining machines were used, against 103,396,452 short tons, or 33.67 per cent of the total in 1905, and 78,606,997 short tons, or 28.8 per cent of the total in 1904. The total number of mining machines in use increased from 7,663 in 1904 to 9,184 in 1905, and to 10,212 in 1906. The average production for each machine in use in 1906 was 11,638 short tons, as compared with 11,258 short tons in 1905, 10,258 short tons in 1904, and 11,712 short tons in 1903, from which it appears that the average tonnage won by the machines per year is something over 11,000 tons. Of the 10,212 machines in use in 1906, 5,911, or 57.9 per cent, were of the pick or puncher, 4,144, or 40.6 per cent, were of the chain-breast, and 157, or 1.5 per cent, of the long-wall type. The largest number of both pick and chain-breast machines in use in any State was in the bituminous mines of Pennsylvania, while a little over 50 per cent of the long-wall machines were employed in the mines of Ohio and Missouri.

The total number of men employed in the coal mines of the United States in 1906 was 640,780, against 626,035 in 1905, and 593,693 in 1904. Of the total number employed in 1906, 162,355 were employed in the anthracite region of Pennsylvania, while the bituminous mines gave employment to 478,425 men. In 1905 the anthracite mines gave employment to 165,406 men, and in 1904 to 155,861 men; the bituminous workers numbered 460,629 in 1905 and 437,832 in 1904. The average number of days worked in the anthracite region in 1906 was 195 against an average of 215 days in 1905 and 200 days in 1904. The bituminous mines worked an average of 213 days in 1906 against 211 days in 1905 and 202 days in 1904. It will be seen from this that notwithstanding the period of suspension among the organized mine workers in the spring of the year, the actual time worked in 1906 in the bituminous mines was 2 days more than that recorded in 1905, while in the anthracite mines the average number of working days in 1906 was 195 against 215 in 1905.

The average production of each employee in the anthracite region of Pennsylvania in 1906 was 439 short tons against 469 short tons in 1905 and 1904. The average bituminous production for each employee in

1906 was 717 short tons against 684 short tons in 1905 and 637 tons in 1904. The average daily tonnage per man in the anthracite region, which decreased from 2.41 in 1903 to 2.35 tons in 1904 and to 2.18 tons in 1905, increased to 2.25 tons in 1906; the average production per day for each employee among the bituminous mines has increased from 3.02 short tons in 1903 to 3.15 tons in 1904, to 3.24 tons in 1905, and to 3.36 tons in 1906. The increased tonnage per day per man in the bituminous regions may be attributed to the more extended use of mining machines and to the increased proportion which the machine-mined tonnage bears to the total output.

There was more time lost by reason of the suspension of work following the termination of the wage agreement on March 31 and until the differences between the operators and the union workers were adjusted than has been lost by strikes or other labor troubles in recent years. The total amount of time lost is shown by the fact that in the anthracite region of Pennsylvania 161,039 men were idle for 37 days, involving a total of 5,958,443 working days in time lost; in the bituminous mines the total number of men idle was 211,304, and the average time lost by them was 63 days, or a total of 13,242,905 working days. In the anthracite region the idleness was equivalent to 18.8 per cent of the working time made, and in the bituminous regions the lost time was equivalent to 13 per cent of the time made.

As the United States Geological Survey makes no attempt to collect the statistics covering the number of fatal and nonfatal accidents in the coal mines of the United States, the report on this feature is incomplete to the extent represented by those States in which there are no mine-inspection laws. These exceptions are, however, of comparative unimportance as practically all of the important coal-mining States have inspection laws, and the officials in charge of their execution compile the statistics of accidents in each year. In some cases these are for fiscal years, but in most cases for calendar years. The compilation contained in the subsequent pages of this report has been prepared from the reports made to the writer by the inspectors or other State officials under whose jurisdiction the work is carried on. The total number of lives lost in 1906 in the coal mines of the States from which these reports have been received was 2,060. These fatalities included 557 in the Pennsylvania anthracite mines and 1,503 in the bituminous mines of Pennsylvania and 20 other States whose aggregate production amounted to 395,742,443 tons, or 96 per cent of the total output of the United States. Particular attention is called to the comparatively small number of deaths which have been caused by dust or gas explosions, which, because of the occasionally large number of victims claimed by one disaster, are looked upon as the greatest source of danger to the workers in coal mines.

Practically the entire output of both anthracite and bituminous coal in the United States is consumed within the confines of this country. The total exports of coal in 1906 amounted to 11,112,437 short tons, which, from the production of 414,157,278 short tons, shows the consumption of coal of domestic production to have amounted to 403,044,841 short tons. If to this is added the imports, which in 1906 amounted to 1,943,371 short tons, the total consumption of coal in theUnited States last year (considering as negligible the stocks on hand at the beginning and end of the year) is shown to have been 404,988,212 short tons, which is equivalent to nearly 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 quantity 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-Hoffmann 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 the operators, who use only slack, an otherwise waste product, do not report this item in their statement of production and do not deem 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 quantity is negligible. The quantity 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 1906 was 46,156,301 short tons, as compared with 42,412,328 short tons in 1905, an increase of 3,743,973 tons, or 8.8 per cent, as compared with an increase of 5.5 per cent in the total production. The coal shipped to market, used in the manufacture of coke, and sold locally, which is considered as a marketable product, amounted in 1906 to 399,323,294 short tons, compared with 378,680,462 short tons in 1905 and 343,939,935 short tons in 1904. 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 1906 was 7,044,230 short tons, or about 10 per cent of the total, while the colliery consumption of the bituminous mines was 7,789,754 short tons, or between 2 and 3 per cent of the bituminous production.

There were 30 States and Territories in the United States in which coal was produced in 1906, with a decrease of one from the preceding year—North Carolina not having reported any production last year. In addition to North Carolina, there were 11 other States and Territories in which the production in 1906 was less than it had been in 1905, while in 19 States and Territories the production increased. In 4 States and Territories in which there was a decreased production, the value of the product in 1906 exceeded that in 1905. Only 3 States in which decreases occurred were in the Appalachian region; these were Virginia, Georgia, and North Carolina. Four were in the western interior field, namely, Kansas, Missouri, Arkansas, and Indian Territory, and 2 were in the Pacific coast States, California and Oregon. The other 2 States in which decreases occurred were North Dakota and Michigan. The largest increase is credited to West Virginia, whose production shows a gain of 5,498,770 short tons. This increase, which was about 2,450,000 tons more than the increase in Illinois, placed West Virginia second in the rank of coal-producing

States, with a lead over Illinois of 1,810,246 short tons. In the value of the product, however, Illinois continues to outrank West Virginia, the value of the Illinois product in 1906 being $44,763,062, while West Virginia's output was valued at $41,051,939.

The production of anthracite in Pennsylvania decreased 6,377,439 short tons, but the bituminous production of that State increased 10,879,569 short tons, making a net increase of a little over 4,500,000 tons.

Illinois is credited with the third largest increase, 3,045,741 short tons; Ohio with the fourth, 2,178,690 short tons; Colorado comes fifth, with 1,284,789 short tons; Alabama sixth, with 1,241,894 short tons, and Kentucky seventh, with 1,221,124 short tons.

The statistics of the production of coal in the United States in 1906 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 1905, by States and Territories, in short tons.

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.
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	2,110,544	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	43,389
Oregon	84,258	7,883	17,500		109,641	282,495	2.58	242	316
Pennsylvania	86,018,241	2,236,728	2,232,386	27,926,282	118,413,637	113,390,507	.96	231	143,629
Tennessee	4,807,684	87,543	93,625	777,838	5,766,690	6,577,881	1.14	221	11,928
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	255,006,483	10,637,726	7,006,248	42,412,328	315,062,785	334,658,294	1.06	211	460,629
Pennsylvania anthracite	69,052,964	1,570,961	7,035,925		77,659,850	141,879,000	1.83	215	165,406
Grand total	324,059,447	12,208,687	14,042,173	42,412,328	392,722,635	476,537,294	1.21	212	626,035

[a] Includes production of Nevada.

Coal production of the United States in 1906, by States and Territories, in short tons.

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.
Alabama	9,409,005	131,881	446,712	3,120,365	13,107,963	$17,514,786	$1.34	237	20,555
Arkansas	1,792,242	14,362	57,664		1,864,268	3,000,339	1.61	165	4,298
California and Alaska	11,878	15,942	3,011		30,831	78,684	2.55	253	56
Colorado	7,697,481	202,579	252,115	1,959,043	10,111,218	12,735,616	1.26	268	11,368
Georgia	194,881	850	8,324	128,052	332,107	424,004	1.28	279	737
Idaho[a]		6,165			6,165	24,238	3.93	157	25
Illinois	37,273,693	2,778,141	1,418,197	10,073	41,480,104	44,763,062	1.08	192	61,988
Indiana	11,106,753	647,432	338,375		12,092,560	13,116,261	1.08	175	20,970
Indian Territory	2,629,731	38,535	122,299	69,635	2,860,200	5,482,366	1.92	166	8,251
Iowa	6,461,208	633,652	171,364		7,266,224	11,619,455	1.60	224	15,260
Kansas	5,547,213	313,150	163,241	1,171	6,024,775	8,979,553	1.49	165	14,355
Kentucky	8,829,501	441,729	246,894	135,523	9,653,647	9,809,938	1.02	212	15,272
Maryland	5,331,321	50,306	53,826		5,435,453	6,474,793	1.19	250	6,438
Michigan	1,189,972	106,538	49,828		1,346,338	2,427,404	1.80	173	3,971
Missouri	3,300,867	386,067	71,074		3,758,008	6,118,733	1.63	185	9,557
Montana	1,621,291	65,858	73,727	69,045	1,829,921	3,240,357	1.77	243	2,394
New Mexico	1,605,798	35,102	34,706	289,107	1,964,713	2,638,986	1.34	242	2,070
North Dakota	189,739	111,638	4,312		305,689	451,382	1.54	209	488
Ohio	25,915,172	1,392,350	422,094	2,024	27,731,640	30,346,580	1.09	167	45,438
Oregon	55,232	7,398	17,101		79,731	212,338	2.66	224	209
Pennsylvania	93,904,804	1,791,889	2,570,319	31,026,194	129,293,206	130,290,651	1.00	231	152,099
Tennessee	5,208,054	87,335	118,051	845,835	6,259,275	7,667,415	1.22	229	11,452
Texas	1,264,218	22,386	26,269		1,312,873	2,178,901	1.66	227	3,048
Utah	1,142,127	21,004	57,012	552,408	1,772,551	2,408,381	1.36	288	1,572
Virginia	1,940,524	50,275	91,666	2,172,414	4,254,879	4,183,991	.98	250	5,131
Washington	3,008,148	61,146	110,669	96,221	3,276.184	5,908,434	1.80	266	4,529
West Virginia	36,389,483	633,487	589,844	5,677,536	43,290,350	41,051,939	.95	220	50,960
Wyoming	5,801,623	59,656	271,060	1,655	6,133,994	8,013,528	1.31	281	5,934
Total bituminous	278,821,959	10,106,853	7,789,754	46,156,301	342,874,867	381,162,115	1.11	213	478,425
Pennsylvania anthracite	62,704,796	1,533,385	7,044,230		71,282,411	131,917,694	1.85	195	162,355
Grand total	341,526,755	11,640,238	14.833,984	46,156,301	414,157,278	513,079,809	1.24	209	640,780

[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 five years, by States, with the increases and decreases in1906 as compared with 1905:

Quantity and value of coal produced in the United States, 1902–1906, in short tons.

State or Territory.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	10,354,570	$12,419,666	11,654,324	$14,246,798	11,262,046	$13,480,111
Arkansas	1,943,932	2,539,214	2,229,172	3,360,831	2,009,451	3,102,660
California and Alaska	87,196	273,398	105,420	301,318	79,582	377,306
Colorado	7,401,343	8,397,812	7,423,602	9,150,943	6,658,355	8,751,821
Georgia and North Carolina	437,083	623,518	434,260	546,759	390,191	476,996
Idaho	2,030	5,180	4,250	13,250	3,480	13,730
Illinois	32,939,373	33,945,910	36,957,104	43,196,809	36,475,060	39,941,993
Indiana	9,446,424	10,399,660	10,794,692	13,244,817	[a] 10,842,189	[a] 12,004,300
Indian Territory	2,820,666	4,265,106	3,517,388	6,386,463	3,046,539	5,532,066
Iowa	5,904,766	8,660,287	6,419,811	10,563,910	6,519,933	10,504,406
Kansas	5,266,065	6,862,787	5,839,976	8,871,953	6,333,307	9,640,771
Kentucky	6,766,984	6,666,967	7,538,032	7,979,342	[a] 7,576,482	[a] 7,868,192
Maryland	5,271,609	5,579,869	4,846,165	7,189,784	4,813,622	5,729,085
Michigan	964,718	1,653,192	1,367,619	2,707,527	1,342,840	2,424,935
Missouri	3,890,154	5,374,642	4,238,586	6,834,297	4,168,308	[a] 6,801,751
Montana	1,560,823	2,443,447	1,488,810	2,440,846	1,358,919	2,194,548
New Mexico	1,048,763	1,500,230	1,541,781	2,105,785	1,452,325	1,904,499
North Dakota	226,511	325,967	278,645	418,005	[a] 271,928	[a] 389,052
Ohio	23,519,894	26,953,789	24,838,103	31,932,327	[a] 24,400,220	[a] 26,579,738
Oregon	65,648	160,075	91,144	221,031	111,540	243,588
Pennsylvania:						
Anthracite	41,373,595	76,173,586	74,607,068	152,036,448	73,156,709	138,974,020
Bituminous	98,574,367	106,032,460	103,117,178	121,752,759	[a] 97,938,287	[a] 94,428,219
Tennessee	4,382,968	5,399,721	4,798,004	5,979,830	4,782,211	5,642,393
Texas	901,912	1,477,245	926,759	1,505,383	1,195,944	1,983,636
Utah	1,574,521	1,797,454	1,681,409	2,026,038	1,493,027	1,943,440
Virginia	3,182,993	2,543,595	3,451,307	3,302,149	[a] 3,410,914	[a] 2,921,911
Washington	2,681,214	4,572,295	3,193,273	5,380,679	3,137,681	5,120,931
West Virginia	24,570,826	24,748,658	29,337,241	34,297,019	[a] 32,406,752	[a] 28,647,014
Wyoming	4,429,491	5,236,339	4,635,293	5,731,281	5,178,556	6,747,909
Total	301,590,439	367,032,069	357,356,416	503,724,381	[a] 351,816,398	[a] 444,371,021

[a] 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.

Quantity and value of coal produced in the United States, 1902–1906, in short tons—Continued.

State or Territory.	1905.		1906.		Increase or decrease, 1906.		Percentage of increase or decrease, 1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	11,866,069	$14,387,721	13,107,963	$17,514,786	+ 1,241,894	+$3,127,065	+10.5	+21.7
Arkansas	1,934,673	2,880,738	1,864,268	3,000,339	− 70,405	+ 119,601	− 3.6	+ 4.2
California and Alaska	80,824	395,975	30,831	78,684	− 49,993	− 317,291	−61.9	−80.1
Colorado	8,826,429	10,810,978	10,111,218	12,735,616	+ 1,284,789	+ 1,924,638	+14.6	+17.8
Georgia and North Carolina	353,548	456,184	[a] 332,107	[a] 424,004	− 21,441	− 32,180	− 6.1	− 7.1
Idaho [b]	5,882	17,846	6,165	24,238	+ 283	+ 6,392	+ 4.8	+35.8
Illinois	38,434,363	40,577,592	41,480,104	44,763,062	+ 3,045,741	+ 4,185,470	+ 7.9	+10.3
Indiana	11,895,252	12,492,255	12,092,560	13,116,261	+ 197,308	+ 624,006	+ 1.7	+ 5.0
Indian Territory	2,924,427	5,145,358	2,860,200	5,482,366	− 64,227	+ 337,008	− 2.2	+ 6.5
Iowa	6,798,609	10,586,381	7,266,224	11,619,455	+ 467,615	+ 1,033,074	+ 6.9	+ 9.8
Kansas	6,423,979	9,350,542	6,024,775	8,979,553	− 399,204	− 370,989	− 6.2	− 4.0
Kentucky	8,432,523	8,385,232	9,653,647	9,809,938	+ 1,221,124	+ 1,424,706	+14.5	+17.0
Maryland	5,108,539	5,831,760	5,435,453	6,474,793	+ 326,914	+ 643,033	+ 6.4	+11.0
Michigan	1,473,211	2,512,697	1,346,338	2,427,404	− 126,873	− 85,293	− 8.6	− 3.4
Missouri	3,983,378	6,291,661	3,758,008	6,118,733	− 225,370	− 172,928	− 5.7	− 2.7
Montana	1,643,832	2,823,350	1,829,921	3,240,357	+ 186,089	+ 417,007	+11.3	+14.8
New Mexico	1,649,933	2,190,231	1,964,713	2,638,986	+ 314,780	+ 448,755	+19.1	+20.5
North Dakota	317,542	424,778	305,689	451,382	− 11,853	+ 26,604	− 3.7	+ 6.3
Ohio	25,552,950	26,486,740	27,731,640	30,346,580	+ 2,178,690	+ 3,859,840	+ 8.5	+14.6
Oregon	109,641	282,495	79,731	212,338	− 29,910	− 70,157	−27.3	−24.8
Pennsylvania:								
Anthracite	77,659,850	141,879,000	71,282,411	131,917,694	− 6,377,439	− 9,961,306	− 8.2	− 7.0
Bituminous	118,413,637	113,390,507	129,293,206	130,290,651	+10,879,569	+16,900,144	+ 9.2	+14.9
Tennessee	5,766,690	6,577,881	6,259,275	7,667,415	+ 492,585	+ 1,089,534	+ 8.5	+16.6
Texas	1,200,684	1,968,558	1,312,873	2,178,901	+ 112,189	+ 210,343	+ 9.3	+10.7
Utah	1,332,372	1,793,510	1,772,551	2,408,381	+ 440,179	+ 614,871	+33.0	+34.3
Virginia	4,275,271	3,777,325	4,254,879	4,183,991	− 20,392	+ 406,666	− 0.5	+10.8
Washington	2,864,926	5,141,258	3,276,184	5,908,434	+ 411,258	+ 767,176	+14.4	+14.9
West Virginia	37,791,580	32,341,790	43,290,350	41,051,939	+ 5,498,770	+ 8,710,149	+14.6	+26.9
Wyoming	5,602,021	7,336,951	6,133,994	8,013,528	+ 531,973	+ 676,577	+ 9.5	+ 9.2
Total	392,722,635	476,537,294	414,157,278	513,079,809	+21,434,643	+36,542,515	+ 5.5	+ 7.7

[a] Georgia only. [b] Includes production of Nevada.

It will be observed that while the net increase in production was 5.5 per cent the value increased 7.7 per cent and that in four cases where the tonnage decreased the value increased. The most notable instance of this is in Virginia, where the production decreased 0.5 per cent and the value increased 10.8 per cent.

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 quarter of a century, during which the statistics of production have been collected by the division of mining and mineral resources of the United States 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. This table shows that while the production of anthracite has increased from 28,649,812 short tons in 1880 to 77,659,850 short tons in 1905, the year of maximum production—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 342,874,867 short tons in 1906, an increase of 300,043,109 short tons, or almost exactly 700 per cent. Although the anthracite production since 1900 has been 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 a luxury. As the expense of mining, due to the foregoing conditions, has increased, prices have necessarily advanced, and little hope can be held out for any permanent decline in the future. The increased 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 40.9 per cent in 1906, while the percentage of the sizes above pea coal, or what may be termed the profitable sizes, has decreased from 77 to 59 per cent. In other words, the production of the profitable sizes has increased 16.8 per cent, while the production of the unprofitable sizes has increased nearly 170 per cent. The profits must be obtained from the prepared domestic sizes, and in the face or 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, 1880–1906.

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	281,306,058	315,062,785	334,658,294
1906	63,645,010	71,282,411	131,917,694	306,138,274	342,874,867	381,162,115

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	350,645,210	392,722,635	476,537,294
1906	369,783,284	414,157,278	513,079,809

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, 1889–1906, in short tons.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.
1889	113,776,701	8,508,699	5,382,265	13,561,848
1890	128,365,965	9,009,285	5,063,953	15,331,760
1891	137,920,346	8,871,882	6,056,001	15,718,440
1892	146,372,098	9,704,678	6,210,767	17,041,528
1893	152,941,890	9,728,815	6,712,284	12,969,785
1894	142,833,319	8,764,538	6,307,296	12,836,373
1895	158,380,289	9,655,505	6,677,539	18,404,197
1896	159,176,155	9,502,927	7,184,832	16,122,443
1897	165,603,626	9,922,276	6,941,419	17,761,878
1898	180,960,111	8,927,514	7,921,289	22,167,353
1899	208,754,746	9,075,756	8,662,864	27,247,826
1900	223,782,088	9,077,242	9,189,746	27,634,951
1901	245,010,812	9,595,308	10,379,546	28,314,150
1902	247,642,852	9,781,996	9,995,861	34,169,730
1903	299,813,428	11,107,917	12,633,653	33,801,418
1904	296,142,355	16,519,043	7,876,463	31,278,537
1905	324,059,447	12,208,687	14,042,173	42,412,328
1906	341,526,755	11,640,238	14,833,984	46,156,301

Year.	Total product.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
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	392,722,635	476,537,294	1.21	212	626,035
1906	414,157,278	513,079,809	1.24	209	640,780

In the following table is presented a statement showing how the coal production of the five principal States—Pennsylvania, West Virginia, Illinois, Ohio, and Alabama—has grown relatively to the total production since 1860. The statistics are given for each ten years from 1860 to 1900, and annually from 1901 to 1906, inclusive. It will be observed that Pennsylvania's proportion has decreased from 74 per cent in 1860 to 48.4 in 1906. West Virginia, which was not a State in 1860, contributed 1.8 per cent of the total in 1870 and 10.5 per cent in 1906. Illinois has just doubled its percentage, that State contributing 5 per cent of the total in 1860 and 10 per cent in 1906. Ohio's percentage has declined from 8.7 to 6.7, while Alabama's has grown from 1.07 to 3.2.

Relative production of Pennsylvania, West Virginia, Illinois, Ohio, and Alabama to total output, 1860–1906, in short tons.

Year.	Total production, United States.	Pennsylvania.		West Virginia.	
		Production.	Percentage of total production.	Production.	Percentage of total production.
1860	14,610,042	10,806,628	74.0	....	....
1870	33,035,580	23,462,793	71.0	608,878	1.8
1880	71,481,570	47,074,975	65.9	1,829,844	2.6
1890	157,770,963	88,770,814	56.3	7,394,654	4.7
1900	269,684,027	137,210,241	50.9	22,647,207	8.4
1901	293,299,816	149,777,613	51.1	24,068,402	8.2
1902	301,590,439	139,947,962	46.4	24,570,826	8.1
1903	357,356,416	177,724,246	49.7	29,337,241	8.2
1904	351,816,398	171,094,996	48.6	32,406,752	9.2
1905	392,722,635	196,073,487	49.9	37,791,580	9.6
1906	414,157,278	200,575,617	48.4	43,290,350	10.5

Year.	Illinois.		Ohio.		Alabama.	
	Production.	Percentage of total production.	Production.	Percentage of total production.	Production.	Percentage of total production.
1860	728,400	5.0	1,265,600	8.7	10,200	0.07
1870	2,624,163	7.9	2,527,285	7.7	11,000	.03
1880	6,115,377	8.6	6,008,595	8.4	323,972	.45
1890	15,292,420	9.7	11,494,506	7.3	4,090,409	2.6
1900	25,767,981	9.6	18,988,150	7.0	8,394,275	3.1
1901	27,331,552	9.3	20,943,807	7.1	9,099,052	3.1
1902	32,939,373	10.9	23,519,894	7.8	10,354,570	3.4
1903	36,957,104	10.3	24,838,103	7.0	11,654,324	3.3
1904	36,475,060	10.4	24,400,220	6.9	11,262,046	3.2
1905	38,434,363	9.8	25,552,950	6.5	11,866,069	3.0
1906	41,480,104	10.0	27,731,640	6.7	13,107,963	3.2

PRODUCTION OF COAL IN THE UNITED STATES FROM THE EARLIEST TIMES TO THE CLOSE OF 1906.

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 Illinois River near the present city of Ottawa, Ill. The first actual mining of coal was in the Richmond basin, Virginia, 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 1906 the total quantity of coal produced in the United States has amounted to 6,384,734,143 short tons. More than 50 per cent of this, or over 3,540,000,000 tons, as been from Pennsylvania, the anthracite production in that State aving amounted to 1,845,906,009 tons, while the bituminous output f Pennsylvania has amounted to 1,695,926,076 short tons. Illinois anks second, with a total production of 594,551,163 tons, and Ohio hird, with 460,626,939 tons; West Virginia, although not coming nto existence as a separate State until 1863, ranks fourth, with a otal production in 44 years of 386,106,956 tons; Alabama comes ifth, with 150,483,856 tons; and Maryland sixth, with 142,073,920 ons.

The following table gives the production in each State from the late of earliest record to the close of 1906:

Production of coal in the United States from 1814 to the close of 1906, in 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	
1843	1,556,753	370,000	60,000	75,000	280,000	650,000	25,000	25,000	1,200	4,500	1,000			12,421	
1844	2,009,207	365,000	75,000	120,000	340,000	675,000	35,000	30,000	1,200	10,000	2,500			18,345	
1845	2,480,032	350,000	100,000	150,000	390,000	700,000	50,000	35,000	1,500	18,000	5,000			30,372	
1846	2,887,815	340,000	115,000	165,000	420,000	760,000	68,000	40,000	1,500	25,000	6,500			36,707	
1847	3,551,005	325,000	120,000	180,000	480,000	399,840	80,000	45,000	2,000	30,000	8,000			65,222	
1848	3.805,942	318,000	125,000	200,000	540,000	500,000	85,000	50,000	2,000	40,000	10,000			98,032	
1849	3,995,334	315,000	140,000	260,000	600,000	750,000	90,000	56,000	2,500	52,000	12,500			175,497	
1850	4,138,164	310,000	150,000	300,000	640,000	1,000,000	100,000	60,000	2,500	60,000	15,000			242,517	

1851	5,481,065	310,000	160,000	320,000	670,000	1,200,000	125,000	60,000	3,000	70,000	18,000			317,460	
1852	6,151,957	325,000	175,000	340,000	700,000	1,400,000	140,000	75,000	3,000	75,000	20,000			411,707	
1853	6,400,426	350,000	180,000	375,000	760,000	1,500,000	160,000	75,000	4,000	85,000	23,000			657,862	
1854	7,394,875	370,000	190,000	385,000	800,000	1,650,000	175,000	80,000	4,500	90,000	25,000			812,727	
1855	8,141,754	380,782	200,000	400,000	890,000	1,780,000	185,000	80,000	6,000	100,000	28,000			735,137	
1856	8,534,779	352,687	215,000	410,000	930,000	1,850,000	200,000	85,000	6,800	115,000	30,000			817,659	
1857	8,186,567	363,605	240,000	450,000	975,000	2,000,000	220,000	85,000	8,000	125,000	33,000			654,017	
1858	8,426,102	377,690	250,000	490,000	1,000,000	2,200,000	240,000	87,000	8,500	135,000	37,500			722,686	
1859	9,619,771	359,055	275,000	530,000	1,060,000	2,400,000	260,000	95,000	9,000	150,000	42,000			833,349	
1860	8,115,842	473,360	285,760	728,400	1,265,600	2,690,786	280,000	101,280	10,200	165,300	41,920	200		438,000	5,374
1861	9,799,654	445,165	280,000	670,000	1,150,000	3,200,000	300,000	128,000	10,000	150,000	50,000			287,073	6,000
1862	9,695,110	445,124	275,000	780,000	1,200,000	4,000,000	320,000	150,000	12,500	140,000	53,000		30,000	346,201	7,000
1863	11,785,320	40,000	250,000	890,000	1,204,581	5,000,000	360,000	200,000	15,000	100,000	57,000		30,000	877,313	8,000
1864	12,538,649	40,000	250,000	1,000,000	1,815,622	5,839,000	375,000	250,000	15,000	100,000	63,000		25,000	755,764	10,000
1865	11,891,746	40,000	200,000	1,260,000	1,536,218	6,350,000	420,000	280,000	12,000	100,000	69,574		20,000	1,025,208	12,000
1866	15,651,183	40,000	180,000	1,580,000	1,887,424	6,800,000	450,000	320,000	12,000	100,000	99,320		20,000	1,217,668	13,000
1867	16,002,109	50,000	175,000	1,800,000	2,092,334	7,300,000	500,000	350,000	10,000	110,000	150,000		20,000	1,381,429	14,500
1868	17,003,405	59,051	160,000	2,000,000	2,475,844	7,500,000	541,000	375,000	10,000	125,000	241,453		18,000	1,529,879	15,000
1869	17,083,134	65,000	160,000	1,854,000	2,461,986	6,750,000	550,000	400,000	10,000	130,000	295,105		16,000	2,216,300	16,200
1870	15,664,275	61,803	150,582	2,624,163	2,527,285	7,798,518	621,930	437,870	11,000	133,418	263,487		15,000	1,819,824	17,844
1871	19,342,057	70,000	250,000	3,000,000	4,000,000	9,040,565	725,000	600,000	15,000	180,000	300,000		15,000	2,670,338	20,000
1872	24,233,166	69,440	380,800	3,360,000	5,315,294	11,695,040	784,000	896,000	16,800	224,000	336,000		12,000	2,647,156	23,000
1873	26,152,837	67,200	400,000	3,920,000	4,550,028	13,098,829	784,000	1,000,000	44,800	350,000	392,000		10,000	3,198,911	26,000
1874	24,818,790	70,000	360,000	4,203,090	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

Production of coal in the United States from 1814 to the close of 1906, in short tons—Continued.

Year.	Pennsylvania.	Virginia.	Kentucky.	Illinois.	Ohio.	Pennsylvania.	Missouri.	Indiana.	Alabama.	Tennessee.	Iowa.	Arkansas.	North Carolina.	Maryland.	Washington.
	Anthracite.					*Bituminous.*									
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	5,766,690	6,798,609	1,934,673	1,557	5,108,539	2,864,926
1906	71,282,411	4,254,879	9,653,647	41,480,104	27,731,640	129,293,206	3,758,008	12,092,560	13,107,963	6,259,275	7,266,224	1,864,268	....	5,435,453	3,276,184
Total	1,845,906,009	52,518,257	111,651,450	594,551,163	460,626,939	1,695,926,076	93,620,170	145,454,677	150,483,856	77,494,358	134,034,470	21,085,963	476,805	142,073,920	39,428,165

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																147,914
1827																172,151
1828																195,908
1829																240,086
1830																320,072
1831																337,942
1832																594,050
1833																734,657
1834																600,515
1835																824,854

1836																984,832
1837																1,253,651
1838																1,355,527
1839																1,560,360
1840															1,520	2,070,039
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
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

[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 1906, in short tons—Continued.

Year.	Michigan.	Georgia.	California.	West Virginia.	Colorado.	Wyoming.	Kansas.	Utah.	Indian Territory.	Oregon.	Montana.	New Mexico.	Texas.	North Dakota.	Miscellaneous.[a]	Total.
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	171,708	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	1,210	269,684,027
1901	1,241,241	342,825	151,079	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	1,300	293,299,816
1902	964,718	414,083	84,984	24,570,826	7,401,343	4,429,491	5,266,065	1,574,521	2,820,666	65,648	1,560,823	1,048,763	901,912	226,511	4,242	301,590,439
1903	1,367,619	416,951	104,673	29,337,241	7,423,602	4,635,293	5,839,976	1,681,409	3,517,388	91,144	1,488,810	1,541,781	926,759	278,645	4,997	357,356,416
1904	1,342,840	383,191	78,888	32,406,752	6,658,355	5,178,556	6,333,307	1,493,027	3,046,539	111,540	1,358,919	1,452,325	1,195,944	271,928	4,174	351,816,398
1905	1,473,211	351,991	77,050	37,791,580	8,826,429	5,602,021	6,423,979	1,332,372	2,924,427	109,641	1,643,832	1,649,933	1,200,684	317,542	9,656	392,722,635
1906	1,346,338	332,107	25,290	43,290,350	10,111,218	6,133,994	6,024,775	1,772,551	2,860,200	79,731	1,829,921	1,964,713	1,312,873	305,689	11,706	414,157,278
Total.	11,807,085	7,761,295	5,016,995	386,106,956	101,878,100	71,565,775	83,853,755	16,889,575	36,202,357	1,719,411	22,722,276	19,696,473	12,796,879	2,436,498	38,948,435	6,384,734,143

[a] See footnote preceeding page.

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 usually when the anthracite fields of the United States are referred to those of eastern Pennsylvania are considered. This region is included in the counties of Susquehanna, Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, Northumberland, Dauphin, and Sullivan, and underlies an area of about 484 square miles. In addition to these well-known anthracite fields of Pennsylvania there are two small areas in the Rocky Mountain region where the coal has been locally anthracited, although the production from these districts has never amounted to as much as 100,000 tons in any one year. One of these localities is in Gunnison County, Colo., and the other in Santa Fe County, N. Mex. The coal, although only locally metamorphosed, is a true anthracite and of a good quality. In previous years some coal which was classed as anthracite was mined and sold in New England. The productive area was confined to the eastern part of Rhode Island and the counties of Bristol and Plymouth, in Massachusetts. This product, however, is in reality a graphitic and not an anthracite coal, and is no longer mined for fuel purposes. The production in the last few years has been included with the graphite production.

The bituminous fields are scattered widely over the United States, and include altogether an area of something over 335,000 square miles. They are divided into the following subdivisions:

(1) The Triassic field, embracing the coal beds of the Triassic or New Red Sandstone formation in the Richmond basin, in Virginia, and in the coal basins along the Deep and Dan rivers, in North Carolina; (2) the Appalachian field, which extends from the State of New York on the north to the State of Alabama on the south, having a length northeast and southwest of over 900 miles and a width ranging from 30 to 180 miles; (3) the northern field, which is confined exclusively to the central part of Michigan; (4) the eastern interior field, embracing the coal areas in Indiana, Illinois, and western Kentucky; (5) the western interior 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 field, 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 1906 it produced 233,473,524 short tons, or 68.1 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 1906 59,457,660 short tons, or 17.34 per cent of the total. The Western coal field, the third in productive importance, contains 94,076 square miles and produced in 1906 23,086,348 short tons, or 6.73 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 1906 22,064,003 short tons, or 6.44 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 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 United States Geological Survey, Part III.

Coal fields of the United States and their production, 1902—1906.

	Area.	1902.	1903.	1904.	1905.	1906.
Anthracite.	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	484	41,373,595	74,607,068	73,156,709	77,659,850	71,282,411
Colorado and New Mexico	16	93,937	72,731	72,074	74,823	[a] 60,248
Total	500	41,467,532	74,679,799	73,228,783	77,734,673	71,342,659
Bituminous.[b]						
Triassic:						
Virginia	270	16,206	18,084	2,100	....	....
North Carolina	800	23,000	17,309	7,000	1,557	....
Appalachian:						
Pennsylvania	12,200	98,574,367	103,117,178	97,938,287	118,413,637	129,293,206
Ohio	12,000	23,519,894	24,838,103	24,400,220	25,552,950	27,731,640
Maryland	510	5,271,609	4,846,165	4,813,622	5,108,539	5,435,453
Virginia	1,850	3,166,787	3,433,223	3,408,814	4,275,271	4,254,879
West Virginia	17,280	24,570,826	29,337,241	32,406,752	37,791,580	43,290,350
Eastern Kentucky	11,180	3,019,757	3,158,972	3,211,418	3,506,597	3,768,651
Tennessee	4,400	4,382,968	4,798,004	4,782,211	5,766,690	6,259,275
Georgia	167	414,083	416,951	383,191	351,991	332,107
Alabama	8,500	10,354,570	11,654,324	11,262,046	11,866,069	13,107,963
Total	68,087	173,274,861	185,600,161	182,606,561	212,633,324	233,473,524
Northern:						
Michigan	11,300	964,718	1,367,619	1,342,840	1,473,211	1,346,338
Eastern Interior:						
Indiana	9,300	9,446,424	10,794,692	10,842,189	11,895,252	12,092,560
Western Kentucky	5,800	3,747,227	4,379,060	4,365,064	4,925,926	5,884,996
Illinois	42,900	32,939,373	36,957,104	36,475,060	38,434,363	41,480,104
Total	58,000	46,133,024	52,130,856	51,682,313	55,255,541	59,457,660
Western Interior:						
Iowa	20,000	5,904,766	6,419,811	6,519,933	6,798,609	7,266,224
Missouri	23,000	3,890,154	4,238,586	4,168,308	3,983,378	3,758,008
Nebraska	3,200	....	....	....	....	....
Kansas	20,000	5,266,065	5,839,976	6,333,307	6,423,979	6,024,775
Arkansas	1,728	1,943,932	2,229,172	2,009,451	1,934,673	1,864,268
Indian Territory	14,848	2,820,666	3,517,388	3,046,539	2,924,427	2,860,200
Texas	11,300	901,912	926,759	1,195,944	1,200,684	1,312,873
Total	94,076	20,727,495	23,171,692	23,273,482	23,265,750	23,086,348
Rocky Mountain, etc.:						
North Dakota	28,620	226,511	278,645	271,928	317,542	305,689
Montana	32,000	1,560,823	1,488,810	1,358,919	1,643,832	1,829,921
Wyoming	16,500	4,429,491	4,635,293	5,178,556	5,602,021	6,133,994
Utah	2,000	1,574,521	1,681,409	1,493,027	1,332,372	1,772,551
Colorado	18,100	7,348,732	7,381,463	6,610,110	8,776,021	10,050,970
New Mexico	2,890	1,007,437	1,511,189	1,428,496	1,625,518	1,964,713
Idaho	....	2,030	4,250	3,330	5,782	5,365
Nevada	....	....	....	150	100	800
Total	100,110	16,149,545	16,981,059	16,344,516	19,303,188	22,064,003
Pacific coast:						
Washington	450	2,681,214	3,193,273	3,137,681	2,864,926	3,276,184
Oregon	320	65,648	91,144	111,540	109,641	79,731
California	280	84,984	104,673	78,888	77,050	25,290
Alaska	....	2,212	747	694	3,774	5,541
Total	1,050	2,834,058	3,389,837	3,328,803	3,055,391	3,386,746
Total production, including colliery consumption	....	301,590,439	357,356,416	351,816,398	392,722,635	414,157,278

[a] Colorado only.

[b] Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.

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 68.1 in 1906. The Eastern Interior or Illinois-Indiana field has increased its percentage of the total from 16.50 to 17.34, and the Rocky Mountain field from 4.15 to 6.44. The Western Interior field, however, which includes Iowa, Kansas, Missouri, Arkansas, Indian Territory, and Texas, and which in 1887 contributed 11.49 per cent of the total, produced only 6.73 per cent in 1905. The following table also shows how the production of each field in 1906 compared with 1905 and with 1887:

Total production of each field, 1887–1906, in short tons.

	Anthracite.	Bituminous.		
		Triassic.	Appalachian.	Northern.
Area ....square miles..	500	1,070	68,087	11,300
Year.				
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	212,633,324	1,473,211
1906	71,342,659	....	233,473,524	1,346,338

	Bituminous.			
	Eastern Interior.	Western Interior.	Rocky Mountain, etc.	Pacific coast.
Area ....square miles..	58,000	94,076	100,110	1,050
Year.				
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
1906	59,457,660	23,086,348	22,064,003	3,386,746

Production of the six principal bituminous coal fields in 1887, 1902, 1903, 1904, 1905, and 1906, compared, in short tons.

Field.	1887.		1902.		1903.		1904.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.
Appalachian	55,888,088	63.11	173,274,861	66.60	185,600,161	65.64	182,606,561	65.53
Eastern Interior	14,478,883	16.50	46,133,024	17.73	52,130,856	18.43	51,682,313	18.55
Western Interior	10,172,634	11.49	20,727,495	7.97	23,171,692	8.20	23,273,482	8.35
Northern	71,461	.08	964,718	.37	1,367,619	.48	1,342,840	.48
Rocky Mountain	3,646,280	4.15	16,149,545	6.21	16,981,059	6.01	16,344,516	5.87
Pacific coast	854,308	1.00	2,834,058	1.07	3,389,837	1.20	3,328,803	1.19

Field.	1905.		1906.		Increase in 1906 over 1887.		Increase in 1906 over 1905.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage.	Quantity.	Percentage.
Appalachian	212,633,324	67.49	233,473,524	68.10	177,585,436	317.75	20,840,200	9.80
Eastern Interior	55,255,541	17.54	59,457,660	17.34	44,978,777	310.65	4,202,119	7.60
Western Interior	23,265,750	7.38	23,086,348	6.73	12,913,714	126.95	[a] 179,402	[a] .77
Northern	1,473,211	.47	1,346,338	.39	1,274,877	1,784,02	[a] 126,873	[a] 8.61
Rocky Mountain	19,303,188	6.13	22,064,003	6.44	18,417,723	505.11	2,760,815	14.30
Pacific coast	3,055,391	.97	3,386,746	.99	2,532,438	296.43	331,355	10.84

[a] Decrease.

RANK OF COAL-PRODUCING STATES.

In the following tables the coal-producing States are arranged according to rank in 1905 and 1906, first in the quantity of coal produced and then according to the value of the product, with the total and percentage of both quantity and value contributed by each State.

The most important change recorded in this table as the result of the conditions which existed in 1906 was the displacement of Illinois as the second in rank among the coal-producing States. For several years West Virginia has been creeping up on Illinois, and in 1906 took the position held by Illinois since 1876, just 30 years before. The fact accomplished in 1906 would unquestionably have occurred within a year or two at any rate, but it was possibly precipitated by the suspension of mining in the spring of 1906 in those States where the mine workers are organized. It is true that notwithstanding the almost complete shut down of the Illinois mines for a period of about 11 weeks, that State exhibited a normal increase over 1905, and it has been claimed that the production would not have been any larger had there been no interruption to mining operations. But it is also true that during the shut down in other States mining in West Virginia was exceptionally active and, in addition to the increased production at the operating mines, new territory was opened up and much new development work started. As a result of these conditions West Virginia in 1906 showed a larger increase than any other State and took second place. It is not likely, in view of the developments made and in progress, that West Virginia will be supplanted.

The only other changes in rank among the 10 leading States was the resumption by Alabama as fifth, exchanging places with Indiana, which had supplanted Alabama in 1905, and the displacing of Kansas by Tennessee as the tenth State in producing importance.

The record for 1906 shows that Pennsylvania has once more fallen below 50 per cent of the total production of the United States. In the combined production of anthracite and bituminous coal, Pennsylvania as recently as 1880 was credited with two-thirds of the total coal output of the country, but the proportion produced in that State has been gradually declining and in four of the last five years the percentage has been less than 50. In 1906 Pennsylvania produced 48.4 per cent of the total, 17.2 per cent being represented by the anthracite and 31.2 per cent by the bituminous production. Of the other important States, West Virginia contributed 10.5 per cent, Illinois 10 per cent, Ohio 6.7 per cent, Alabama 3.2 per cent, and Indiana 2.9 per cent.

Rank of coal-producing States in 1905, with quantity and value of product and percentage of each.

Production.				Value.			
Rank.	State or Territory.	Quantity (short tons).	Percentage of total production.	Rank.	State or Territory.	Value.	Percentage of total value.
	Pennsylvania:				Pennsylvania:		
1	Anthracite	77,659,850	19.8	1	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	5,766,690	1.5	11	Wyoming	7,336,951	1.5
12	Wyoming	5,602,021	1.4	12	Tennessee	6,577,881	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		25	North Dakota	424,778	
26	Oregon	109,641		26	California and Alaska	395,975	.2
27	California and Alaska	80,824	.1	27	Oregon	282,495	
28	Idaho	[a]5,882		28	Idaho	[a]17,846	
	Total	392,722,635	100.0		Total	476,537,294	100.0

[a]Includes production of Nevada.

Rank of coal-producing States in 1906, with quantity and value of product and percentage of each.

Production.				Value.			
Rank.	State or Territory.	Quantity (short tons).	Percentage of total production.	Rank.	State or Territory.	Value.	Percentage of total value.
	Pennsylvania:				Pennsylvania:		
1	Anthracite	71,282,411	17.2	1	Anthracite	$131,917,694	25.7
	Bituminous	129,293,206	31.2		Bituminous	130,290,651	25.4
2	West Virginia	43,290,350	10.5	2	Illinois	44,763,062	8.7
3	Illinois	41,480,104	10.0	3	West Virginia	41,051,939	8.0
4	Ohio	27,731,640	6.7	4	Ohio	30,346,580	5.9
5	Alabama	13,107,963	3.2	5	Alabama	17,514,786	3.4
6	Indiana	12,092,560	2.9	6	Indiana	13,116,261	2.6
7	Colorado	10,111,218	2.4	7	Colorado	12,735,616	2.4
8	Kentucky	9,653,647	2.3	8	Iowa	11,619,455	2.3
9	Iowa	7,266,224	1.8	9	Kentucky	9,809,938	1.9
10	Tennessee	6,259,275	1.5	10	Kansas	8,979,553	1.7
11	Wyoming	6,133,994	1.5	11	Wyoming	8,013,528	1.6
12	Kansas	6,024,775	1.5	12	Tennessee	7,667,415	1.5
13	Maryland	5,435,453	1.3	13	Maryland	6,474,793	1.3
14	Virginia	4,254,879	1.0	14	Missouri	6,118,733	1.2
15	Missouri	3,758,008	.9	15	Washington	5,908,434	1.1
16	Washington	3,276,184	.8	16	Indian Territory	5,482,366	1.1
17	Indian Territory	2,860,200	.7	17	Virginia	4,183,991	.8
18	New Mexico	1,964,713	.5	18	Montana	3,240,357	.6
19	Arkansas	1,864,268	.5	19	Arkansas	3,000,339	.6
20	Montana	1,829,921	.4	20	New Mexico	2,638,986	.5
21	Utah	1,772,551	.4	21	Michigan	2,427,404	.5
22	Michigan	1,346,338	.3	22	Utah	2,408,381	.5
23	Texas	1,312,873	.3	23	Texas	2,178,901	.4
24	Georgia	332,107	.1	24	North Dakota	451,382	.1
25	North Dakota	305,689		25	Georgia	424,004	.1
26	Oregon	79,731		26	Oregon	212,338	
27	California and Alaska	30,831	.1	27	California and Alaska	78,684	.1
28	Idaho	a 6,165		28	Idaho	a 24,238	
	Total	414,157,278	100.0		Total	513,079,809	100.0

a Includes production of Nevada.

KINDS OF COAL PRODUCED IN THE UNITED STATES.

In the general discussion of the coal production of the United States only two divisions are considered, anthracite and bituminous, the latter product including the small anthracite output of Colorado and New Mexico. In the bituminous production, however, in addition to the small Rocky Mountain output of anthracite is also included the production of coals generally classed as semianthracite, semibituminous, cannel, block, splint, and lignite or subbituminous. In the following table the production of these varieties of coal in 1905 and 1906 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 production of anthracite in Pennsylvania there were 50,408 short tons mined in Colorado in 1905 and 60,248 tons in 1906. New Mexico produced 24,415 short tons of anthracite in 1905, but no production of this variety of coal was reported from that Territory in 1906. Semianthracite is reported from Pennsylvania, Colorado, Indian Territory, Virginia, Montana, and Arkansas. Bituminous coal was produced in 27 States and Territories in 1905 and from 24 in 1906 and forms by long odds the largest part of the total production. Semibituminous coal is produced in 17 States and Territories, with West Virginia first, followed in order by Pennsylvania, Maryland, Illinois, Virginia, and Montana. Wyoming leads in the production of lignite or subbituminous coals, over 70 per cent of the production of the 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 was obtained from 9 States in 1905 and 7 in 1906, of which Kentucky, Indiana, and West Virginia 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 1905, by States and Territories, in 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	5,763,690					3,000			5,766,690
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
Alaska	450			3,324					3,774
North Carolina	1,557								1,557
Total	289,925,071	77,427,606	13,139,846	6,886,485	1,176,232	951,372	2,669,789	546,234	392,722,635

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.

Classification of the coal product of the United States in 1906, by States and Territories, in short tons.

State or Territory.	Bituminous.	Anthracite.	Semi-bituminous.	Lignite and sub-bituminous.	Semi-anthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	126,153,741	71,282,411	3,133,305					6,160	200,575,617
West Virginia	33,923,554		5,422,422				3,929,894	14,480	43,290,350
Illinois	40,559,550		920,554						41,480,104
Ohio	27,679,846		37,458			10,500		3,836	27,731,640
Alabama	13,107,963								13,107,963
Indiana	11,267,194					[a] 799,891		25,475	12,092,560
Colorado	8,095,279	60,248	399,695	1,555,996					10,111,218
Kentucky	9,345,274		9,893			12,000	208,747	[b] 77,733	9,653,647
Iowa	7,200,519					52,685		13,020	7,266,224
Tennessee	6,148,064		111,211						6,259,275
Wyoming	1,317,974		421,680	4,394,340					6,133,994
Kansas	6,022,175			2,600					6,024,775
Maryland	4,035,987		1,399,466						5,435,453
Virginia	3,427,486		778,653		48,740				4,254,879
Missouri	3,731,183					21,725		5,100	3,758,008
Washington	2,909,706		204,165	162,313					3,276,184
Indian Territory	2,771,211		5,119		83,870				2,860,200
New Mexico	1,416,726			547,987					1,964,713
Arkansas	1,180,873		84,607		598,788				1,864,268
Montana	1,163,328		646,381	19,562	650				1,829,921
Utah	1,735,809		1,325	35,417					1,772,551
Michigan	1,346,338								1,346,338
Texas	839,985			472,888					1,312,873
Georgia	95,096		237,011						332,107
North Dakota				305,689					305,689
Oregon				79,731					79,731
California			3,090	22,200					25,290
Idaho [c]				6,165					6,165
Alaska				5,541					5,541
Total	315,474,861	71,342,659	13,816,035	7,610,429	732,048	896,801	4,138,641	145,804	414,157,278

[a] Includes 23,325 tons of semiblock coal.
[b] Includes 4,650 tons of semicannel coal.
[c] 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 1906 was 640,780, against 626,035 in 1905, and 593,693 in 1904. Of the total number of employees in 1906, 478,425, or nearly 75 per cent, were bituminous-mine workers, and 162,355, or something over 25 per cent, were employed in the anthracite mines. An interesting fact exhibited in this table is that notwithstanding the loss of time due to the suspension of operations in the spring of 1906, which is referred to more particularly in another portion of this report, the average number of days worked by each employee in the bituminous mines was 213, against 211 in 1905, when the amount of idle time due to labor disaffections was insignificant. During 1906, 211,304 men, or 44 per cent of the total bituminous workers, were idle for an average of 63 days, and the total time lost was equal to 13 per cent of the total time made; but in spite of this the average number of days worked was greater than in either 1905 or 1904. In the anthracite mines of Pennsylvania the suspension lasted about six weeks, and the average number of days made by each employee last year was 195, against 215 days in 1905. The average number of days for all the mine workers, anthracite and bituminous, in 1906, was 209, against 212 in 1905 and 202 in 1904.

Statistics of labor employed in coal mines of the United States, 1902–1906, by States.

State or Territory.	1902.		1903.		1904.		1905.		1906.	
	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	256	16,439	228	21,438	216	17,811	225	19,595	237	20,555
Arkansas	188	3,595	223	4,157	165	4,580	177	4,192	165	4,298
California	a 302	a 217	a 301	a 208	a 282	a 168	a 294	a 144	a 253	56
Colorado	261	8,956	245	9,229	261	8,123	255	11,020	268	11,368
Georgia	b 312	b 795	b 296	b 730	b 223	b 906	b 266	b 816	279	737
Idaho	74	20	197	32	c 112	c 32	c 107	c 37	157	25
Illinois	226	47,411	228	50,596	213	54,685	201	58,053	192	61,988
Indiana	205	15,457	197	17,017	177	19,587	151	25,323	175	20,970
Indian Territory	232	5,574	247	7,704	199	8,487	188	7,712	166	8,251
Iowa	227	12,434	226	14,162	213	15,629	209	15,113	224	15,260
Kansas	220	9,461	215	10,924	213	12,198	212	11,926	165	14,355
Kentucky	209	13,727	207	14,354	197	14,235	200	14,685	212	15,272
Maryland	242	5,827	219	5,859	226	5,671	252	5,948	250	6,438
Michigan	171	2,344	222	2,768	183	3,549	186	3,696	173	3,971
Missouri	202	9,742	215	9,544	206	10,137	194	8,962	185	9,557
Montana	270	1,938	254	2,155	243	2,505	243	2,181	243	2,394
New Mexico	217	1,849	260	1,789	228	1,849	234	2,108	242	2,070
North Dakota	213	402	198	486	192	554	187	626	209	488
Ohio	200	38,965	194	41,936	175	43,634	176	43,399	167	45,438
Oregon	234	265	258	235	149	334	242	316	224	209
Pennsylvania bituminous	248	112,630	235	129,265	196	135,100	231	143,629	231	152,099
Tennessee	230	8,750	227	9,961	217	10,416	222	11,928	229	11,452
Texas	267	2,369	242	2,380	220	2,921	238	3,008	227	3,048
Utah	259	1,826	248	1,925	294	1,374	247	1,361	288	1,572
Virginia	293	3,912	267	5,608	238	5,165	241	5,730	250	5,131
Washington	275	4,404	285	4,768	243	5,287	227	4,765	266	4,529
West Virginia	205	35,500	210	41,554	197	47,235	209	48,389	220	50,960
Wyoming	248	5,250	252	4,993	262	5,660	236	5,977	281	5,934
Total	230	370,059	225	415,777	202	437,832	211	460,629	213	478,425
Pennsylvania anthracite	116	148,141	206	150,483	200	155,861	215	165,406	195	162,355
Grand total	197	518,200	220	566,260	202	593,693	212	626,035	209	640,780

a Includes Alaska. b Includes North Carolina. c Includes Nevada.

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 1906. 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. In 1906, owing to the suspension of operations from April 1 to May 16, the average production per man for the year in the anthracite mines was 439 short tons and the daily average production per man was 2.25 tons. In the bituminous mines, on the other hand, in spite of the shut down, the average production per man in 1906 was 717 tons and the average daily production was 3.36 tons, both being the highest on record. 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 worked in the year (173) the average production per man amounted to only 433 tons. The highest yearly average per man in the bituminous mines prior to 1906 was 713 tons, made in 1899, while the best average daily tonnage was that made in 1906. It will be observed that the daily efficiency record in the anthracite region has shown a declining tendency during the last few years, while that of the workers in the bituminous regions has increased. But it will also be observed that in 1903, 1904, and 1905, when there were no strikes to speak of, the number of days worked in the anthracite mines was considerably above the average, as was also the tonnage per man per year. This was 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. Except for the suspension in the spring of 1906 the averages for the year would have compared favorably with those of the three preceding years. 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 subsequent pages of this report.

Production of coal according to number of persons employed, 1890–1906.

Year.	Anthracite.				Bituminous.			
	Men employed.	Days worked.	Average tonnage per man per day.	Average tonnage per man per year.	Men employed.	Days worked.	Average tonnage per man per day.	Average tonnage per man per year.
1890	126,000	200	1.85	369	192,204	226	2.56	579
1891	126,350	203	1.98	401	205,803	223	2.57	573
1892	129,050	198	2.06	407	212,893	219	2.72	596
1893	132,944	197	2.06	406	230,365	204	2.73	557
1894	131,603	190	2.08	395	244,603	171	2.84	486
1895	142,917	196	2.07	406	239,962	194	2.90	563
1896	148,991	174	2.10	365	244,171	192	2.94	564
1897	149,884	150	2.34	351	247,817	196	3.04	596
1898	145,504	152	2.41	367	255,717	211	3.09	651
1899	139,608	173	2.50	433	271,027	234	3.05	713
1900	144,206	166	2.40	398	304,375	234	2.98	697
1901	145,309	196	2.37	464	340,235	225	2.94	664
1902	148,141	116	2.40	279	370,056	230	3.06	703
1903	150,483	206	2.41	496	415,777	225	3.02	680
1904	155,861	200	2.35	469	437,832	202	3.15	637
1905	165,406	215	2.18	470	460,629	211	3.24	684
1906	162,355	195	2.25	439	478,425	213	3.36	717

In connection with the statistics of labor employed in the bituminous coal mines of the United States, the Geological Survey has during the past 4 or 5 years included in 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 per 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 miners 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 miners have worked 8 hours a day for the last 3 or 4 years. In Pennsylvania there were in 1906, 92,082 men employed at 744 mines that worked 8 hours, against 60,297 men at 669 mines in 1905 and 77,960 men at 637 mines in 1904. 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 the increase of 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 1905 and 1906, by States and Territories.

1905.

State or Territory.	8 hours.		9 hours.		10 hours.		All others.[a]
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Men.
Alabama	24	1,069	32	3,570	65	11,279	3,677
Arkansas	45	4,146	1	16	....	....	30
Colorado	61	3,660	4	189	40	6,551	620
Illinois	583	56,296	8	64	6	405	1,288
Indiana	271	24,484	2	24	3	15	800
Indian Territory	59	7,544	....	....	3	108	60
Iowa	186	13,569	5	56	3	22	1,466
Kansas	121	11,004	6	129	5	54	739
Kentucky	50	3,445	52	4,050	94	5,995	1,195
Maryland	2	70	2	60	39	5,385	433
Michigan	23	3,327	....	....	....	....	369
Missouri	194	8,096	6	70	4	25	771
Montana	23	[b] 1,707	....	....	2	6	468
New Mexico	4	83	5	92	12	1,923	10
North Dakota	8	79	7	50	20	374	123
Ohio	524	42,262	7	527	4	27	573
Oregon	2	109	1	14	2	193	....
Pennsylvania	669	60,297	226	26,090	179	31,314	25,928
Tennessee	8	876	62	5,693	33	4,463	896
Texas	11	1,442	3	[b] 125	13	1,135	306
Utah	13	1,352	....	....	2	6	3
Virginia	2	522	7	591	25	3,999	618
Washington	18	3,644	1	28	8	353	740
West Virginia	49	3,532	161	14,387	251	25,731	4,739
Wyoming	2	8	2	456	26	5,492	21
Total	2,952	252,623	600	56,281	839	104,855	45,873

1906.

State or Territory.	8 hours.		9 hours.		10 hours.		All others.[a]
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Men.
Alabama	27	1,096	37	7,808	91	11,258	393
Arkansas	55	4,282	....	....	....	....	16
Colorado	67	[b] 5,259	9	655	48	5,222	232
Illinois	482	[b] 60,081	9	610	1	30	1,267
Indiana	230	19,842	2	100	....	....	1,028
Indian Territory	70	7,824	3	167	4	81	179
Iowa	195	14,869	2	20	1	8	363
Kansas	141	12,606	7	94	3	399	1,256
Kentucky	60	4,171	65	3,972	79	5,941	1,188
Maryland	....	....	1	50	45	6,358	30
Michigan	27	3,941	....	....	....	....	30
Missouri	134	8,645	6	58	6	80	774
Montana	28	[b] 2,203	1	85	....	....	106
New Mexico	8	78	2	24	16	1,856	112
North Dakota	6	47	4	38	20	323	80
Ohio	461	44,003	8	174	3	76	1,185
Oregon	1	4	....	....	2	195	10
Pennsylvania	744	[b] 92,082	233	25,695	190	30,895	3,427
Tennessee	4	246	79	6,938	30	4,034	234
Texas	10	1,817	....	....	8	703	528
Utah	12	1,554	1	2	1	3	13
Virginia	6	105	5	727	31	4,294	5
Washington	29	[b] 4,179	4	106	2	13	231
West Virginia	43	[b] 2,510	190	15,208	308	31,531	1,711
Wyoming	2	8	2	25	29	5,500	401
Total	2,842	291,452	670	62,556	918	108,800	14,799

[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 three years, and this State furnishes the best record of all in both respects, while Wyoming, Colorado, New Mexico, 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 for the year per man in the States working the longer day in 1905 was 730.6 tons, and in 1906, 801.3 tons. In the 8-hour States the corresponding figures were 580.8 tons in 1905 and 517.7 tons in 1906. Moreover, it appears that the men who work 10 hours per day make more days in the year. The average number of days made in the 9 States working 9 or 10 hours was 230 in 1905 and 243 in 1906, while in the 13 8-hour States it was 203 in both 1905 and 1906. The average daily production per man was 3.16 tons in 1905 and 3.28 tons in 1906.

Average production per man compared with hours worked per day and average number of days per year in 1904, 1905, and 1906.

State or Territory.	1904.				1905.				1906.			
	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	216	632.3	2.93	9 and 10	225	605.6	2.69	9 and 10	237	637.7	2.69
Arkansas	8	165	438.7	2.66	8	177	461.5	2.60	8	165	433.8	2.63
Colorado	10	261	819.7	3.14	10	255	800.9	3.14	8 and 10	268	889.4	3.32
Illinois	8	213	667.0	3.13	8	201	662.1	3.29	8	192	669.2	3.49
Indiana	8	177	553.5	3.13	8	151	469.7	3.11	8	175	576.7	3.30
Indian Territory	8	199	359.9	1.80	8	188	379.2	2.02	8	166	346.6	2.09
Iowa	8	213	417.2	1.96	8	209	449.9	2.15	8	224	476.2	2.13
Kansas	8	213	519.2	2.44	8	212	538.7	2.54	8	165	419.7	2.54
Kentucky	8, 9, and 10	197	532.2	2.70	9 and 10	200	574.2	2.87	9 and 10	212	632.1	2.98
Maryland	10	226	848.8	3.76	10	252	858.9	3.41	10	250	844.3	3.38
Michigan	8	183	378.4	2.07	8	186	398.6	2.14	8	173	339.0	1.96
Missouri	8	206	411.2	2.00	8	194	444.5	2.29	8	185	393.2	2.13
Montana	9	243	542.5	2.23	8	243	753.7	3.10	8	243	764.4	3.15
New Mexico	10	228	785.5	3.45	10	234	782.7	3.34	10	242	949.1	3.92
Ohio	8	175	559.2	3.20	8	176	588.9	3.35	8	167	610.3	3.65
Pennsylvania:												
Anthracite	9	200	469.4	2.35	9	215	469.5	2.18	9	195	439.1	2.25
Bituminous	[a] 8	196	724.9	3.70	8	231	824.4	3.57	8	231	850.1	3.68
Tennessee	9 and 10	217	459.1	2.12	9 and 10	221	483.5	2.29	9 and 10	229	546.6	2.39
Utah	8	294	1,086.6	3.70	8	247	979.0	3.96	8	288	1,127.6	3.92
Virginia	10	238	660.4	2.77	10	241	746.1	3.10	10	250	829.2	3.32
Washington	8	243	593.5	2.44	8	227	601.2	2.65	8	266	723.4	2.72
West Virginia	9 and 10	197	686.1	3.48	9 and 10	209	781.0	3.74	9 and 10	220	849.5	3.86
Wyoming	10	262	914.9	3.49	10	236	937.3	3.97	10	281	1,033.7	3.68

[a] Represents 60 per cent of employees; the other 40 per cent about evenly divided between 9 and 10 hours.

LABOR TROUBLES.

With the exception of 1902, a year made famous in the history of coal mining by the most bitterly contested strike ever known in the anthracite region of Pennsylvania and by sympathetic or coordinate strikes in the organized bituminous States, there was more idle time due to labor controversies in 1906 than in any year for which statistics of this character have been compiled. And yet, as it appears on the record, there were practically no "strikes" in 1906, and the statistics for the year show that the average time made by the mine workers was normal when compared with the averages in recent years.

It was apparent to both operators and miners several months in advance that there would be a suspension of mining operations when the existing wage-scale agreements expired on March 31, and in anticipation of such suspension the mines in all the organized districts were worked to their utmost capacity during the winter and the month of March, the operators being actuated by a desire to provide a supply of fuel, while the miners were urged on by the necessity of providing a fund to carry them over the threatened period of idleness. Each side of the controversy thus in helping itself helped the other, and when April 1 arrived without an agreement having been reached each side was in an unusually strong position. The officials of the mine workers' union were not authorized by a vote of the organization to call a strike. The men were simply requested to suspend work on April 1, pending a settlement of the wage scale, and this request was generally complied with. In the anthracite region of Pennsylvania the miners formulated demands for certain changes in their conditions of employment, but as the region had been peaceful and prosperous for 3 years under the awards of the Strike Commission, the operators declined to entertain the demands and simply proposed a renewal of those awards for another term of 3 years. After an idleness of about 6 weeks this proposition was finally accepted without amendment by the miners.

The controversy in the bituminous fields was more prolonged and attended with more ill feeling than in the anthracite region. At times appearances of a peaceful settlement were decidedly remote, and several attempts were made to secure the intervention of the President of the United States. Fortunately, however, there were comparatively few cases of assault or other lawlessness, and the situation did not develop any condition requiring the interference of the Federal Government. Reference to some of the incidents of the suspension which possessed humorous tendencies have been made in the introduction to this report. The most important effect of the suspension on the industry as a whole was the disintegration of the interstate agreement which had been in existence for several years.

The total number of men idle because of the suspension or because of strikes in 1906 was 372,343, of whom 211,304 were bituminous workers and 161,039 were employed in the anthracite mines of Pennsylvania. The average idle time for each man in the bituminous mines was 63 days, and the aggregate number of working days lost was 13 per cent of the total time made. The average time idle for each man in the anthracite mines of Pennsylvania was 37 days and the time lost was 18.8 per cent of the time worked. During the period of "suspension," from April 1 to May 14, there was only one mine in the anthracite region which kept at work. The washeries which reclaim the coal from the old culm banks, 27 in number, were operated without interruption.

The statistics of labor troubles in the coal mines of the United States in 1905 and 1906, by States, are presented in the following tables:

Statistics of labor strikes in the coal mines of the United States in 1905 and 1906.

State or Territory.	1905.			1906.		
	Number of men on strike.	Total days lost.	Average number of days lost per man.	Number of men on strike.	Total days lost.	Average number of days lost per man.
Alabama	667	33,262	50	549	6,576	12
Arkansas	625	7,806	12	3,828	291,095	76
Illinois	15,289	321,967	21	49,792	2,900,525	58
Indiana	981	12,528	13	15,875	995,217	63
Indian Territory	397	3,509	9	7,372	535,504	72
Iowa	1,774	10,353	6	7,969	204,860	28
Kansas	1,482	14,686	10	11,827	709,422	59
Kentucky	923	62,651	68	1,242	44,812	36
Maryland				30	300	10
Michigan				3,340	294,630	88
Missouri	435	6,788	16	6,212	483,790	78
Montana	200	36,000	180	230	7,030	31
North Dakota				37	92	2
Ohio	3,250	49,495	15	37,636	2,687,288	71
Pennsylvania	5,686	186,250	33	59,593	3,941,835	66
Tennessee	150	4,770	32	180	1,185	7
Texas	25	375	15	1,260	9,245	7
Utah	6	6	1			
West Virginia	462	12,111	26	4,101	123,724	30
Wyoming	192	192	1	231	5,775	25
Total bituminous	32,544	762,749	23.4	211,304	13,242,905	63
Pennsylvania anthracite	4,998	33,986	7	161,039	5,958,443	37
Grand total	37,542	796,735	21	372,343	19,201,348	51.5

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, 1899–1906.

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
1906	372,343	19,201,348	51.5

[a] Bituminous mines only.

COAL MINED BY MACHINES.

In 1906, as in 1905, one of the notable features presented by the statistics of bituminous coal production was the growth exhibited in the use of machines and in the quantity of coal 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, but that the increase in the production of machine-mined coal was comparatively unimportant. No such condition is exhibited in the statistics for 1905 or 1906. 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. In 1906 the quantity of machine-mined coal was 15,451,075 short tons greater than in 1905, while the total production of bituminous coal increased 21,434,643 tons, showing that 72 per cent of the increase in 1906 over 1905 was in the machine-mined product. The statistics also show 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, and to 11,638 tons in 1906. 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 1906 was 118,847,527 short tons, compared with 103,396,452 short tons in 1905 and with 78,606,997 short tons in 1904. The increase in 1906 was 15,451,075 short tons, or 15 per cent. 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 7,663 in 1904 to 9,184 in 1905 and to 10,212 in 1906.

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; in 1905, 33.69, and in 1906, 35.1.

Of the 10,212 machines in use in 1906, 5,911, or 58 per cent, were of the pick or puncher type; 4,144, or 40.5 per cent, were chain-breast machines, and 157, or 1.5 per cent, were long wall.

In the number of machines in use and in the quantity of machine-mined tonnage, as in the total production of coal, Pennsylvania stands far in the lead, with 45 per cent of the number of machines and 45.6 per cent of the machine-won product in 1906. The quantity of coal mined by machines in Pennsylvania increased from 49,335,660 short tons in 1905 to 54,146,314 short tons in 1906. West Virginia, with 1,322 machines, ranks second in the number of machines in use, closely followed by Ohio, with 1,255. The position of these two States is reversed in the quantity of coal mined by machines, Ohio's production by machines in 1906 being 20,004,416 short tons, while West Virginia's was 15,565,113 tons. Ohio stands first in the percentage of machine-mined coal to the State total. Illinois, the third 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-mined tonnage, and second in the percentage of the machine-mined coal to the State total. Indiana comes next to Kentucky in the use of mining machines. The six 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 five years are shown in the following table, together with the number of machines used in each State, the number of tons mined by machines, the total production of the States in which machines were used, and the percentage of the machine-mined product to the total of those States:

Bituminous coal mined by machines in the United States, 1902–1906, by States and Territories.

State or Territory.	Number of machines in use.					Number of tons mined by machines.				
	1902.	1903.	1904.	1905.	1906.	1902.	1903.	1904.	1905.	1906.
Alabama	66	98	141	213	238	300,670	577,317	741,170	1,584,942	1,641,476
Arkansas	7					8,989				
Colorado	98	157	125	121	141	857,279	1,270,221	945,965	1,247,687	1,337,006
Georgia				6					11,684	
Illinois	508	553	643	882	1,048	7,112,039	7,381,027	7,110,902	8,697,547	11,585,419
Indiana	269	329	403	506	471	2,421,342	3,334,961	3,613,532	4,207,246	4,251,740
Indian Territory	23	36	18	29	29	119,195	73,304	42,594	40,203	33,357
Iowa	31	10	39	32	34	110,489	55,085	175,742	186,224	193,666
Kansas	6	5	5	10	6	48,000	9,876	10,600	19,101	30,450
Kentucky	318	308	453	527	600	3,091,626	2,843,805	3,595,513	4,409,054	5,175,950
Maryland	25	36	38	42	45	252,753	401,144	484,373	468,822	427,450
Michigan	58	46	85	106	110	196,248	180,943	310,007	432,266	417,073
Missouri	20	33	31	30	48	223,969	311,602	376,505	375,194	419,288
Montana	65	63	57	58	76	691,669	693,504	482,924	752,665	974,306
New Mexico	17	12	12			71,744	105,000	100,000		
North Dakota	10	9	9	9	11	89,838	115,222	125,097	97,789	97,035
Ohio	559	724	865	1,041	1,255	12,094,641	14,007,326	13,983,647	16,888,417	20,004,416
Pennsylvania	2,620	3,310	3,645	4,254	4,515	35,058,038	37,146,253	35,174,613	49,335,660	54,146,314
Tennessee	38	51	85	89	128	303,995	304,602	440,618	479,471	747,500
Texas	8	8	9	8	12	25,500	29,000	33,154	22,400	22,682
Utah	13	13	9		2	74,502	75,000	34,054		1,000
Virginia	11	10	18	35	37	132,709	82,040	245,536	399,029	424,343
Washington					1					12,521
West Virginia	579	788	901	1,105	1,322	5,738,045	8,193,840	9,526,749	12,504,301	15,565,113
Wyoming	69	59	72	81	83	588,302	783,822	1,053,702	1,236,750	1,339,422
Total	5,418	6,658	7,663	9,184	10,212	69,611,582	77,974,894	78,606,997	103,396,452	118,847,527

Bituminous coal mined by machines in the United States, 1902–1906, by States and Territories—Continued.

State or Territory.	Total tonnage of States using mining machinery.					Percentage of total product mined by machines.				
	1902.	1903.	1904.	1905.	1906.	1902.	1903.	1904.	1905.	1906.
Alabama	10,354,570	11,654,324	11,262,046	11,866,069	13,107,963	2.90	4.95	6.58	13.36	12.52
Arkansas	1,943,932	....	....	....	....	.46	....	....	....	....
Colorado	7,401,343	7,423,602	6,658,355	8,826,429	10,111,218	11.58	17.11	14.21	14.14	13.22
Georgia	....	....	....	351,991	....	....	....	....	3.32	....
Illinois	32,939,373	36,957,104	36,475,060	38,434,363	41,480,104	21.59	19.97	19.50	22.63	27.93
Indiana	9,446,424	10,794,692	10,842,189	11,895,252	12,092,560	25.63	30.90	33.33	35.37	35.16
Indian Territory	2,820,666	3,517,388	3,046,539	2,924,427	2,860,200	4.23	2.08	1.40	1.37	1.17
Iowa	5,904,766	6,419,811	6,519,933	6,798,609	7,266,224	1.87	.86	2.70	2.74	2.67
Kansas	5,266,065	5,839,976	6,333,307	6,423,979	6,024,775	.91	.17	.17	.30	.51
Kentucky	6,766,984	7,538,032	7,576,482	8,432,523	9,653,647	45.69	37.73	47.46	51.44	53.62
Maryland	5,271,609	4,846,165	4,813,622	5,108,539	5,435,453	4.28	8.28	10.06	9.18	7.86
Michigan	964,718	1,367,619	1,342,840	1,473,211	1,346,338	20.34	13.23	23.09	29.34	30.98
Missouri	3,890,154	4,238,586	4,168,308	3,983,378	3,758,008	5.76	7.35	9.03	9.42	11.16
Montana	1,560,823	1,488,810	1,358,919	1,643,832	1,829,921	44.31	46.58	35.54	45.79	53.24
New Mexico	1,048,763	1,541,781	1,452,325	....	....	6.84	9.40	6.89	....	....
North Dakota	226,511	278,645	271,928	317,542	305,689	39.66	41.35	46.00	30.80	31.74
Ohio	23,519,894	24,838,103	24,400,220	25,552,950	27,731,640	51.42	56.39	57.31	66.10	72.14
Pennsylvania	98,574,367	103,117,178	97,938,287	118,413,637	129,293,206	35.57	36.02	35.92	41.66	41.88
Tennessee	4,382,968	4,798,004	4,782,211	5,766,690	6,259,275	6.94	6.35	9.21	8.31	11.94
Texas	901,912	926,759	1,195,944	1,200,684	1,312,873	2.83	3.13	2.77	1.86	1.73
Utah	1,574,521	1,681,409	1,493,027	....	1,772,551	4.81	4.46	2.28	....	.06
Virginia	3,182,993	3,451,307	3,410,914	4,275,271	4,254,879	4.17	2.38	7.20	9.33	9.97
Washington	....	....	....	....	3,276,184	....	....	....	....	.38
West Virginia	24,570,826	29,337,241	32,406,752	37,791,580	43,290,350	23.35	27.93	29.40	33.09	35.96
Wyoming	4,429,491	4,635,293	5,178,556	5,602,021	6,133,994	13.10	16.91	20.35	22.08	21.84
Total	256,943,673	276,691,829	272,927,764	307,082,977	338,597,052	[a] 27.09	[a] 28.18	[a] 28.80	[a] 33.67	[a] 35.10

[a] Average.

In the following table are shown the number and kinds of machines in use in each State in 1905 and 1906.

Number and kinds of machines in use in 1905 and 1906, by States and Territories.

State or Territory.	1905.				1906.			
	Pick.	Chain breast.	Long wall.	Total.	Pick.	Chain breast.	Long wall.	Total.
Alabama	171	42	....	213	177	61	....	238
Colorado	74	42	5	121	80	51	10	141
Georgia	6	....	....	6	....	....	....	....
Illinois	758	123	1	882	874	171	3	1,048
Indiana	142	362	2	506	124	329	18	471
Indian Territory	25	4	....	29	18	11	....	29
Iowa	9	9	14	32	11	14	9	34
Kansas	10	....	....	10	6	....	....	6
Kentucky	381	144	2	527	419	175	6	600
Maryland	42	....	....	42	45	....	....	45
Michigan	90	16	....	106	88	22	....	110
Missouri	....	2	28	30	4	....	44	48
Montana	55	3	....	58	70	6	....	76
North Dakota	....	9	....	9	....	11	....	11
Ohio	128	878	35	1,041	141	1,081	33	1,255
Pennsylvania	3,020	1,232	2	4,254	3,103	1,393	19	4,515
Tennessee	77	12	....	89	112	14	2	128
Texas	5	....	3	8	9	....	3	12
Utah	....	....	....	....	1	....	1	2
Virginia	10	25	....	35	10	27	....	37
Washington	....	....	....	....	....	....	1	1
West Virginia	473	628	4	1,105	571	744	7	1,322
Wyoming	49	26	6	81	48	34	1	83
Total	5,525	3,557	102	9,184	5,911	4,144	157	[a] 10,212

[a] Includes 11 pick and 26 chain shearing machines.

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 quantity 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, in short tons.

Year.	Number of machines in use.	Total tonnage won by machines.	Average production for each machine.
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
1906	10,212	118,847,527	11,638

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 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 Ohio the percentage of the machine-mined product to the State total increased from 66.1 in 1905 to 72.14 in 1906, and the average production per man per day advanced from 3.35 tons to 3.65 tons. Kentucky's machine percentage increased from 51.44 to 53.62, and the daily production per man from 2.87 to 2.98 tons. Illinois's increases were from 22.63 to 27.93 and from 3.29 to 3.49, and West Virginia's from 33.09 to 35.96 and from 3.74 to 3.96. Striking exceptions, however, are shown in Alabama and Colorado. In the former the percentage of machine coal to the State total decreased from 13.36 to 12.52 and the production per man remained the same, while in the latter the machine percentage decreased from 14.14 to 13.22 and the tonnage per man increased from 3.14 to 3.32.

Average production per man compared with production by machines in 1905 and 1906, by States and Territories, in short tons.

State or Territory.	Average tonnage. Per year. 1905.	Average tonnage. Per year. 1906.	Average tonnage. Per day. 1905.	Average tonnage. Per day. 1906.	Production by machines. Total tonnage by machines. 1905.	Production by machines. Total tonnage by machines. 1906.	Per cent of machine coal to State total. 1905.	Per cent of machine coal to State total. 1906.
Alabama	605.6	637.7	2.69	2.69	1,584,942	1,641,476	13.36	12.52
Arkansas	461.5	433.8	2.60	2.63				
Colorado	800.9	889.4	3.14	3.32	1,247,687	1,337,006	14.14	13.22
Illinois	662.1	669.2	3.29	3.49	8,697,547	11,585,419	22.63	27.93
Indiana	469.7	576.7	3.11	3.30	4,207,246	4,251,740	35.37	35.16
Indian Territory	379.2	346.6	2.02	2.09	40,203	33,357	1.37	1.17
Iowa	449.9	476.2	2.15	2.13	186,224	193,666	2.74	2.67
Kansas	538.7	419.7	2.54	2.54	19,101	30,450	.30	.51
Kentucky	574.2	632.1	2.87	2.98	4,409,054	5,175,950	51.44	53.62
Maryland	858.9	844.3	3.41	3.38	468,822	427,450	9.18	7.86
Michigan	398.6	339.0	2.14	1.96	432,266	417,073	29.34	30.98
Missouri	444.5	393.2	2.29	2.13	375,194	419,288	9.42	11.16
Montana	753.7	764.4	3.10	3.15	752,665	974,306	45.79	53.24
New Mexico	782.7	949.1	3.34	3.92				
North Dakota	507.3	626.4	2.71	3.00	97,789	97,035	30.80	31.74
Ohio	588.9	610.3	3.35	3.65	16,888,417	20,004,416	66.10	72.14
Pennsylvania:								
Anthracite	469.5	439.1	2.18	2.25				
Bituminous	824.4	850.1	3.57	3.68	49,335,660	54,146,314	41.66	41.88
Tennessee	483.5	546.6	2.29	2.39	479,471	747,500	8.31	11.94
Texas	399.2	430.7	1.68	1.90	22,400	22,682	1.86	1.73
Utah	979.0	1,127.6	3.96	3.92		1,000		.06
Virginia	746.1	829.2	3.10	3.32	399,029	424,343	9.33	9.97
Washington	601.2	723.4	2.65	2.72		12,521		.38
West Virginia	781.0	849.5	3.74	3.86	12,504,301	15,565,113	33.09	35.96
Wyoming	937.3	1,033.7	3.97	3.68	1,236,750	1,339,422	22.08	21.84

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 tables is presented a statement showing the number of fatal and nonfatal accidents occurring in the coal mines of the United States in 1905 and 1906, so far as it has been possible to obtain statistics of this kind. These tables show also 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 17 of the 31 States and Territories in which coal was produced in 1905, and 20 States and Territories in 1906. These States and Territories included, however, nearly all of the more important coal producers, their aggregate tonnage representing over 90 per cent of the total output of the United States in the last two years.

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. All of these statistics for Illinois, Iowa, New Mexico, and West Virginia are for the fiscal year ending June 30, 1906. The accident statistics for Wyoming are for the fiscal year ending September 30, 1906, and those for Maryland are for the fiscal year ending May 31, 1907, while for both of these States the Geological Survey statistics of production, etc., in 1906 are used.

For the information contained in these tables and for more specific notes on the causes of 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, State mine inspector, Kentucky; Mr. Thomas Murphy, State mine inspector, Maryland; Mr. M. J. McLeod, commissioner of labor, Michigan; Mr. J. W. Marstellar, secretary, bureau of mines, Missouri; Mr. J. B. McDermott, State coal-mine inspector, Montana; Mr. J. E. Sheridan, United States mine inspector, New Mexico; Mr. George Harrison, chief inspector of mines, Ohio; Mr. James E. Roderick, chief of the department of mines, Pennsylvania; Mr. J. W. Allen, statistician, bureau of labor, Tennessee; 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. D. M. Elias and Noah Young, State mine inspectors, Wyoming.

In the 17 States and Territories from which returns were received in 1905 the total number of men killed was 2,097 and the total number injured was 4,402; in 1906, with reports from 20 States, the number of deaths was 2,061 and the number of nonfatal injuries 4,798. The death rate per thousand was decreased from 3.53 in 1905 to 3.4 in 1906.

The State which made the lowest record in the death rate per thousand for 1906 was Maryland, with 1.09 men killed per thousand of employees. Michigan was second on the roll of honor, with a death rate per thousand of 1.51, and Missouri third, with 1.68. Colorado had the highest death rate, 7.74 per thousand, and West Virigina came second, with 5.65.

On account of the prominence given by the press to the description of mine explosions when such disasters claim a number of victims, the opinion naturally held by the general public is that the danger from explosions is the greatest of the many to which the coal-mine workers are exposed. Statistics do not bear out this impression, as is shown in the table giving causes of accidents in the coal mines in 1906. The danger from gas or dust explosions is a serious one, as shown by the record and by the reports of horrors which only too frequently are depicted in the columns of the daily press; but it appears that the number of deaths due to this cause was only 15 per cent of the total in 1906, and that there were more than three times as many deaths due to falls of roof and coal than were due to explosions, whether of powder or gas or dust or mixtures of these. The deaths due to falls of roof usually occur singly, and the news of them seldom gets beyond the immediate vicinity of the mine in which the accident occurs, and yet to this cause alone was due nearly one-half (1,008 out of 2,061) of the fatalities in the coal mines of the 20 States included in the following tables. The deaths from gas and dust explosions totaled 228; powder explosions claimed 80 victims, and 732 deaths were due to miscellaneous causes.

Fatal and nonfatal accidents in coal mines of the United States in 1905 and 1906, by States and Territories.

1905.

State or Territory.	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 [a]						
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	2,097	4,402	3.53	174,524	893	2,065

1906.

State or Territory.	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	96	89	4.67	136,541	52	73
Arkansas	13	31	3.02	143,405	6	14
Colorado	88	160	7.74	114,900	40	(a)
Illinois	155	480	2.50	247,210	103	333
Indiana [a]						
Indian Territory	44	48	5.33	65,005	26	51
Iowa	37	116	2.42	196,384	(a)	(a)
Kansas	31	58	3.04	185,633	(a)	(a)
Kentucky	40	139	2.62	241,341	(a)	(a)
Maryland	7	52	1.09	776,493	6	28
Michigan	6	27	1.51	224,398	(a)	(a)
Missouri	16	27	1.68	233,221	10	34
Montana	13	46	5.43	140,763	(a)	(a)
New Mexico	9	(a)	3.82	199,359	(a)	(a)
Ohio	127	528	2.80	218,359	(a)	(a)
Pennsylvania:						
Anthracite	557	1,212	3.43	127,976	314	728
Bituminous	477	1,160	3.14	271,055	269	566
Tennessee	33	210	2.88	189,675	16	44
Utah	7	21	4.45	253,222	2	5
Washington	22	76	4.86	148,917	7	5
West Virginia	268	299	5.65	156,313	107	216
Wyoming	15	21	2.53	408,933	1	1
Total	2,061	4,800	3.40	190,353	959	2,098

[a] Not reported.

Causes of fatal and nonfatal accidents in coal mines in 1906.

State or Territory.	Gas and dust explosions.		Powder explosions.		Falls of roof and coal.		Other causes.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Alabama	13	20	4	14	50	34	29	21	96	89
Arkansas	6	2	....	....	7	18	....	11	13	31
Colorado	35	11	4	9	44	105	5	35	88	160
Illinois	2	7	12	24	84	258	57	191	155	480
Indiana [a]	....	....	....	....	....	....	....	....	....	....
Indian Territory	6	12	14	6	7	13	17	17	44	48
Iowa	....	....	3	....	24	62	10	54	37	116
Kansas	....	....	2	2	17	24	12	32	31	58
Kentucky	2	8	1	3	18	29	19	99	40	139
Maryland	....	....	....	....	....	....	....	....	7	52
Michigan	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	6	27
Missouri	....	....	....	2	13	17	3	8	16	27
Montana	....	4	....	....	4	14	9	28	13	46
New Mexico	....	....	....	....	7	(a)	2	....	9	....
Ohio	....	....	7	33	80	173	40	178	127	528
Pennsylvania:										
Anthracite	43	195	28	49	214	314	272	654	557	1,212
Bituminous	10	26	1	58	305	596	161	480	477	1,160
Tennessee	1	....	2	9	20	37	10	164	33	210
Utah	4	....	....	....	3	17	....	4	7	21
Washington	1	9	....	....	6	18	15	49	22	76
West Virginia	105	13	2	6	99	128	62	152	268	299
Wyoming	....	....	....	....	6	6	9	15	15	21
Total	228	307	80	215	1,008	1,863	732	2,192	2,061	4,800

[a] Not reported.

QUANTITY OF COAL WASHED AT THE MINES IN 1906.

In collecting the statistics of coal production in 1906 inquiries for information regarding the washing of bituminous coal were included in the schedules. The replies to these inquiries show that 10,425,455 short tons of coal were washed in 1906 either before marketing or before being charged into ovens for coking. The cleaned product from the washeries amounted to 9,251,946 short tons, and the refuse to 1,173,509 tons. In Alabama, Pennsylvania, Tennessee, West Virginia, and other coking-coal producing States a large portion of the coal washed was slack coal used in coke making. It should be remembered that the statistics relating to washed coal in this table include only the coal washed at the mines. The returns to the Survey from the coke manufacturers show that in 1906 about 13,200,000 tons of the coal used in coke making were washed before being charged into the ovens, indicating that a considerable portion of the coal was washed at points distant from the mines, or that the replies to the inquiries on the coal schedules were incomplete.

The statistics on the production of Pennsylvania anthracite by Mr. William W. Ruley show that 3,846,501 long tons (equivalent to 4,308,081 short tons) were recovered from the washing of culm last year. These figures are not included in the following table, which shows the quantity of bituminous coal washed at the mines in 1906:

Bituminous coal washed at the mines in 1906, with quantity of washed coal and of refuse obtained from it, by States and Territories, in short tons.

State or Territory.	Number of jigs or washers.	Quantity of coal washed.	Quantity of coal obtained.	Quantity of refuse.
Alabama	38	1,985,889	1,753,537	232,352
Arkansas	4	36,309	27,711	8,598
Georgia	3	106,850	101,563	5,287
Illinois	232	2,600,817	2,216,593	384,224
Indiana	4	16,589	14,793	1,796
Indian Territory	5	121,875	104,832	17,043
Kentucky	6	92,612	82,322	10,290
Maryland	1	5,227	4,704	523
Missouri	4	15,765	12,221	3,544
Montana	37	390,135	303,318	86,817
New Mexico	7	160,347	139,728	20,619
Ohio	17	85,169	74,441	10,728
Pennsylvania	171	2,851,034	2,689,304	161,730
Tennessee	10	739,531	675,454	64,077
Virginia	3	807	767	40
Washington	34	784,817	657,030	127,787
West Virginia	8	431,682	393,628	38,054
Total	584	10,425,455	9,251,946	1,173,509

PRICES.

The following tables show the fluctuations in the average prices prevailing in each State since 1902, 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 advanced generally throughout the United States in 1906, this being the result of the shortage caused by the suspension of work on April 1.

Average price per short ton for coal at the mines since 1902, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	$1.20	$1.22	$1.20	$1.21	$1.34
Arkansas	1.31	1.51	1.54	1.49	1.61
California	a 3.14	a 2.86	a 4.74	a 4.97	a 2.55
Colorado	1.13	1.23	1.31	1.22	1.26
Georgia	b 1.42	b 1.26	b 1.22	b 1.29	1.28
Idaho	c 2.50	3.10	c 3.95	c 3.03	3.93
Illinois	1.03	1.17	1.10	1.06	1.08
Indiana	1.10	1.23	1.11	1.05	1.08
Indian Territory	1.51	1.82	1.82	1.76	1.92
Iowa	1.47	1.65	1.61	1.56	1.60
Kansas	1.30	1.52	1.52	1.46	1.49
Kentucky	.99	1.06	1.04	.99	1.02
Maryland	1.06	1.48	1.19	1.14	1.19
Michigan	1.71	1.97	1.81	1.71	1.80
Missouri	1.38	1.61	1.63	1.58	1.63
Montana	1.65	1.64	1.61	1.72	1.77
New Mexico	1.43	1.37	1.31	1.33	1.34
North Carolina	(d)	(d)	(d)	(d)	....
North Dakota	1.44	1.50	1.43	1.34	1.54
Ohio	1.14	1.29	1.09	1.04	1.09
Oregon	2.44	2.43	2.18	2.58	2.66
Pennsylvania bituminous	1.08	1.18	.96	.96	1.00
Tennessee	1.23	1.25	1.18	1.14	1.22
Texas	1.64	1.62	1.66	1.64	1.66
Utah	1.14	1.20	1.30	1.35	1.36
Virginia	.80	.96	.86	.88	.98
Washington	1.72	1.69	1.63	1.79	1.80
West Virginia	1.01	1.17	.88	.86	.95
Wyoming	1.18	1.24	1.30	1.31	1.31
Total bituminous	1.12	1.24	1.10	1.06	1.11
Pennsylvania anthracite	1.84	2.04	1.90	1.83	1.85
General average	1.22	1.41	1.26	1.21	1.24

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 27 years.

Year.	Anthracite.	Bituminous.	Year.	Anthracite.	Bituminous.
1880	$1.47	$1.25	1894	$1.51	$0.91
1881	2.01	1.12	1895	1.41	.86
1882	2.01	1.12	1896	1.50	.83
1883	2.01	1.07	1897	1.51	.81
1884	1.79	.94	1898	1.41	.80
1885	2.00	1.13	1899	1.46	.87
1886	1.95	1.05	1900	1.49	1.04
1887	2.01	1.11	1901	1.67	1.05
1888	1.91	1.00	1902	1.84	1.12
1889	1.44	.99	1903	2.04	1.24
1890	1.43	.99	1904	1.90	1.10
1891	1.46	.99	1905	1.83	1.06
1892	1.57	.99	1906	1.85	1.11
1893	1.59	.96			

SHIPMENTS BY RAILROADS.

From the reports received from producers the following tables, showing the quantity 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 quantity 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 lines penetrating, with a few exceptions, two or three States only. The shipments by the New York Central and Hudson River, the Buffalo, Rochester and Pittsburg, the Bessemer and Lake Erie, the Southern Indiana, and the Evansville and Terre Haute railroads are included in this table, for although in each case the shipments originated in one State only, the quantity in each case exceeded 1,000,000 tons. In the case of the New York Central and Hudson River Railway the shipments exceeded 5,000,000 tons, while the Buffalo, Rochester and Pittsburg Railway tonnage approximates that figure. In both instances the shipments originated in Pennsylvania. The third table shows the shipments over lines less important, but whose tonnage exceeded 100,000 in 1906.

The shipments represented by these tables amounted to 246,179,169 tons, whereas the total quantity of bituminous coal loaded for shipment during 1906 amounted to 278,821,959 tons.

According to these tables, it appears that 57,529,662 short tons, or 23 per cent of the total, originated in 1906 on the lines of the Pennsylvania system, which includes the Pennsylvania Company, the Pennsylvania lines west of Pittsburg, the Terre Haute and Indianapolis, and the Vandalia railroads. In 1905 the shipments originating on the Pennsylvania system amounted to 49,181,843 short tons, or something over 20 per cent of the total. Second in importance is the Baltimore and Ohio, including the Baltimore and Ohio Southwestern Railway, the shipments originating on which in 1906 amounted to 25,052,126 short tons, or 10 per cent of the total, against 20,298,832 short tons, or 9 per cent of the total, in 1905. The 'Frisco system, which includes the Chicago and Eastern Illinois Railway, shipped 10,772,933 short tons in 1906 and 10,384,458 in 1905; the Norfolk and Western, 10,547,066 short tons in 1906 and 9,823,992 tons in 1905; the Chesapeake and Ohio, 10,037,494 tons in 1906 and 8,934,840 tons in 1905; the Illinois Central, 9,889,044 tons in 1906 and 9,429,755 tons in 1905.

The shipments over the larger systems and lines of the United States in 1906 were distributed as shown in the subjoined tables. For the detailed figures for 1905 the reader is referred to the report for that year.

Shipments of bituminous coal in 1906 over the principal railroad lines and systems of the United States, by States and Territories, in short tons.

State or Territory.	Pennsylvania.[a]	Baltimore and Ohio.[b]	'Frisco.[c]	Norfolk and Western.	Chesapeake and Ohio.	Illinois Central.	Louisville and Nashville.
Pennsylvania	43,048,390	6,912,436					
West Virginia	396,601	9,757,157		9,669,598	9,524,547		
Illinois	852,330	1,459,938	3,334,536			7,026,819	631,697
Ohio	7,354,814	5,882,307					
Alabama			1,765,704			92,186	3,097,366
Indiana	2,704,801	126,922	2,728,949			154,004	39,622
Kentucky				266,498	425,546	2,616,035	3,550,210
Tennessee							922,560
Kansas			2,457,123				
Maryland	3,172,726	913,366			87,401		
Virginia				610,970			103,400
Missouri			26,295				
Indian Territory			98,575				
Arkansas			361,751				
Total	57,529,662	25,052,126	10,772,933	10,547,066	10,037,494	9,889,044	8,344,855

State or Territory.	Wabash.[d]	Southern.	Burlington.[e]	Missouri Pacific.[f]	Santa Fe.	Rock Island.[g]
Pennsylvania	273,431					
West Virginia	1,859,255					
Illinois	2,630,661	760,069	1,962,271	1,281,857	445,695	549,305
Ohio	2,530,928					
Alabama		3,235,767				
Indiana		743,558				
Colorado			224,558		572,292	32,559
Kentucky		183,741				
Iowa	275,783		1,305,863			884,048
Tennessee		2,225,059				
Wyoming			1,210,276			
Kansas			25,837	21,688	1,274,231	48,584
Maryland	460,920					
Virginia		18,000				
Missouri	212,067		303,980	710,664	253,521	63,250
Indian Territory					16,923	985,380
New Mexico					379,525	
Arkansas				1,362,173		163,754
Texas						51,410
Total	8,243,045	7,166,294	5,032,785	3,376,382	2,942,187	2,778,290

[a] Includes the Pennsylvania Company, Pennsylvania lines west of Pittsburg, Vandalia, and other subsidiary companies.
[b] Includes the Baltimore and Ohio Southwestern.
[c] Includes the Chicago and Eastern Illinois.
[d] Includes the Wabash Pittsburg Terminal, Western Maryland, West Virginia Central and Pittsburg, and Wheeling and Lake Erie.
[e] Includes the Chicago, Burlington and Quincy, Burlington and Missouri River, Burlington and Western, and subsidiary lines.
[f] Includes the St. Louis, Iron Mountain and Southern and Kansas Northwestern.
[g] Includes the Choctaw, Oklahoma and Gulf.

Shipments of bituminous coal over the principal railroads, by railroads and States and Territories.

Railroad.	State.	Quantity, short tons.	Total.
New York Central and Hudson River	Pennsylvania	5,331,491	5,331,491
Buffalo, Rochester and Pittsburg	....do	4,884,858	4,884,858
Union Pacific	Colorado	22,525	4,677,714
	Wyoming	4,528,562	
	Kansas	70,272	
	Utah	56,355	
Hocking Valley	Ohio	4,346,816	4,346,816
Ohio Central	West Virginia	1,898,953	4,245,860
	Ohio	2,346,907	
Big Four	Illinois	3,016,972	3,398,894
	Indiana	381,922	
Pittsburg and Lake Erie	Pennsylvania	3,185,310	3,193,710
	Ohio	8,400	
Denver and Rio Grande	Colorado	2,066,528	3,190,788
	New Mexico	41,600	
	Utah	1,082,660	
Colorado and Southern	Colorado	3,139,897	3,139,897
Missouri, Kansas and Texas	Kansas	1,606,375	3,001,013
	Missouri	125,283	
	Indian Territory	1,125,531	
	Texas	143,824	
Chicago and Northwestern	Illinois	1,079,650	2,979,478
	Iowa	1,841,410	
	Wyoming	58,418	
Northern Pacific	Washington	2,102,679	2,799,773
	Montana	624,270	
	North Dakota	72,824	
Chicago and Alton	Illinois	2,535,451	2,739,968
	Missouri	204,517	
Bessemer and Lake Erie	Pennsylvania	2,111,557	2,111,557
Southern Indiana	Indiana	1,882,379	1,882,379
Chicago, Milwaukee and St. Paul	Illinois	537,805	1,375,055
	Iowa	837,250	
Evansville and Terre Haute	Indiana	1,274,201	1,274,201
Erie	Pennsylvania	1,019,372	1,240,397
	Ohio	221,025	
Great Northern	Montana	986,316	1,002,379
	North Dakota	16,063	
Cincinnati, Hamilton and Dayton	Illinois	219,159	967,896
	Ohio	438,919	
	Michigan	309,818	
Nashville, Chattanooga and St. Louis	Alabama	18,800	917,821
	Tennessee	886,381	
	Georgia	12,640	
Mobile and Ohio	Illinois	642,452	879,209
	Alabama	236,757	
Iowa Central	Illinois	302,395	855,653
	Iowa	553,258	
Missouri and Louisiana	Missouri	645,702	821,997
	Arkansas	176,277	
Cincinnati, New Orleans and Texas Pacific	Kentucky	296,484	702,385
	Tennessee	405,901	
Kansas City Southern	Kansas	568,215	619,064
	Missouri	12,200	
	Indian Territory	38,649	
Midland Valley	....do	149,737	398,101
	Arkansas	248,364	

The shipments, less than 1,000,000 tons and over 100,000 tons over the railroads receiving coal in one State only, have been reported for 1906, as follows:

Shipments, over 100,000 tons and less than 1,000,000 tons, by railroads receiving coal from only one State.

Railroad.	State.	Quantity, short tons.
Alabama Great Southern	Alabama	266,449
Buffalo and Susquehanna	Pennsylvania	589,719
Central of Georgia	Alabama and Georgia	450,937
Chicago Great Western	Iowa and Kansas	293,202
Chicago and Illinois Midland	Illinois	185,392
Chicago, Indiana and Southern	....do	167,729
Chicago, Indianapolis and Louisville	Indiana	339,523
Chicago, Peoria and St. Louis	Illinois	510,746
Coal and Coke	West Virginia	224,597
Colorado Midland	Colorado	259,280
Colorado and Southeastern	....do	948,679
Colorado and Wyoming	....do	209,568
Columbia and Puget Sound	Washington	846,223
Denver, Northwestern and Pacific	Colorado	199,920
Des Moines, Iowa Falls and Northern	Iowa	172,778
Detroit, Toledo and Ironton	Ohio	590,615
East Broad Top	Pennsylvania	181,688
East St. Louis and Suburban	Illinois	351,791
Elgin, Joliet and Eastern	....do	705,893
El Paso and Southwestern	New Mexico	483,757
Evansville and Indianapolis	Indiana	184,870
Fort Smith and Western	Indian Territory	151,583
Georges Creek and Cumberland	Maryland	137,426
Harriman and Northeastern	Tennessee	361,651
Huntingdon and Broad Top Mountain	Pennsylvania	572,530
Illinois Southern	Illinois	230,673
Indianapolis Southern	Indiana	283,116
International and Great Northern	Texas	308,111
Iowa and St. Louis	Missouri	134,738
Lake Erie, Alliance and Wheeling	Ohio	988,907
Lake Shore and Michigan Southern	Pennsylvania	147,010
Ligonier Valley	....do	125,244
Litchfield and Madison	Illinois	897,781
Louisville, Henderson and St. Louis	Kentucky	577,388
Michigan Central	Michigan	500,530
Monongahela	Pennsylvania	441,417
New Haven and Dunbar	....do	273,860
Newton and Northwestern	Iowa	223,709
Peoria and Pekin Union	Illinois	258,061
Philadelphia and Reading	Pennsylvania and Maryland.	394,510
Pittsburg, Shawmut and Northern	Pennsylvania	521,696
Quincy, Omaha and Kansas City	Missouri	250,249
St. Louis and Belleville Electric	Illinois	311,496
St. Louis and O'Fallon	....do	600,000
St. Louis, Rocky Mountain and Pacific	New Mexico	182,027
St. Louis, Troy and Eastern	Illinois	897,523
Seaboard Air Line	Alabama	161,620
Texas and Pacific	Texas	580,000
Thomas and Sayreton (private)	Alabama	269,683
Toledo, Peoria and Western	Illinois	335,352
Toledo, St. Louis and Western	Illinois and Indiana	221,756
Toluca, Marquette and Northern	Illinois	134,379
Virginia and Southwestern	Virginia	459,811
Western Allegheny	Pennsylvania	649,938
Zanesville and Western	Ohio	741,539

It should be remembered that the foregoing statement refers to bituminous coal only. Mr. William W. Ruley, who has prepared a chapter on the production of anthracite in Pennsylvania for this report, is the authority for the statement that the shipments of anthracite by the principal railroads penetrating that region in 1905 and 1906 were as follows:

Shipments of Pennsylvania anthracite, 1905 and 1906, in long tons.

	1905.	1906.
Philadelphia and Reading	20,557,776	18,241,512
Lehigh Valley (including Delaware, Susquehanna, and Schuylkill)	11,677,498	9,971,699
Lackawanna	9,554,046	9,201,875
Erie	6,225,622	5,636,537
Delaware and Hudson	5,640,528	5,346,695
Pennsylvania	4,890,635	4,856,004
New York, Ontario and Western	2,864,095	2,444,273

COAL CONSUMED BY RAILROADS.

In connection with the foregoing statement of shipments over the principal railroads of the United States, it may be of interest to note that, according to information obtained by the technologic branch of the Geological Survey in the course of its investigation of the fuel values of the different kinds of coal and the uses to which they are best adapted, for the fiscal year ended June 30, 1906, the total railroad consumption of coal was 95,804,002 short tons, which was 23.4 per cent, or nearly one-fourth of the total production of the United States during the calendar year 1906. In addition to this coal, the railroads consumed 16,632,963 barrels of fuel oil (which was equivalent to about 4,160,000 tons of coal) and 84,997 cords of wood. The information regarding the consumption of fuel was obtained under a promise that the detailed figures of the different railroads should not be published.

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 1902 to 1906, 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 provided 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 the 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 of anthracite and bituminous coal, the quantity of bituminous being the greater in the last few years. They are made principally by rail over the international bridges and by lake and sea to the Canadian provinces. Exports are also made by sea to the West Indies, to Central and South America, and elsewhere.

The imports are principally from Australia and British Columbia to San Francisco, from Great Britain to the Atlantic and Pacific coasts, and from Nova Scotia to Atlantic coast points.

The total exports of coal for the United States during 1906 were 9,921,819 long tons, valued at $30,683,659, of which 2,216,969 long tons, valued at $10,896,200, were anthracite, and 7,704,850 long tons, valued at $19,787,459, were bituminous coal. The imports of anthracite amounted in 1906 to 32,354 long tons, valued at $105,161, and those of bituminous coal to 1,702,799 long tons, valued at $4,102,355. 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 of domestic production exported from the United States, 1902–1906, in long tons.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
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
1906	2,216,969	10,896,200	7,704,850	19,787,459

Coal imported and entered for consumption in the United States, 1902–1906, in long tons.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
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	20,664	[b] 1,550,751	3,895,469
1905	34,241	107,314	[b] 1,611,002	3,903,765
1906	32,354	105,161	[b] 1,702,799	4,102,355

[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 $\frac{1}{2}$-inch screen imported in 1902, 577,274 tons imported in 1903, 579,204 tons imported in 1904, 611,053 tons imported in 1905, and 659,486 tons imported in 1906.

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. It will be observed that the United States produced 37 per cent of the total world's supply of coal; that this country in 1906 produced 132,961,535 short tons, or 43.7 per cent, more coal than Great Britain, and 191,806,752 short tons, or 85 per cent, more than Germany. Exclusive of Great Britain, the United States in 1906 produced more coal than all of the other countries of the world combined. It may also be noted that more than 98 per cent of the total world's production of coal is from countries lying north of the equator, the countries south of that line contributing less than 20,000,000 tons annually.

The world's production of coal.

Country.		Usual unit in producing country.	Equivalent in short tons.
United States (1906)	long tons	369,783,284	414,157,278
Great Britain (1906)	do	251,067,628	281,195,743
Germany (1906)	metric tons	201,715,074	222,350,526
Austria-Hungary (1904)	do	41,014,182	45,209,933
France (1906)	do	34,313,645	37,823,931
Belgium (1906)	do	23,610,740	26,026,119
Russia and Finland (1905)	do	17,233,871	18,996,896
Japan (1905)	do	11,630,000	12,819,749
Canada (1905)	short tons	8,775,933	8,775,933
India (1905)	long tons	8,417,739	9,427,868
New South Wales (1906)	do	7,626,362	8,541,525
Spain (1906)	metric tons	3,284,576	3,620,588
Transvaal[a] (1906)	long tons	2,751,136	3,081,272
New Zealand (1905)	do	1,585,756	1,776,047
Natal (1906)	do	1,238,713	1,387,359
Mexico (1906)	metric tons	767,864	846,186
Queensland (1905)	long tons	529,326	592,845
Holland (1904)	metric tons	466,997	514,771
Italy (1904)	do	362,151	399,199
Sweden (1905)	do	322,384	355,364
Victoria (1905)	long tons	155,135	173,751
Cape Colony (1904)	do	154,272	172,785
Tasmania (1905)	do	51,993	58,232
Other countries[b]	do	7,298,935	8,174,807
Total			1,106,478,707
Percentage of the United States			37

[a] Year ended June 30.
[b] 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 39 years the percentage of the world's total produced by the United States has increased from 14.32 to 37, and this country now stands far in the lead of the world's coal producers. It has been only 8 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.

World's production of coal, by countries, 1868-1906.

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	350,645,210	392,722,635	236,128,936	264,464,408	173,796,674	191,576,074
1906	369,783,284	414,157,278	251,067,628	281,195,743	201,715,074	222,350,526

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

World's production of coal, by countries, 1868–1906—Continued.

Year.	Austria-Hungary.		France.		Belgium.	
	Metric tons.	Short tons.	Metric tons.	Short tons.	Metric tons.	Short tons.
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	....	....	35,336,442	38,951,360	21,844,200	24,078,862
1906	....	....	34,313,645	37,823,931	23,610,740	26,026,119

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	18.19
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	10,772,240	11,874,240	43,332,409	983,527,562	35.78
1905	[a] 17,233,871	18,996,896	11,630,000	12,819,749	45,478,314	1,034,156,604	37.98
1906	....	....	....	....	[b] 47,898,532	[c] 1,106,478,707	37.43

[a] These figures also include the production of Finland.

[b] This includes the output of Canada (1905, 8,775,933 short tons); India (1905, 9,427,868 short tons); New South Wales (1906, 8,541,525 short tons); Spain (1906, 3,620,588 short tons); South African Republic (1906, 3,081,272 short tons); New Zealand (1905, 1,776,047 tons); Sweden (1905, 355,364 tons); Italy (1904, 399,199 tons); Queensland (1905, 592,845 tons); also that of Holland, Natal, Cape Colony Tasmania, Mexico, China, Turkey, Servia, Portugal, etc. (estimated), 8,174,807 tons.

[c] Latest available figures are used in making up totals for 1906.

COAL TRADE REVIEW.

The principal feature connected with the coal-mining industry of the United States in 1906 was the practically complete suspension of operations in the anthracite region of Pennsylvania and in the organized bituminous coal-producing States during the spring months while the adjustment of the wage scale was under way. This suspension in the anthracite region lasted from April 1 to May 14, during which period only one mine in that district was kept in operation. The amount of time lost in the anthracite region represented 18.8 per cent of the time worked, and resulted in a decrease of nearly 5,700,000 long tons. The suspensions in the bituminous coal-producing States ranged from about 30 days in some cases to nearly 11 weeks in others. During the period of idleness a lack of harmony developed in the ranks of the operators and the associations composed of them throughout the several States, and by degrees compromises were concluded with the miners and work was from time to time resumed. The most serious effect of the suspensions was the breaking up of what has been known as the interstate agreement, which was in effect in the competitive States of Pennsylvania, Ohio, Illinois, Indiana, and parts of Kentucky and West Virginia, which also largely controlled the agreements made between the operators and the miners in the southwestern district, composed of Kansas, Missouri, Arkansas, and Indian Territory.

In spite of the fact that 211,304 men in the bituminous States were idle for an average of 63 days each, and that the idle time was equal to 13 per cent of the total number of working days made, the bituminous coal production of the United States increased 27,812,082 short tons over that of 1905. This was due to the fact that during the earlier months of the year, in anticipation of the suspension of mining, production was pushed to the utmost by both miners and operators. During the suspension mining in the unorganized States, such as West Virginia and Alabama, in the East, and in the Rocky Mountain States, was unusually active; and this, with the activity following the period of suspension, brought the tonnage up to what would have been a normal increase over the output of the preceding year, and it is doubtful if there would have been any larger total production had no suspension of operations occurred.

Notwithstanding the almost complete shut down in the mining districts dominated by the United Mine Workers for, as stated, periods varying from 1 month to 11 weeks there was no formally declared strike, the miners being simply requested by their leaders to suspend work pending the adjustment of the wage scale. The occasion was remarkable for the comparatively few instances of lawlessness, and while the chances for a peaceful settlement seemed at times sadly remote the differences were finally adjusted without governmental interference or an appeal to arbitration.

During portions of the year the usual complaints were made of shortage of car supply and of motive power on the part of the transportation companies. This was particularly felt in the earlier months, when mining was so active and coal was being hurried as fast as possible to distant points for storage against a period of idleness.

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 have been prepared by secretaries of boards of trade or other local authorities familiar with the 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:

The local coal trade of New York City continued to increase during 1906, as was to be expected from the steady growth of population and the activity of all classes of manufacturing operations. There was also a certain tendency to concentrate the trade, owing to the increase in the number of large consumers. The greater number of new buildings in the city are large houses, giving room for a number of tenants, in which heat and hot water are distributed from a single plant for each building. The use of electric light and power is also continually growing, requiring additions to the electric generating and distributing plants. Moreover, during the year there were under construction several large plants for the transportation companies, including those made necessary by the adoption of electricity on the trunk-line railroads entering the city. Most of these transportation plants did not enter into use in 1906, but they will nearly all be large consumers during the current year.

There have never been any statistics kept from which the approximate coal consumption of New York City could be deduced. The best informed men in the trade hesitate to name any definite figures, and an attempt to compile records of deliveries and tonnage has been surrounded with so many difficulties that it was necessarily abandoned. The district to be covered properly includes, besides the city itself, a number of large suburban towns and the adjacent manufacturing cities, such as Jersey City, Newark, Paterson, Yonkers, and Portchester. Estimates of the consumption of anthracite coal in this district vary from 15 to 25 per cent of the total output, and these are made by men of long experience in the trade. The most that can be said is that a much larger part of the anthracite production is consumed in this district than in any other equivalent area of this country, and this is supplemented by a large quantity of bituminous coal drawn from Pennsylvania, Maryland, and West Virginia.

New York, if we include, as must properly be done, all the New York Harbor shipping ports, is each year taking more of the coastwise trade which supplies a large part of New England. Of these shipments a record is kept by the Bureau of Statistics. The totals reported from the New York Harbor ports for the year 1906 were 12,739,518 tons of anthracite and 9,527,131 tons of bituminous coal, or 22,266,649 tons in all. There is no available record, however, of the destination of this coal. This coastwise coal is not shipped from the city docks, but from what are known as the harbor ports, the terminals of the coal-carrying railroads. These are nearly all on the New Jersey shore, including Weehawken, Hoboken, Jersey City, Port Johnson, Port Reading, Elizabethport, Perth Amboy, and South Amboy. Some bituminous coal is shipped from the Baltimore and Ohio terminals on Staten Island.

This coastwise trade continues to be done largely by sailing vessels, notwithstanding the extended use of barges towed by steam tugs.

The barges are, for the most part, owned by the railroad companies and have a large carrying capacity. The tows are subject to some drawbacks in stormy weather, and in 1906 there was rather a large percentage of loss among the barges; larger in proportion than among the sailing vessels. The number of barges, however, is increasing, but perhaps not faster than the total trade grows.

One thing which favored the coasting trade was the absence of the severe storms which sometimes descend on the Atlantic coast in the late summer and fall. There was some stormy weather, of course, but no great tempest, and the percentage of wrecks of coal-carrying vessels was lower than in several preceding years. There was some complaint of delays in unloading at New England ports, especially at those where coal is transferred to the cars of the New York, New Haven and Hartford Railroad. This brought about a general enforcement of demurrage charges and a disposition to insist upon the "loading and unloading" clause in vessel charters. The supply of vessels for the coastwise trade was generally good for three quarters of the year. In the closing quarter, October–December, there was some scarcity, especially of the smaller vessels, which are in demand for certain ports, and freight rates were forced up. In some cases shipments were delayed. In October there is always a rush for the smaller boats which can make what are known as the shoal-water ports in Maine, which are closed by ice in the winter. In 1906 ice did not form until later than usual, owing to the continued mild weather of November and early December, and fall supplies reached those ports without trouble.

There was some trouble in the second half of the year over car supply on the railroads. This caused at times considerable delay in the deliveries of coal to the eastern markets. This trouble, however, did not at any time reach the acute stage which developed in the West. The anthracite companies have their car supply better in hand and more under their own control than any other group of railroads in the country. The trouble in anthracite deliveries was comparatively small, and that with bituminous traffic was felt chiefly in the West Virginia coals. The mild winter and the absence of snow helped to prevent excessive trouble from this cause.

There was the usual trouble with the New England roads, and at least twice an embargo was placed on cars going to the New York, New Haven and Hartford road on account of delays in returning cars sent to points on its lines.

The bituminous trade in New York for the year followed very much its usual course with little variation from previous years in volume and prices, and with few special incidents. In the usual season for contracting in the spring there was some holding back on account of the delay of the trunk lines in announcing freight rates for the season. When this was settled there was rather less than the usual number of contracts, because some large consumers thought it might be better policy to hold back and trust to the open market. There was, rather conspicuously, an absence of the undercutting and sharp practice between operators in the West Virginia and Pennsylvania regions, which has been much in evidence in former years. Some apprehension was felt as to the probability of a strike of the miners; but in the end this did not seriously affect the New York trade. The supplies for this trade are drawn chiefly from the Clearfield and minor districts in central Pennsylvania, the Cumberland district in Maryland, and the New River and Pocahontas fields in West Virginia. The coal coming from western Pennsylvania is largely bunker coal for steamships and does not enter into the local trade to any extent. In the regions named settlement came early, and there was no real trouble in getting coal at any time. Dealers were inclined in April to restrict deliveries to actual needs as a precaution, but this disposition lasted for two or three weeks only. The settlement with the miners, when made, caused hardly a ripple on the market.

Prices were fairly well maintained all through the year. Most contracts were made approximately on the basis of $2.55 to $2.65 per ton, free on board, New York Harbor, for good-grade Clearfield. The price in the open market was from $2.60 to $2.70, for the same grade as a basis, for the greater part of the year. In the late fall sales were made up to $2.80 and even $2.90 for Clearfield; but in most cases these were for lots needed for immediate shipment to shoal-water ports. The price given for good-grade Clearfield applies to most of the bituminous coal including New York Harbor, with one exception. Cumberland coal has its special customers and usually commands a higher price, very little of it coming on the open market.

On the whole, the year in the bituminous trade was quiet and uneventful. The coal companies were generally prosperous, as was shown in several cases by increased dividends.

The anthracite trade presented the unusual feature of a year hardly at all disturbed by a threatened strike and an actual suspension of work for six weeks. The negotiations between the companies and the miners' union were followed with much interest, but there was a general belief that a peaceful solution would be reached, and consequently there was very little excitement.

Moreover, it was evident that provision for the suspension had been made by the companies in the storage of large quantities of coal at various points on their lines. These stocks proved sufficient to tide over the suspension, and there was no break nor delay in deliveries, except that supplies were furnished only as needed, simply as a precaution. This, however, did not involve any close restriction upon trade. The main effect was that the discounts of 50 cents per ton in April and 40 cents in May, usually given from the tide-water list prices, were withheld on account of the uncertainty. The discounts of 30 cents in June, 20 cents in July, and 10 cents in August were given, as usual.

For the rest of the year the market for anthracite was generally quiet. About September an unusually large demand for the small or steam sizes developed, and this continued up to the end of the year. As a rule, in previous years there has been a surplus of such coal offered, so that at times it has been sold at a shade below the list prices and there has been a competition for orders. In 1906 there was no pressure to sell; on the contrary, some dealers found it difficult to keep up with orders. This pressure was not, however, sufficient to bring about any advance in prices. Since the close of the year the question of an increase in price in the steam sizes has been discussed and it will probably be made.

The list prices of anthracite continued unchanged throughout the year. They were for the prepared sizes, $4.70 for lump and $5 for egg, stove, and chestnut, free on board, New York Harbor. As already mentioned, no discount for April and May was given; the usual discounts of 30, 20, and 10 cents per ton for June, July, and August, respectively, were allowed. These summer discounts have been found to work well so far. For the small or steam sizes prices were generally uniform, averaging \$2.80 to \$3 per ton for pea; \$2.25 to \$2.50 for buckwheat; \$1.40 to \$1.45 for rice or buckwheat No. 2; \$1.30 to \$1.35 for barley, or buckwheat No. 3; all free on board, New York Harbor.

If exact figures could be compiled, it would probably be found that the local consumption of the prepared sizes was somewhat less in 1906 than in the previous year, owing chiefly to the mild winter; in part also to the increased disposition to use pea coal as a domestic fuel. The consumption of steam sizes showed an increase, owing to activity in manufacturing and to their use in the large office buildings and apartment houses having central heating plants. There was also a disposition to enforce the city smoke ordinances a little more strictly, which tended to an increased use of anthracite steam sizes instead of bituminous coal.

An improvement is in progress which will affect the delivery of coal for local use in the boroughs of Brooklyn and Queens. The close connection of the Long Island Railroad with the Pennsylvania and the improvements on the former line will make it possible to deliver coal in large quantities at a number of central points where distributing yards will be established. In many cases it will be possible to place cars directly in the yards of the factories and power houses. This will make it possible to decrease largely the cartage required in local distribution, which has heretofore been made entirely from the water front. The Long Island Company has a belt line, with several branches, which has made this improvement possible, and it will prove an important economy in the delivery of coal to nearly one-third of the city.

There was some discussion during the year as to the cost of distributing coal to consumers. In New York, when the tide-water price is \$5, the usual charge to small consumers is \$6.25 to \$6.50 per ton. Where coal is sold by the 100-pound bag or by the bucket, of course the buyer pays much more. Local consumers complain of the high price they have to pay; but local dealers claim that \$1.25 per ton is only a small margin to provide for cost of storage, cartage, labor, waste, and other items, and that it leaves but little to pay the interest on invested capital. It is evident that present methods of distribution are costly and wasteful, but it is not easy to plan any decided improvement. The only great betterment in sight is the general substitution of gas or electricity for coal for domestic purposes.

BOSTON, MASS.

Mr. Daniel D. Morss, secretary of the Boston Chamber of Commerce, has prepared for this report the following review of the coal trade of that city in 1906:

The year 1906 opened with a good trade in coal. Both consumers and dealers were disposed to keep their stocks well up in view of the uneasiness which prevailed at that time regarding the outcome of the prospective differences which seemed likely to develop between the operators and miners in the anthracite regions when the question of renewal of contracts came up for settlement.

An unusually mild winter curtailed consumption to an appreciable extent during the months of January and February, and led some of the larger retailers early in the year to send out circulars advising their customers to keep their bins filled up, reminding them of their uncomfortable experiences during the last strike, and urging them to try to avoid the possibility of a repetition of those experiences by being prepared for the worst.

In April, while negotiations were actively in progress between the miners and operators, the latter did not advance their schedule, but practically ceased shipping out New England orders, merely putting them on file to be considered in order when shipments were resumed. In this way local dealers were left in a position of uncertainty that was far from comfortable.

After the danger from strike conditions was averted the market became dull and lifeless, as dealers' stocks were unusually heavy for the season, the demand from small consumers was materially lessened, and the usual midsummer dullness was intensified.

The usual monthly advances of 10 cents made by the anthracite companies had little effect in stimulating the demand until early fall, when there came the usual demand from the dilatory class of traders. For the remainder of the year the trade was normal.

The total receipts of anthracite for the year 1906 were 1,659,679 long tons, against 1,977,398 tons in 1905, and were the smallest for a number of years, excepting always the year of the strike, 1902.

On the other hand, the receipts of bituminous coal are steadily increasing from year to year, and totaled 3,517,916 long tons in 1906, against 3,406,761 tons in 1905.

Of the total anthracite receipts 197,690 long tons were forwarded to New England points, while the quantity of bituminous forwarded was 1,370,477 long tons, leaving the net receipts of same for consumption 2,147,439 tons, against 2,312,882 tons in 1905.

The following table shows the receipts of both anthracite and bituminous coal by months for 1906, the totals for 1906 compared with those for 1905 and 1904, the quantity 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 1906, with comparisons, in long tons.

Month.	Receipts.		Quantity forwarded to New England points.		Net receipts (for local consumption).	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.
January	120,761	309,952	17,231	126,091	103,530	183,861
February	93,236	330,360	13,004	118,274	80,232	212,086
March	158,810	343,574	20,933	163,994	137,877	179,580
April	102,599	324,680	17,714	133,447	84,885	191,233
May	120,475	300,430	9,627	104,917	110,848	195,513
June	190,089	263,819	14,041	108,872	176,048	154,947
July	125,623	299,153	11,766	127,051	113,857	172,102
August	113,347	247,345	10,201	120,790	103,146	126,555
September	134,971	309,213	13,084	92,540	121,887	216,673
October	164,806	298,357	21,850	90,075	142,956	208,282
November	171,009	237,942	26,192	95,821	144,817	142,121
December	163,953	253,091	22,047	88,605	141,906	164,486
Total, 1906	1,659,679	3,517,916	197,690	1,370,477	1,461,989	2,147,439
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

The receipts of anthracite coal by rail fell off from 35,920 tons in 1905 to 29,005 tons in 1906, while the rail receipts of bituminous increased from 41,104 tons in 1905 to 87,251 tons in 1906.

The receipts of foreign coal were 658,072 tons in 1906, against 608,471 tons in 1905, and were practically all gas coal from the Provinces.

For steam purposes domestic coal holds the trade.

The following table shows the receipts of domestic and foreign coal at this port for a series of five years:

Receipts of coal at Boston, Mass., for five years, in long tons.

Year.	Domestic.				Foreign.		Total.
	By water.		By rail.				
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.	
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
1906	1,630,674	2,772,593	29,005	87,251		658,072	5,177,595

Coastwise coal freights in 1906 averaged somewhat higher than in 1905. While the minimum summer rates were as low as at the corresponding time in 1905, the maximum rates were considerably higher than the maximum of 1905. Rates from New York to Boston ranged from 50 cents to 90 cents; from Philadelphia, from 60 cents to \$1.05; from Baltimore, from 65 cents to \$1.15; and from Norfolk and Newport News, from 65 cents to \$1.10; the average range from minimum to maximum being 45 cents in 1906, against 25 cents in 1905.

Coal freights to Boston during 1906.

From—	Minimum.		Maximum.	
	Rate.	Date.	Rate.	Date.
New York	\$0.50	July 1-July 15	\$0.90	December 15.
Philadelphia	.60	July 1-August 31	1.05	November 24.
Baltimore	.65	July 3	1.15	November 30.
Norfolk and Newport News	.65	August 15	1.10	December 10.

Retail prices opened at \$7.25 for stove and chestnut, \$7 for egg, \$6.50 for furnace, \$8.50 for Franklin, and \$7.50 for Shamokin.

On March 31 prices were advanced to \$8 for all sizes of ordinary anthracite, with Franklin at \$9 and Shamokin at \$8.25. About the middle of April the earlier prices were restored, and in May all prices were reduced to the summer level, as follows: \$6.75 for stove and chestnut, \$6.50 for egg, \$6.25 for furnace, \$8 for Franklin, and \$7 for Shamokin. These prices prevailed till the last week in October, when an advance of 25 cents per ton on all sizes was established and maintained through the remainder of the year.

PHILADELPHIA, PA.

The following review of the coal trade of Philadelphia has been prepared for this report by Mr. Samuel R. Kirkpatrick:

During the early part of 1906 there was grave apprehension as to the outcome of the anthracite coal trade. The agreement which had been entered into between the operators and the miners expired on March 31, and there were threats of another strike unless they could be brought together. This situation caused considerable uneasiness, which in a measure strengthened not only the wholesale trade but the retail as well. The strike of 1902 had taught the consumer a lesson, and the quantity of coal stored during the early months of 1906 was greater than ever before. During the month of March the demand for anthracite for domestic use was unprecedented, and the retailers had more orders than they could fill. Everybody anticipated trouble between the operators and the miners in April, and it was thought that if there should be a strike it would be of long duration. The coal companies had prepared for a long struggle, and the coal stored in the various yards of the more important coal companies amounted, it is estimated, to over 7,000,000 tons. The year 1906 was not a record-breaking one, yet the consumption of anthracite was very large, and if the winter of 1906–7 had been a severe one, it is believed that a greater quantity of coal would have been consumed. The previous winter was a mild one, and the quantity of coal used for domestic purposes was considerably less. It is thought that at the end of February, 1906, there was more coal in the bins of the consumers than ever before. Although since the anthracite strike of 1902 the price of anthracite has been higher, there has been a large increase in the quantity of coal consumed. The strike also taught the consumer the wisdom of economy in the use of his coal supply. Each year the Eastern cities show an increased consumption of coal, which is natural and warranted by the increase in population. There is also, however, a further increase in the consumption of anthracite in the Far West. Owing to the threatened strike of the miners in the spring of 1906, the shipments of anthracite to the lake ports were not begun as early as usual, but when the mining situation became settled large quantities of hard coal were sent to the West. During the winter of 1905–6 the quantity of anthracite used was considerably less than is usual. This was on account of the open season, and was general throughout the country where anthracite is used. Although the quantity of coal used was considerably less, there was a great demand for anthracite during March and April. This was occasioned by the unsettled condition of affairs in the anthracite region, and in order to be prepared for any emergency the housekeeper, as well as the large consumer, began to lay in his stock prior to April 1. In a number of cases open plots of ground adjacent to manufacturing sites were leased and thousands of tons of anthracite were stored thereon. At the same time the domestic sizes of coal were sought by all consumers, and it is safe to say that the retail trade during March, April, and May had all it could do to supply the demand. In many cases the quantity of coal laid in was much more than was needed.

On April 1 the anthracite miners suspended work, and for over one month they were out. During that time there was a large demand for anthracite, and although the regular coal companies did not advance the price at the mines, retail prices of anthracite soared. Usually the coal-producing companies make a reduction of 50 cents a ton on all coal ordered in April, and until the 50 cents is restored there is an advance of 10 cents a month. Notwithstanding the fact that there was no reduction in April, orders for immediate delivery were large—so large, indeed, that the coal companies made an allotment, and in no case did the dealers secure all they asked for. At the same time the independent operators were reaping a harvest and were selling their product to the dealers who were willing to pay for it. In many cases as high as $7 a ton was paid by the dealers for domestic sizes of anthracite. Generally, however, the coal purchased was bought at the regular circular price.

The shut down of the mines lasted about six weeks, and then the coal companies reduced the price 40 cents a ton on domestic sizes in May, 30 cents in June, 20 cents in July, and 10 cents in August, so that by September the regular circular prices were again in effect. The demand for anthracite during March and April had a depressing effect on the trade during the rest of the summer months. It is said that there was more coal stored in the early part of 1906 than ever before. All sizes of anthracite were in demand, and the smaller sizes, which had accumulated so fast as to give the producing companies some apprehension, were readily taken. Considerably more coal could have been sold in March and April if the larger producing companies had delivered it. The manufacturing establishments sought all they could get, but had to be satisfied with what was given them. Public plants were provided for, and the stock of coal secured by these plants in March and April was unusually large. The officials of the producing companies were uncertain as to the outcome, and made arrangements for a prolonged struggle. The stocks of hard coal on hand on March 1 are said to have been the largest in the history of anthracite mining.

The anthracite coal companies produced a smaller quantity of coal in 1906 than in 1905, owing to the shutting down of the mines. Since the strike of 1902 the coal companies have not regained all of their lost trade. During that time many manufacturing plants converted their furnaces into bituminous burners, and they have not resumed the burning of anthracite. While some of the trade has been regained, there are still many plants that have practically given up the use of hard coal. In Philadelphia, however, certain restrictions exist which almost compel the manufacturers to use only anthracite.

If it had not been for the strike of the anthracite coal miners it is believed that the output in 1906 would have exceeded that of the previous year, or would at least have been as large. As previously stated, there was a great demand for immediate delivery in March and April, which somewhat unsettled the trade. During these months, however, the large coal companies depended upon the stock they had stored, and they were careful as to whom they sold coal. It is said there was considerable discrimination, and the dealers in many cases had to depend on the individual operators to secure the little coal that could be had. The individual operators took advantage of the situation, and prices were higher at the mines than those which obtain generally for coal delivered to the consumer. Naturally in many cases exorbitant prices were paid by the consumers, who were afraid that it would be several months before harmony was restored in the anthracite region. From February until about the end of May there was good demand for domestic and steam sizes, and the stocks on hand were considerably reduced. With the beginning of June the demand fell off, and there was no general resumption until after the summer holidays. During the months of October, November, and December trade was brisk, and retail dealers had all they could do to supply the demand.

Philadelphia continues to rank as one of the greatest coal-shipping ports of the country, and sends coal to all parts of the world, although the bulk of the product sent out from Philadelphia is destined to ports on the New England coast. The Philadelphia and Reading Coal and Iron Company, and the Pennsylvania and the Baltimore and Ohio Railroad companies are the three most important shippers of coal from this port. The Reading has the largest and most improved piers for the handling of anthracite coal on Delaware River, although the Pennsylvania and the Baltimore and Ohio railroads have lately installed better facilities for the handling of coal in bulk. The Reading's Port Richmond piers are well known. Here this company not only sends out millions ot tons of anthracite, but a very large quantity of soft coal. During the last few years the Reading's soft-coal shipments have increased, and every effort is being made to encourage this branch of the business. At the Greenwich piers the Pennsylvania Railroad Company sends out daily a large quantity of soft coal as well as of anthracite. This company has the largest soft-coal trade. The Baltimore and Ohio has also increased its tonnage from Philadelphia.

The quantity of anthracite coal consumed in Philadelphia during 1906 was 3,999,953 tons, as compared with 4,371,478 tons in 1905. This reduction was principally due to the labor troubles in the anthracite mines and to the mild winter of 1906–7, which left a large quantity of coal in the bins of the consumers. There was an increase in the consumption of bituminous coal—2,327,019 tons, as against 2,143,024 tons in 1905. This increase was in a measure brought about by many manufacturing plants stocking up early in the year, so that in case of trouble they would be prepared.

All the coal and railroad companies have greatly improved their facilities for the handling of both anthracite and bituminous coal. It is no longer a problem to ship each month 5,000,000 tons of coal. A few years ago two months' production of this quantity brought about a congestion at the mines, and embargoes had to be placed on certain sections. Now the companies are better prepared to handle any quantity, and it is thought that if it were necessary 6,000,000 tons a month could be produced and handled. The total shipments of anthracite to Philadelphia in 1906 were 5,622,137 tons, as compared with 6,243,089 tons in 1905, a decrease of 620,952 tons. The shipments of bituminous in 1906 were 6,566,757 tons, as compared with 6,658,320 tons in 1905, a decrease of 91,563 tons. There was a decrease in the shipments of anthracite for export amounting to 1,316 long tons, and of bituminous amounting to 100,275 long tons. There was also a falling off in coastwise and harbor shipments of bituminous.

Owing to the strike of the anthracite miners in April the coal companies did not issue the regular spring prices until May, and then, instead of a decrease of 50 cents, only 40 cents was taken off. The circulars that have been in force for the last several years were continued at the expiration of the four months during which the reduction was in force. The Philadelphia and Reading Railway Company maintained its lead as the largest anthracite carrier in the

United States. For years this company has been known as the greatest anthracite carrier, and of late years it has been steadily forging to the front as a carrier of bituminous coal. Owing to the many and varied industries along its line, it has always a large demand for all kinds of coal in times of prosperity. During 1906 there were few manufacturing plants that were not working to their full capacity.

During the labor troubles in the anthracite region the same sort of difficulty prevailed in the bituminous region. In some sections of the soft coal belt the mines were shut down for four months, but owing to the employment of nonunion men by a number of independent operators shipments of coal were kept up. Although the production was curtailed, enough coal was brought from the mines in West Virginia and other points to satisfy all who were in need of fuel. Prices were at times higher, and in some instances bituminous coal rose to $2 a ton at the mines. The strike of the bituminous miners in a measure assisted the producers of anthracite to get rid of some of their steam sizes. Many of the manufacturers, however, had laid in large quantities of coal prior to the going out of the men, and with the soft coal that was being mined by the independent operators they had no trouble in securing all the fuel they required.

There is a growing demand on the part of the consumer for pea size of anthracite. This grade of coal is being more extensively used by the householder than ever before. In some cases furnaces have been altered so that pea size can be used to advantage. Some of the coal companies are turning out what they call extra large pea. The size of this coal is between that of ordinary pea and chestnut.

The prices of the smaller sizes of anthracite coal at the mines for each month of 1906, as compared with the same time in 1905, are shown in the following table:

Prices per long ton for steam sizes of anthracite at the mines in 1905 and 1906, by months.

Month.	1905.			1906.		
	Pea.	Buckwheat.	Rice.	Pea.	Buckwheat.	Rice.
January	$1.40-$1.75	$0.80-$1.25	$0.40-$0.75	$1.60-$1.75	$0.90-$1.25	$0.45-$0.75
February	1.40- 1.75	.80- 1.25	.40- .75	1.50- 1.75	.90- 1.25	.45- .75
March	1.40- 1.75	.80- 1.25	.40- .75	1.50- 2.35	1.00- 1.50	.45- 1.25
April[a]	1.40- 1.75	.80- 1.25	.40- .60	(Strike.)	(Strike.)	(Strike.)
May	1.40- 1.65	.80- 1.10	.40- .60	1.50- 1.75	.90- 1.25	.50- .65
June	1.30- 1.50	.80- 1.10	.40- .55	1.35- 1.75	.90- 1.25	.40- .65
July	1.20- 1.50	.70- 1.00	.35- .55	1.25- 1.75	.90- 1.25	.45- .65
August	1.20- 1.50	.70- 1.00	.30- .60	1.25- 1.75	.75- 1.25	.40- .65
September	1.20- 1.50	.65- 1.00	.30- .60	1.25- 1.75	.75- 1.25	.40- .65
October	1.35- 1.50	.75- 1.00	.40- .60	1.35- 1.75	.90- 1.25	.40- .65
November	1.40- 1.75	.85- 1.25	.50- .65	1.50- 1.75	.90- 1.25	.50- .75
December	1.50- 1.85	.85- 1.25	.50- .75	1.75- 2.00	.90- 1.25	.50- .75

[a] During April, 1906, the mines were shut down and very little coal was sold. Individual operators received as much as $3 a ton for pea, $2 for buckwheat, and $1.50 for rice.

There was a falling off in the exports of anthracite to foreign countries from Philadelphia in 1906 as compared with 1905. The shipments of hard coal to points outside of the United States amounted to 39,098 long tons in 1906, as against 40,414 tons in 1905, a decrease of 1,316 tons. The largest quantity of hard coal exported in 1906 from this port, 25,569 long tons, was sent to Cuba. Mexico received 472 tons, or 72 tons more than was shipped during 1905. The exports to Canada in 1906 amounted to 8,032 tons; to Newfoundland, 4,026 tons; and to Bermuda, 846 tons. The export shipments of bituminous also showed a falling off in 1906, the tonnage amounting to 603,151 long tons, as against 703,426 tons in 1905, a decrease of 100,275 tons. Cuba takes the largest quantity of bituminous coal, which in 1906 amounted to 285,647 long tons; Mexico took 190,437 tons, the British West Indies 11,246 tons, the Danish West Indies 15,243 tons, and the French West Indies 31,651 tons; 6,685 tons were sent to Italy, 26,824 tons to Canada, and 2,893 tons to the Philippines. The total value of the anthracite coal exported was $175,705 and that of the bituminous was $1,647,119.

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 per long ton on anthracite from coal regions to Philadelphia, Pa.

Region.	Prepared sizes.	Pea.	Buck-wheat.
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 1905 and 1906, in long tons.

Destination.	1905.		1906.	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.
Export	40,414	703,426	39,098	603,151
Coastwise and harbor	1,831,197	3,811,870	1,583,086	3,636,587
Local	4,371,478	2,143,024	3,999,953	2,327,019
Total	6,243,089	6,658,320	5,622,137	6,566,757

The price circular of the Philadelphia and Reading Coal and Iron Company, which is the same as that of other companies, is as follows:

Circular prices for anthracite coal in Philadelphia, Pa., in 1904, 1905, and 1906.

Size.	1904.		1905.		1906.		
	April.	September.	April.	September.	April.	May.	September.
Lump and steamboat	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
Broken	3.00	3.50	3.00	3.50	3.50	3.10	3.50
Egg	3.25	3.75	3.25	3.75	3.75	3.35	3.75
Stove	3.25	3.75	3.25	3.75	3.75	3.35	3.75
Chestnut	3.25	3.75	3.25	3.75	3.75	3.35	3.75
Pea	2.00	2.00	1.50	1.50	3.00	2.00	1.75
Buckwheat	1.50	1.50	1.00	1.00	2.00	1.25	1.25

BALTIMORE, MD.

The following review of the coal trade of Baltimore in 1906 has been prepared by Mr. Maurice J. Lunn, editor of Coal and Coke:

In contrast with the severe winter of 1904–5, the weather conditions of 1905–6 were not favorable to a large consumption of coal, such as would have been the case with severe weather, consequent delays to transportation, possible congestions, etc.

The anthracite-coal business was quite satisfactory during the year. In common with other points where anthracite is used, a considerable quantity of this coal was laid up in Baltimore in anticipation of a strike in the hard-coal fields, and this, together with the mild weather which prevailed, created something of an oversupply. The suspension in the anthracite fields, however, during April and the first week or more in May, soon absorbed this surplus, and the hard-coal trade ran through the year in fairly good condition, although the consumption of this kind of coal was not as large as during 1905.

The bituminous-coal trade showed some improvement over the conditions existing during 1905. The tonnage was large, and the open-weather conditions both in the first three months and the last two or three months of the year afforded a good movement of this commodity. There were the usual shortages in cars for the movement of soft coal from the mines, but they were not frequent nor long. Prices in the bituminous trade in 1906, unlike those of 1905, were fair and well maintained throughout the year, and the soft-coal business at this port was, as a whole, quite satisfactory.

Notwithstanding the fact that there were suspensions in the bituminous-coal fields of western and central Pennsylvania, Ohio, Indiana, and Illinois, pending a settlement of the wage questions in these fields, there was little trouble in securing an ample supply of coal, as the suspensions had been anticipated by the storage of considerable coal, which was quite sufficient to supply the trade until mining operations were resumed. There was some difficulty in connection with the tide-water shipments during the fall, owing to a scarcity of vessels and to unfavorable weather conditions. Both the coastwise shipments and the domestic exports of coal from Baltimore, however, showed gains as compared with those of 1905, as will be seen from the following tables:

Coastwise coal shipments from Baltimore, Md., 1903–1906, in long tons.

Year.	Anthracite.	Bituminous.	Total.
1903			1,731,896
1904	238,728	2,064,060	2,302,788
1905	252,568	2,832,321	3,084,889
1906	238,162	3,176,710	3,414,872

Domestic exports of bituminous coal from Baltimore, Md., 1903–1906, in long tons.

1903	116,294	1905	341,107
1904	150,912	1906	458,203

The exports of coke from Baltimore during 1906 amounted to 69,230 tons, as against 32,954 tons in 1905.

The following table shows the receipts and shipments of both anthracite and bituminous coal at Baltimore during the past year:

Receipts and shipments of coal at Baltimore, Md., in 1906, in long tons.

	Receipts.	Tide-water shipments.	
		Coastwise.	Exports.
Bituminous	4,208,800	3,176,710	458,203
Anthracite	707,425	238,162	....
Total	4,916,225	3,414,872	458,203

In compiling 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 of the Central Foundry Company, located at Dundalk, about 6 miles out of the city. These figures, which are not included in the tables, are given in the following paragraphs:

Mr. F. W. Wood, president of the Maryland Steel Company, states that its consumption of bituminous coal for all purposes, during 1906, amounted to 615,333 long tons, as against 632,450 long tons in 1905, and that the company consumed 117,154 long tons of coke during the year, purchased from outside sources, in addition to the coke manufactured in its own ovens at the plant.

Mr. J. W. Voorhis, manager of the Central Foundry Company, states that 4,098 short tons of coke and 4,105 short tons of coal were consumed at its plant during the past year, as compared with 4,183 short tons of coke and 2,863 short tons of coal in 1905.

PITTSBURG, PA.

In the following tables is presented a statement showing the quantity of coal received at and in the vicinity of Pittsburg, by both rail and water, and the shipments of coal through and from the Pittsburg district to the west during the last five years. This statement 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 at Davis Island dam on the Ohio River below Pittsburg. The railroad officials furnishing the information in this report to whom special acknowledgment is due are Messrs. J. G. Searles, general coal freight agent of the Pennsylvania Railroad at Philadelphia; W. L. Cromlish, coal and coke agent of the Baltimore and Ohio Railroad at Pittsburg; C. F. Perkins, general ore and coal agent of the Pennsylvania lines west of Pittsburg, at Pittsburg; W. A. Terry, general freight agent of the Pittsburg and Lake Erie Railroad at Pittsburg; J. B. Safford, superintendent of the Pittsburg, Chartiers and Youghiogheny Railroad at Pittsburg, and H. J. Booth, general freight agent of the Wheeling and Lake Erie Railroad (Wabash) at Pittsburg. The statistics of the movement of coal through the Monongahela River locks and the Davis Island dam have been furnished by Maj. H. C. Newcomer, Corps of Engineers, U. S. Army.

These tables show that the total movement of coal to and through Pittsburg in 1906 amounted to 37,251,690 short tons, against 33,312,240 short tons in 1905, an increase of 3,933,450 short tons;

this in spite of the two months' suspension of operations in the bituminous districts of Pennsylvania in the spring of 1906.

The statement showing this movement has been arranged, first, to show the total receipts and shipments by rail and the total receipts and shipments by water; and second, the total receipts by rail and water to the Pittsburg district, and the total shipments by rail and water to points west of Pittsburg. It will be observed that the rail shipments to Pittsburg show a decrease in 1906 of 355,599 short tons, while the rail shipments to the west of Pittsburg increased 4,049,128 short tons. On the other hand, the river shipments to the Pittsburg district showed an increase of 1,282,275 short tons, while the river shipments to points west of Pittsburg showed a decrease of 1,042,354 short tons. The total shipments to the Pittsburg district showed an increase of 926,676 short tons, while the total shipments to points west of Pittsburg showed an increase of 3,006,774 short tons.

In addition to the coal shipped from the Pittsburg district west and that consumed locally, a considerable quantity of coal is shipped from the Pittsburg district to eastern points. Complete statistics covering the eastern movements have not been compiled. It is estimated that the total eastern movement in 1906 was between 9,000,000 and 10,000,000 tons. This would indicate that the total coal trade of Pittsburg in 1906 amounted to between 45,000,000 and 50,000,000 tons.

Movement of coal to and through Pittsburg, 1902–1906, in short tons, showing totals by rail and water.

	1902.	1903.	1904.	1905.	1906.
By rail:					
To Pittsburg district	5,385,017	5,160,275	5,083,535	5,463,012	5,107,413
To west of Pittsburg	14,568,750	15,965,442	16,017,327	18,370,368	22,419,496
Total by rail	19,953,767	21,125,717	21,100,862	23,833,380	27,526,909
By Monongahela River locks: [a]					
To Pittsburg district	5,686,022	6,303,365	4,173,992	5,558,541	6,840,816
To west of Pittsburg	3,619,905	3,069,299	2,811,584	3,926,319	2,883,965
Total by water	9,305,927	9,372,664	6,985,576	9,484,860	9,724,781
Total shipments	29,259,694	30,498,381	28,086,438	33,318,240	37,251,690

[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 1906 there were consumed in pools Nos. 1 and 2 5,060,861 tons river coal, and in the harbor below No. 1, including the lower Allegheny River, 1,779,955 tons of Monongahela River coal, a total of 6,840,816 tons.

Movement of coal to and through Pittsburg, 1902–1906, in short tons, showing totals to Pittsburg district and west of Pittsburg.

	1902.	1903.	1904.	1905.	1906.
To Pittsburg district:					
By rail	5,385,017	5,160,275	5,083,535	5,463,012	5,107,413
By water	5,686,022	6,303,365	4,173,992	5,558,541	6,840,816
Total to Pittsburg district	11,071,039	11,463,640	9,257,527	11,021,553	11,948,229
To west of Pittsburg:					
By rail	14,568,750	15,965,442	16,017,327	18,370,368	22,419,496
By water	3,619,905	3,069,299	2,811,584	3,926,319	2,883,965
Total to west of Pittsburg	18,188,655	19,034,741	18,828,911	22,296,687	25,303,461
Total shipments	29,259,794	30,498,381	28,086,438	33,318,240	37,251,690

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 1906 to 6,827,087 short tons, an increase, as compared with 1905, of 1,102,449 short tons, or 19 per cent. The receipts in 1905 were 416,846 tons less than in 1904 and the smallest since 1901. The receipts in 1906 included 6,021,958 short tons of bituminous coal, against 4,846,162 tons in 1905; 145,822 short tons of anthracite, against 295,423 tons in 1905; and 659,307 tons of coke, against 583,053 tons in 1905. The shipments by rail and lake in 1906 were 3,099,822 short tons, against 2,664,092 short tons in 1905. The local consumption (the difference between the receipts and the shipments) amounted to 3,727,265 short tons, an increase of 666,719 short tons over 1905, when the local consumption was 3,060,546 short tons.

The following tables show the quantities of bituminous and anthracite coal and of coke received and shipped and the local consumption at Cleveland during the last five years:

Coal and coke receipts and shipments at Cleveland, Ohio, 1902–1906, in short tons.

RECEIPTS.

Kind.	1902.	1903.	1904.	1905.	1906.
Bituminous	4,949,027	5,577,964	5,347,476	4,846,162	6,021,958
Anthracite	158,405	254,193	199,907	295,423	145,822
Coke	737,603	763,430	594,101	583,053	659,307
Total	5,845,035	6,595,587	6,141,484	5,724,638	6,827,087

SHIPMENTS.

Kind.	1902.	1903.	1904.	1905.	1906.
Anthracite by rail	6,214	6,590	27	74	10,138
Bituminous by rail	116,184	62,082	61,047	50,575	45,687
Bituminous by lake	2,234,029	2,752,549	3,052,819	2,567,916	2,926,279
Coke by rail	24,191	18,170	21,655	45,527	117,718
Total	2,380,618	2,839,391	3,135,548	2,664,092	3,099,822

Total coal receipts and shipments, with local consumption, at Cleveland, Ohio, 1902–1906, in short tons.

Year.	Receipts.	Shipments.	Local consumption.
1902	5,845,035	2,380,618	3,464,417
1903	6,595,587	2,839,391	3,756,196
1904	6,141,484	3,135,548	3,005,936
1905	5,724,638	2,664,092	3,060,546
1906	6,827,087	3,099,822	3,727,265

CHICAGO, ILL.

The following review of the coal trade of Chicago in 1906 was compiled by the Chicago bureau of coal statistics and published in the Black Diamond of January 26, 1907:

From a tonnage standpoint the year 1906 was a good one for bituminous coal and a disappointing one for anthracite coal. The receipts of anthracite at Chicago by lake for the year were 781,751 tons, compared with 958,025 tons in 1905, 960,630 tons in 1904, and 1,176,306 tons in 1903. Receipts of anthracite by rail for last year were 744,531 tons, compared with 833,576 tons in 1905, 882,238 tons in 1904, and 993,093 tons in 1903. This falling off in anthracite receipts, both lake and rail, is undoubtedly due to the growing popularity of bituminous coal as a domestic fuel. The advance in the price of anthracite has in a great measure been responsible for the substitution of the higher grade of bituminous coal where anthracite was deemed a necessity a few years ago. By-product coke is also becoming a factor as a domestic fuel and is probably responsible for a small per cent of the decrease in anthracite consumption.

The receipts of bituminous coal from Pennsylvania for the year amounted to 925,237 tons, as compared with 707,846 tons for 1905, which is an increase of 217,391 tons. There was an increase in receipts every month in the year, ranging from 580 tons in February to 28,612 tons in August.

Ohio coal enjoyed a greater demand, with the result that the receipts for the year showed an increase of 225,199 tons. The receipts for 1906 were 856,833 tons as compared with 631,634 tons for the previous year.

The receipts from Indiana for 1906 were 2,961,926 tons, compared with 2,744,405 tons for the previous year. There were comparatively few new operations opened up in Indiana during the year, and the increase can be traced to the greater development of the old mines. The month of March showed the greatest increase, when 519,549 tons of coal were shipped to the Chicago market. This was an increase of 271,684 tons over March, 1905.

The receipts of coke have been dropping steadily for the past year, and coke produced by the Semet-Solvay ovens at South Chicago is undoubtedly responsible for the falling off in the demand for the Connellsville and West Virginia varieties. The receipts of coke for 1906 were 342,919 tons, compared with 462,734 tons for 1905, which was a decrease of 119,815 tons.

West Virginia and Kentucky coals were not in as great favor last year as they have been in previous years. The receipts for 1906 were 914,420 tons, compared with 968,137 tons in 1905, which was a decrease of 53,717 tons. It might be well to mention the fact that Kentucky tonnage recorded in this table does not represent much of the total, being small compared with the West Virginia tonnage. The decrease in West Virginia coal is due to successful competition of western coals which do not have to pay a heavy freight rate before its product reaches the consumer.

Illinois coal was shipped into Chicago in greater quantities than ever before. The receipts for last year amounted to 4,968,102 tons, compared with 3,894,986 tons in 1905, which was an increase of 1,073,116 tons. New fields have been opened up rapidly, and the older mines have been worked to their utmost capacity. If the car shortage had not retarded the movement of coal during the months of November and December a mark would have been set that would probably not be reached again for years to come. The Franklin County field showed greater development than any other, and this district will give a good account of itself in a coal-producing way during 1907.

Shipments of anthracite to the country decreased 41,089 tons, from 583,643 tons in 1905 to 542,554 tons in 1906. The shipments of bituminous coal during 1906 were 2,772,294 tons, compared with 2,183,937 tons for the year previous, which was an increase of 588,357 tons.

The receipts of anthracite coal at Chicago by lake and rail in 1905 and 1906 by months are shown in the following table:

Receipts of anthracite coal at Chicago, Ill., in short tons, by lake and rail, 1905–1906.

Month.	Anthracite by lake.		Anthracite by rail.		Total anthracite.		Increase or decrease in 1906.
	1905.	1906.	1905.	1906.	1905.	1906.	
January	....	....	68,244	86,137	68,244	86,137	+ 17,893
February	....	....	59,389	80,404	59,389	80,404	+ 21,015
March	....	....	124,741	92,037	124,741	92,037	− 32,704
April	59,802	66,859	66,068	43,140	125,870	109,999	− 15,871
May	89,931	9,300	72,415	45,584	162,346	54,884	−107,462
June	86,129	50,021	52,041	58,266	138,170	108,287	− 29,883
July	113,855	79,522	48,284	52,670	162,139	132,192	− 29,947
August	155,623	127,370	68,042	47,978	223,665	175,348	− 48,317
September	154,601	95,649	40,667	50,904	195,268	146,553	− 48,715
October	76,818	105,302	58,016	44,653	134,834	149,955	+ 15,121
November	102,854	155,805	77,900	61,425	180,754	217,230	+ 36,476
December	118,412	91,923	97,769	81,333	216,181	173,256	− 42,925
Total	958,025	781,751	833,576	744,531	1,791,601	1,526,282	[a] −265,319

[a] Net decrease.

The following table gives a statement of the receipts of bituminous coal and coke at Chicago for the last five years:

Receipts of bituminous coal and coke at Chicago, Ill., 1902–1906, in short tons.

State from which received.	1902.	1903.	1904.	1905.	1906.	Increase or decrease in 1906.
Pennsylvania	487,134	617,521	516,362	707,846	925,237	+ 217,391
Ohio	616,335	666,265	566,076	631,634	856,833	+ 225,199
West Virginia and Kentucky	969,132	908,154	960,079	968,137	914,420	− 53,717
Illinois	2,958,493	4,301,803	4,094,594	3,894,986	4,968,102	+1,073,116
Indiana	2,403,519	2,610,716	2,713,597	2,744,405	2,961,926	+ 217,521
By lake	63,106	85,164	64,688	79,072	93,729	+ 14,657
Total bituminous coal	7,497,719	9,189,623	8,915,396	9,026,080	10,720,247	+1,694,167
Coke	602,740	591,125	369,731	462,734	342,919	− 119,815

In the following table is presented a statement of the receipts and shipments of coal and coke for Chicago during the last five years:

Receipts and shipments of coal and coke at Chicago, Ill., 1902–1906, in short tons.

Year.	Anthracite.		Bituminous.		Coke.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
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	2,183,937	462,734	296,091
1906	1,526,282	542,554	10,720,247	2,772,294	342,919	258,316

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 of that city:

Receipts of coal at Milwaukee during the year 1906 show a greater increase than in any former year in the existence of the city. The total quantity received by lake, rail, and car ferry was 3,815,275 tons, an increase over the total receipts of 1905 of 657,811 tons.

Receipts of the last year from lower lake ports consisted of 756,646 tons of anthracite and 2,597,426 tons of bituminous coal, making the total from lower lakes of 3,354,072 short tons. In addition, there were received by car ferry from Michigan 319,935 tons and by all rail from Indiana, Illinois, and Iowa 141,268 tons. These figures place Milwaukee far in advance of any other lake port in the coal trade, and, large as they already are, the facilities for the rapid handling of coal are in constant process of improvement and enlargement.

Of the coal received at Milwaukee in 1906, 1,184,304 tons were shipped westward by rail and 4,138 tons by lake along shore. Owing to the scarcity of cars during the closing months of the year, shipments by rail were materially curtailed, whereas under normal conditions they would have shown a corresponding increase with receipts.

The following tables give receipts and shipments of coal at Milwaukee by rail and lake for the last five years:

Receipts of coal at Milwaukee, Wis., 1902–1906, in short tons.

Source.	1902.	1903.	1904.	1905.	1906.
By lake from—					
Buffalo	132,803	914,901	809,471	800,814	748,644
Erie	141,130	153,325	91,310	60,641	66,964
Oswego	....	7,003	22,000	4,369	8,002
Cleveland	354,485	436,834	341,658	247,878	560,475
Ashtabula	97,378	230,726	187,772	245,455	263,527
Lorain	69,132	104,549	194,361	159,788	157,515
Sandusky	131,285	213,124	254,014	359,427	362,408
Toledo	416,057	477,950	689,641	770,962	851,521
Fairport	20,690	65,981	22,800	23,051	25,627
Ogdensburg	4,083	....	3,972	....	....
Huron, Ohio	2,528	23,046	38,012	87,008	160,274
Other ports	4,400	21,912	41,323	75,739	149,115
Total, lake	1,373,971	2,649,351	2,696,334	2,835,132	3,354,072
By railroad	267,124	374,626	248,105	322,332	[a] 461,203
Receipts	1,641,095	3,023,977	2,944,439	3,157,464	3,815,275

[a] Including 319,935 tons by car-ferry lines.

Shipments of coal from Milwaukee, Wis., 1902–1906, in short tons.

Shipped by—	1902.	1903.	1904.	1905.	1906.
Chicago, Milwaukee and St. Paul Rwy	376,710	350,505	569,330	668,509	631,205
Chicago and Northwestern Rwy	243,535	259,941	361,824	512,536	459,333
Wisconsin Central R. R	28,823	33,339	55,368	87,105	93,766
Lake	180	6,645	6,040	9,460	4,138
Total	649,248	650,430	992,562	1,277,610	1,188,442

Total receipts of coal by lake at Milwaukee, Wis., 1902–1906, by kinds, in short tons.

Kind.	1902.	1903.	1904.	1905.	1906.
Anthracite	[a] 172,676	946,596	876,169	802,083	756,646
Bituminous	1,468,419	1,702,755	1,820,165	2,033,049	2,597,426
Total	1,641,095	2,649,351	2,696,334	2,835,132	3,354,072

[a] Strike.

Receipts of coal at Milwaukee, Wis., by lake and rail in 1865, 1870, 1880, 1890, and annually from 1900 to 1906, in short tons.

1865	36,369	1902	1,641,095
1870	122,865	1903	3,023,977
1880	368,568	1904	2,944,439
1890	999,657	1905	3,157,464
1900	1,808,593	1906	3,815,275
1901	1,953,489		

CINCINNATI, OHIO.

Mr. Charles B. Murray, superintendent of the chamber of commerce of Cincinnati, Ohio, has furnished the following review of the coal trade of that city in advance of publication of his report:

For the calendar year 1906 the receipts of coal at Cincinnati, according to returns to and records of the chamber of commerce, represented a total of 173,957,000 bushels, compared with 160,820,000 bushels for 1905, and an annual average of 117,470,000 bushels for five years prior to 1906. These comparisons indicate for 1906 a gain of 8 per cent over the preceding year, and of 48 per cent over the annual average for five years.

Receipts of coal by river in 1906 were decidedly reduced in comparison with the preceding year, when they were exceptional in quantity. For 1906 the river receipts were 56,739,000 bushels, compared with 72,935,000 bushels for 1905, and an annual average of 56,666,000 bushels for five years. The large arrivals for 1905 embraced delayed shipments from 1904, when the quantity which came forward was reduced by interruption to navigation due to low water. It therefore is evident that the river movement in 1906 was fully up to the average of a series of recent years.

Receipts of coal in 1906 by railroad were much in excess of any previous record, indicating a total of 117,218,000 bushels, compared with 87,885,000 bushels for 1905, and an annual average of 60,803,000 bushels for five years prior to 1906.

Shipments of coal in 1906 by river were 5,833,000 bushels, compared with 6,433,000 bushels for 1905, and an annual average of 4,798,000 bushels for five years prior to 1906. Shipments by railroad in 1906 were 93,212,000 bushels, compared with 57,541,000 bushels for 1905, and an annual average of 37,595,000 bushels for five years. Total shipments for the year were 99,045,000 bushels, compared with 58,974,000 bushels for 1905, and an annual average of 41,393,000 bushels for five years prior to 1906. The proportion of the reported shipments by railroad representing through movement, in distinction from coal received by local dealers and sold for shipment, can not be definitely stated.

The receipts of coal in 1906 were about 33 per cent by river and 67 per cent by railroad. For a period of five years previously river receipts represented about 48 per cent and railroad receipts 52 per cent.

Prices of coal afloat from the Pittsburg and Kanawha districts ranged at 7½ to 8½ cents per bushel, at Cincinnati, with an average of 7.80 cents for the year. For run of mine coal from the Pittsburg district the prevailing price was 7¼ cents per bushel; for nut and slack, 5½ to 6 cents per bushel. Kanawha nut and slack about 5 to 5½ cents per bushel. The price of lump coal, for both Pittsburg (Youghiogheny) and Kanawha, delivered to consumers, was $3.25 per ton for about half of the year, and $3.50 for the remaining time, making an average of $3.38 per ton, compared with $3.35 for 1905. On the bushel basis the average for 1906 was 12.20 cents, compared with 12.05 cents for 1905, and an annual average of 11.80 cents for five years prior to 1906, for deliveries to consumers. For nut and slack the range was mainly $1.90 to $2.25 per ton for deliveries to consumers, with $1.90 to $2 the prevailing range.

Anthracite coal is but moderately consumed in this market, the total receipts in 1906 being 792,000 bushels, compared with 545,000 bushels for 1905, and an annual average of 545,000 bushels for five years prior to 1906. The price for lots delivered to consumers was $7.50 per ton throughout the year.

The local consumption of coal, as nearly as it can be estimated from statements of dealers, has been pretty evenly divided between industrial and household uses, with a tendency to enlargement of the industrial proportion, so that probably 55 per cent is not too high an estimate for such consumption for 1906.

For the year 1906 the local gas works consumed coal to the extent of 222,819 tons of 2,000 pounds, or 6,190,000 bushels. There were sent out from the works during the year 2,468,000,000 cubic feet of gas, and the product of electric current represented 35,615,000 kilowatts. Compared with the preceding year there was an increase of about 13 per cent in coal consumed, 14 per cent in quantity of gas sent out, and 21 per cent in product of electric current.

The yearly range and average prices of Pittsburg coal, afloat and delivered, per bushel, based on weekly records, compared for a series of years, are shown in the following table:

Prices of Pittsburg coal at Cincinnati, 1902–1906, in cents per bushel.

Year.	Afloat.			Delivered.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
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
1906	7½	8½	7.80	11¾	12⅝	12.20

Summary of coal movements at Cincinnati, Ohio, in 1905 and 1906, in bushels.

Details.	1905.	1906.	Details.	1905.	1906.
Total received	160,820,000	173,957,000	Anthracite	545,000	792,000
Pittsburg	40,689,000	31,118,000	Total:		
Ohio River	310,000	1,970,000	By river	72,935,000	56,739,000
Kanawha:			By rail	87,885,000	117,218,000
By river	31,936,000	23,651,000	Shipped:		
By rail	48,037,000	64,034,000	By river	6,433,000	5,833,000
Total Kanawha	79,973,000	87,685,000	By rail	57,541,000	93,212,000
Other kinds by rail	39,303,000	52,392,000	Total shipped	63,974,000	99,045,000

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 1906, 5,502,000 bushels; locally manufactured, 8,000,000 bushels; shipments, 7,402,000 bushels.

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 5,502,000 bushels, and the quantity locally manufactured was 8,000,000 bushels, making a total of 13,502,000 bushels, compared with 11,799,000 bushels the preceding year. For city manufacture the average price for the year was $10\frac{3}{4}$ cents per bushel; of gas-house, 9 cents; of Connellsville, \$6.50 per ton.

Total annual receipts of coal at Cincinnati, 1901–1906, in short tons.

1901	3,292,604	1904	4,257,613
1902	3,766,796	1905	5,791,000
1903	4,046,710	1906	6,265,000

ST. LOUIS, MO.

The following summary of the coal trade of St. Louis for 1906 has been prepared for this report by Mr. William Flewellyn Saunders, secretary and general manager of the Business Men's League of that city:

Coal prices at St. Louis during 1906 ruled higher because of the shut down of the mines during part of the year while differences between the operators and the miners were being adjusted, and because of the desire of manufacturers to supply themselves with larger quantities of coal both before and after the shut down to provide against emergencies. The St. Louis field supplied nearly all of the soft coal used in St. Louis, the exception being that consumed by the Laclede Gas Company, which for years has been bringing its gas coal from Pittsburg down the Ohio River and up the Mississippi River to St. Louis by barges and towboats.

The St. Louis coal market is broadening greatly, the shipments into the Southwest increasing markedly, and one large company is making such heavy contracts for shipment into the Southeastern States that it is considering the establishment next year of a towboat and barge line to take the coal down the Mississippi River to the various river shipping points near the places of consumption.

The manufacturing output of St. Louis has also increased more than 37 per cent over the value of the output in 1900, according to the figures of the United States census of 1905, and this, of course, increases the demand on the Illinois fields. The mines, however, even as now operated are able to meet the demand without difficulty, and there seems to be no strain on the resources of any of them.

Arkansas anthracite is little used in St. Louis, but large quantities of it are going to Kansas City and to Omaha, a favoring freight rate from the fields to these cities accounting for this.

Coal prices at St. Louis, Mo., during 1905 and 1906, per short ton.

Kind.	1905.			1906.		
	Highest.	Lowest.	Closing.	Highest.	Lowest.	Closing.
Standard Illinois lump coal	$2.00	$1.52½	$1.55	$2.85	$1.45	$1.70
High-grade Illinois lump coal	2.55	1.80	2.30	3.05	1.85	2.50
Anthracite, large	7.15	6.65	7.15	6.85	6.35	6.85
Anthracite, small	7.40	6.90	7.40	7.10	6.60	7.10
Connellsville coke	6.80	5.45	6.80	6.65	5.45	6.65
New River coke	6.00	5.25	6.00	6.45	5.30	6.45
Kentucky coke	5.45	3.50	3.50	4.10	3.00	4.10
Gas coke	5.50	4.20	5.50	5.00	3.70	4.90

Coal and coke receipts at St. Louis, Mo., 1901–1906.

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	1906	190,540,325	174,226	18,244,444

PRODUCTION OF COAL BY STATES AND TERRITORIES.

Including Alaska, Idaho, and Nevada, in which a few thousand tons of coal were produced, there were 30 States and Territories which contributed to the total production in 1906 against 31 coal producing States in 1905. North Carolina, whose production has decreased each year since 1902, reported no output in 1906.

Of the 30 States and Territories which produced coal in 1906, 12 are east of the Mississippi River and 18 are west of it. In 1906 the 12 States east of the Mississippi River produced 365,559,933 short tons (a little over a million tons a day for each day in the year), or 88.5 per cent of the total output; while the 18 States west of the Mississippi River produced 48,597,345 short tons, or 11.5 per cent of the total. Of the 12 States east of the Mississippi, 6 are located north of the dividing line formed by the Ohio and Potomac rivers, and 6 lie south of the dividing line. The 6 States north of the two rivers produced 288,661,712 short tons in 1906, or 70 per cent of the total for the United States, while the southern States contributed 76,898,221 short tons, or 18.5 per cent of the total. But while the northern States excel the southern ones to such an extent in the total production, the ratio of increase during the last quarter of a century 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 17 times the latter. In 1890 the northern States produced 122,296,267 short tons, which was about 7 times the 17,378,754 short tons produced in the southern States. In 1900 the southern States produced 42,607,053 short tons and the northern States, 193,324,621, less than 5 times that of the southern States.

In 1906 the production of the southern States was more than one-fourth that of the northern. The States west of the Mississippi River have increased their whole production from 4,624,324 short tons in 1880 to 48,597,345 short tons in 1906, the output in the latter year being a little more than 10 times that of 1880.

In the following tables the production of the different States, grouped according to geographical divisions made by the Mississippi, Ohio, and Potomac rivers, is given for the years 1880, 1890, 1900, 1905, and 1906, 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, 1905, and 1906, in short tons.

State.	1880.		1890.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Illinois	38,434,363	$40,577,592	41,480,104	$44,763,062
Indiana	11,895,252	12,492,255	12,092,560	13,116,261
Maryland	5,108,539	5,831,760	5,435,453	6,474,793
Michigan	1,473,211	2,512,697	1,346,338	2,427,404
Ohio	25,552,950	26,486,740	27,731,640	30,346,580
Pennsylvania:				
Anthracite	77,659,850	141,879,000	71,282,411	131,917,694
Bituminous	118,413,637	113,390,507	129,293,206	130,290,651
Total	278,537,802	343,170,551	288,661,712	359,336,445

Coal production in States south of Ohio and Potomac rivers in 1880, 1890, 1900, 1905, and 1906, in short tons.

State.	1880.		1890.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Alabama	11,866,069	$14,387,721	13,107,963	$17,514,786
Georgia	351,991	453,848	332,107	424,004
Kentucky	8,432,523	8,385,232	9,653,647	9,809,938
North Carolina	1,557	2,336	....	....
Tennessee	5,766,690	6,577,881	6,259,275	7,667,415
Virginia	4,275,271	3,777,325	4,254,879	4,183,991
West Virginia	37,791,580	32,341,790	43,290,350	41,051,939
Total	68,485,681	65,926,133	76,898,221	80,652,073

Coal production in States and Territories west of Mississippi River in 1880, 1890, 1900, 1905, and 1906, in short tons.

State or Territory.	1880.		1890.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Arkansas	14,778	$33,535	399,888	$514,595	1,447,945	$1,653,618
California	236,950	663,013	110,711	283,019	172,908	540,031
Colorado	462,747	1,041,350	3,094,003	4,344,196	5,244,364	5,858,036
Idaho	....	....	....	....	10	50
Indian Territory	....	....	869,229	1,579,188	1,922,298	2,788,124
Iowa	1,461,116	2,507,453	4,021,739	4,995,739	5,202,939	7,155,341
Kansas	771,442	1,517,444	2,259,922	2,947,517	4,467,870	5,454,691
Missouri	884,304	1,464,425	2,735,221	3,382,858	3,540,103	4,280,328
Montana	224	800	517,477	1,252,492	1,661,775	2,713,707
Nebraska	200	750	1,500	4,500	....	....
New Mexico	....	....	375,777	504,390	1,299,299	1,776,170
North Dakota	....	....	30,000	42,000	129,883	158,348
Oregon	43,205	97,810	61,514	177,875	58,864	220,001
Texas	....	....	184,440	465,900	968,373	1,581,914
Utah	14,748	33,645	318,159	552,390	1,147,027	1,447,750
Washington	145,015	389,046	1,263,689	3,426,590	2,474,093	4,700,068
Wyoming	589,595	1,080,451	1,870,366	3,183,669	4,014,602	5,457,953
Total	4,624,324	8,829,722	18,113,635	27,656,918	33,752,353	45,786,130

State or Territory.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Arkansas	1,934,673	$2,880,738	1,864,268	$3,000,339
California	[a] 80,824	[a] 395,975	[a] 30,831	78,684
Colorado	8,826,429	10,810,978	10,111,218	12,735,616
Idaho	[b] 5,882	[b] 17,846	[b] 6,165	24,238
Indian Territory	2,924,427	5,145,358	2,860,200	5,482,366
Iowa	6,798,609	10,586,381	7,266,224	11,619,455
Kansas	6,423,979	9,350,542	6,024,775	8,979,553
Missouri	3,983,378	6,291,661	3,758,008	6,118,733
Montana	1,643,832	2,823,350	1,829,921	3,240,357
Nebraska	....	....	....	....
New Mexico	1,649,933	2,190,231	1,964,713	2,638,986
North Dakota	317,542	424,778	305,689	451,382
Oregon	109,641	282,495	79,731	212,338
Texas	1,200,684	1,968,558	1,312,873	2,178,901
Utah	1,332,372	1,793,510	1,772,551	2,408,381
Washington	2,864,926	5,141,258	3,276,184	5,908,434
Wyoming	5,602,021	7,336,951	6,133,994	8,013,528
Total	45,699,152	67,440,610	48,597,345	73,091,291

[a] Includes Alaska. [b] Includes Nevada.

The production of coal in the several States and Territories in 1906 and preceding years is discussed more in detail in the following pages.

ALABAMA.

Total production in 1906, 13,107,963 short tons; spot value, $17,514,786.

Alabama ranks fifth among the coal-producing States, the output of 1906 being the largest production in the history of the State. Compared with that of 1905, the production in 1906 exhibits an increase of 1,241,894 short tons, or 10.5 per cent in quantity, and of $3,127,065, or 21.7 per cent in value. The average price per ton advanced from $1.21 in 1905 to $1.34 in 1906. This is the highest average attained in recent years.

The total number of men employed in the coal mines of Alabama in 1906 was 20,555, who worked an average of 237 days, as compared with 19,595 men working an average of 225 days in 1905. Considering these figures with the total production, it appears that the average production per man in 1906 was 637.7 tons, against 605.6 in 1905. The average output per day per man was the same in both years, 2.69 tons. In 1904 the men averaged 2.93 tons per day and 632.3 tons for the year. The lower averages in the two later years are probably due in part to the less efficient character of the miners who have been employed subsequent to the strike of 1904, since when the mines of the companies affected have been operated on a nonunion or open-shop basis.

The statistics for 1905 showed a marked increase in the use of mining machines and in the production of machine-mined coal. The statistics for 1906 show a slight increase in both. According to the report for 1905, there was a total of 213 machines in use, which produced 1,584,942 tons of machine-mined coal; the total number of machines reported in 1906 was 238, an increase of 25, and the machine-mined coal increased to 1,641,476 tons. The figures for 1906 do not include 5 machines purchased by one company in 1905, but not operated in 1906. Of the total number of machines in use in 1906, 177 were of the pick or puncher type and 61 were chain-breast machines. No long-wall machines were reported.

Interruptions to mining operations in Alabama by reason of strikes or lockouts were of comparative unimportance. There were only 4 mines at which strikes occurred, and these were of short duration, the average time lost being 12 days for the 549 men affected.

Most of the coal mines of Alabama are operated on a 10-hour day, 91 operations employing 11,258 men, or nearly 55 per cent of the total number in 1906, having reported 10 hours as the length of the working day; 37 mines employing 7,808 men worked 9 hours, and 27 mines employing 1,096 men worked 8 hours.

The accident statistics for 1906, as reported by Mr. J. M. Gray, State mine inspector, show a gratifying decrease in the number of accidental deaths as compared with 1905, when 185 lives were lost, but the record was not as good as those of the four years from 1900 to 1903, inclusive. The total number of fatal accidents in 1906 was 96, a decrease of 89 as compared with the preceding year. There were 89 serious but nonfatal accidents in 1906. Of the men killed, 52 were married. Seventy-three children were left fatherless. More than one-half of the deaths, or 49 in all, were due to falls of roof in the rooms; 1 was due to fall of slate in gangway; 1 was caused by an explosion of gas; 12 were due to an explosion of dust following a windy shot; 4 were due to powder explosions, and 29 were ascribed to other causes. Comparing the figures of casualties as reported by Mr. Gray with the statistics of production it is found that there were 136,541 short tons of coal mined for each life lost, as compared with 64,141 tons in 1905, 134,072 tons in 1904, and 204,462 tons in 1903. The death rate per thousand of employees in 1906 was 4.67, against 9.44 in 1905, 4.7 in 1904, and 2.7 in 1903.

Of the total production of coal in Alabama in 1906, over 15 per cent, or 1,985,889 short tons, was washed at the mines, there being 11 mines in the State where washeries have been installed. The 11 washeries included 38 jigs, and the operations resulted in the production of 1,753,537 short tons of washed coal and 232,352 tons of refuse. These statistics do not include the coal washed for coke making at plants located at a distance from the mines.

The statistics of production in Alabama in 1905 and 1906, with the distribution of the product of consumption, are shown in the following tables:

Coal production of Alabama in 1905 and 1906, by counties, in short tons.

1905.

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.
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	1,509	....	....	40,109	62,233	1.55	161	145
Other counties [a]	297,413	10,693	7,280	54,397	369,783	402,968	1.09	224	841
Small mines	....	1,360	....	....	1,360	1,720	1.03	....	....
Total	8,003,053	380,210	350,872	3,131,934	11,866,069	14,387,721	1.21	225	19,595

1906.

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.
Bibb	1,236,950	4,274	83,432	....	1,324,656	$1,921,915	$1.42	244	1,790
Etowah	133,560	100	....	....	133,660	173,758	1.30	231	347
Jefferson	4,092,863	39,759	236,955	2,253,538	6,623,115	9,086,329	1.37	253	9,834
St. Clair	245,020	847	10,360	....	256,227	341,163	1.33	196	528
Shelby	213,496	500	11,091	....	225,087	331,487	1.47	220	608
Tuscaloosa	379,936	33,847	32,911	604,098	1,050,792	1,490,745	1.42	229	1,380
Walker	2,721,253	37,879	62,857	240,529	3,062,518	3,586,167	1.17	218	5,149
Winston	26,701	375	....	....	27,076	44,617	1.65	187	85
Other counties [a]	359,226	12,800	9,106	22,200	403,332	536,550	1.33	215	834
Small mines	....	1,500	....	....	1,500	2,055	1.37	....	....
Total	9,409,005	131,881	446,712	3,120,365	13,107,963	17,514,786	1.34	237	20,555

[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 1906 as compared with 1905:

Coal production of Alabama, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−) in 1906.
Bibb	1,487,407	1,651,157	1,386,079	1,335,923	1,324,656	− 11,267
Blount Cullman	[a] 253,178	[a] 260,802	[a] 279,070	[a] 294,550	337,848	+ 43,298
Etowah	101,790	119,830	128,989	170,484	133,660	− 36,824
Jefferson	5,855,536	6,194,832	5,821,663	5,873,268	6,623,115	+ 749,847
St. Clair	156,243	152,313	144,223	186,595	256,227	+ 69,632
Shelby	136,043	240,962	128,307	157,569	225,087	+ 67,518
Tuscaloosa	431,711	610,392	663,412	885,361	1,050,792	+ 165,431
Walker	1,903,976	2,365,385	2,583,473	2,845,617	3,062,518	+ 216,901
Winston	28,686	50,841	40,356	40,109	27,076	− 13,033
Other counties and small mines	([b])	7,810	[c] 86,474	76,593	[c] 66,984	− 9,609
Total	10,354,570	11,654,324	11,262,046	11,866,069	13,107,963	+ 1,241,894
Total value	$12,419,666	$14,246,798	$13,480,111	$14,387,721	$17,514,786	+$3,127,065

[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 areas mentioned, derive their names from the rivers which drain them. The Plateau regions include Blount, Lookout, and Sand or Raccoon mountains.

The Coosa basin is a deep syncline forming the southeast margin of the Alabama coal fields and 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 are reported having a thickness of 3 feet or more.

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 quantity of coal in the basin is large.

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 have probably a considerable and possibly 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. Something over one-third of the total production in this district comes from the Pratt seam, and one-fourth comes from the Mary Lee seam. From 8 to 10 other seams furnish the remainder of the production.

The Plateau regions 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.

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 attention was directed to the large iron deposits near the city of Birmingham, and thus the great "boom" of that city and vicinity was inaugurated. 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 reached the maximum of over 13,000,000 tons in 1906.

The record from 1840 is shown in the table on a preceding page, giving the statistical history of coal mining in the United States from the earliest times to the close of 1906.

ALASKA.

Total production in 1906, 5,541 short tons; spot value, $17,974.

Through the cooperation of Messrs. Alfred H. Brooks and George C. Martin, of the division of mineral resources of Alaska, complete returns from the coal producers of that Territory for 1906 have been secured. These show that the production in 1906 amounted to 5,541 short tons, valued at $17,974, as compared with 3,774 tons, valued at $13,250 in 1905. Prior to 1905 the returns from Alaskan producers were very incomplete. In 1904, for instance, the production reported was 694 tons, and in 1903, 747 tons, whereas Mr. Martin states that the total output was at least 2,000 tons, and was probably between 2,500 and 3,000 tons in each of those years.

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 table showing the shipments of coal to Alaska has been prepared by Mr. Martin. From this it appears that the consumption in the Territory is between 135,000 and 140,000 tons, compared with which the local production is insignificant.

Shipments of coal to Alaska, 1903–1906, in short tons.

	12 months ending June 30, 1903.		12 months ending June 30, 1904.		12 months ending June 30, 1905.		12 months ending June 30, 1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Domestic anthracite	22	$276			6	$85	0	0
Domestic bituminous	62,854	255,841	46,709	$193,740	47,314	187,352	75,368	$265,047
Domestic coke	73	288	439	2,251	535	4,281	389	3,676
Canadian bituminous	60,561	216,089	71,290	261,987	[a] 66,397	260,266	[a] 46,463	187,348
Australian bituminous			1,802	4,303				
Foreign bituminous shipped via United States	45	350	3,723	23,904	6,216	29,673	[b] 1,127	6,638
Total	123,555	472,844	123,963	486,185	120,468	481,657	123,347	462,709

[a] Includes a small quantity of Canadian anthracite.
[b] Includes 336 tons of foreign anthracite shipped direct.

The production of coal in the Territory, as reported to the Survey, for the last five years has been as follows:

Production of coal in Alaska since 1902, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	2,212	$19,048	1905	3,774	$13,250
1903	747	6,582	1906	5,541	17,974
1904	694	1,725			

The latest information relating to the coal fields of Alaska is contained in a report by Mr. G. C. Martin, published in Bulletin No. 314 of the United States Geological Survey.

ARKANSAS.

Total production in 1906, 1,864,268 short tons; spot value, $3,000,339.

During 1904 and 1905 conditions affecting the coal-mining industry in Arkansas were far from satisfactory, the large production of petroleum in Texas and the adoption of oil as a locomotive fuel by a number of the railroads in Texas having cut off a goodly portion of the markets of both Arkansas and Indian Territory coal. As a result of these conditions, the production of Arkansas coal declined from 2,229,172 short tons in 1903 to 2,009,451 tons in 1904, and to 1,934,673 tons in 1905. A further decline of 70,405 short tons, or 3.6 per cent, is noted in the returns for 1906, but in this case the decrease was due to other causes. Some tonnage was probably lost through the suspension of work during the spring months when miners and operators were at loggerheads over the wage scale, but according to statements of some of the important producers it is doubtful if the production for the year would have been materially larger had there been no difficulties with the miners. In an ordinary business year the coal mines of Arkansas are usually operated only about two days in the week from the 1st of March to the end of June. In 1906 the business in March was the largest ever done in that month, this being in anticipation of the shut down, but that the suspension did not cause serious inconvenience is shown by the fact that there was little or no business for a month or six weeks after work was resumed on June 18. The operators attribute the unsatisfactory condition partly to the comparatively high cost of mining (due to the pitch of the beds, bad roofs, surplus of water, and explosive gas and dust), and to unfavorable freight rates. The claim is made that Arkansas coal costs more to mine than any other coal in the United States, with the exception of Pennsylvania anthracite. Ninety per cent of the cost is made up of labor, and the higher value shown for Arkansas coal in 1906 was due to the advance necessary because of the increased cost of mining following the suspension in April and May.

In regard to the unfavorable freight rates, the operators claim that railroad companies transport Illinois, Alabama, and Colorado coal, all of which are mined at less cost than Arkansas coal, into markets tributary to the Arkansas fields at much less rate per ton per mile than that assessed on the Arkansas product. The higher cost of coal added to the higher freight rates restricts the market for Arkansas coal to within a small radius, embracing north Texas, north Louisiana, and western Arkansas. The Arkansas coal can not be shipped north of the Indian Territory, because of the competition of the more cheaply mined coal in Kansas. The limited market naturally makes the demand irregular, and the irregularity of employment again reacts in increasing the cost of production. The advance in price placed upon Arkansas coal—and the same conditions obtained to a considerable extent in Indian Territory—resulted in an increased value of the product in both State and Territory in 1906, as compared with the preceding year. In Arkansas the gain in value was $119,601, or 4.2 per cent, while the average price advanced from $1.49 to $1.61, the highest point reached in recent years. The decreased production in Arkansas and Indian Territory was shared by the neighboring States of Kansas and Missouri, so that the decline was general throughout the southwestern district, except in Texas. Kansas and Missouri, however, did not show an increase in value, though prices advanced in both States. Owing to the fact that Texas is not a party to the Southwestern Interstate agreement, the mines in that State were not shut down during the period of suspension in the other States, and production and value both made substantial gains.

There were employed in the coal mines of Arkansas in 1906, 4,298 men, who worked an average of 165 days, against 4,192 men working for 177 days in 1905. The average production per man in 1906 was 433.8 tons, as compared with 461.5 tons per man in 1905. The average tonnage per man per day was 2.63, against 2.60 in 1905. During the last four years, since the coal miners of Arkansas have been unionized, practically all of the mines have been operated on the basis of an 8-hour day.

As previously stated, the production of coal in Arkansas in 1906 was somewhat reduced because of the suspension of work during the spring months, and by unfavorable conditions of mining and marketing the product. Nearly all of the mines in the State were shut down from April 1 until June 18, and in a few cases the suspension lasted beyond the latter date, some of the idleness extending into August. The total number of men idle during the year was 3,828, out of the 4,298 men employed. The average number of days lost for each man was 76, and the total time lost amounted to 291,095 days, which was equivalent to 41 per cent of the time worked during the year. Assuming that the market could have taken all of the coal which it was possible to produce, it appears from this that the total production of the State would have amounted to something over two and a half millions of tons instead of 1,864,268 tons.

According to Mr. Martin Rafter, State mine inspector, 13 men were killed and 31 injured in the coal mines of Arkansas during 1906, as against 8 men killed and 34 injured in 1905. Of the 31 men injured in 1906, 6 were seriously hurt and 25 sustained minor injuries. Six wives were made widows and 14 children left fatherless. Of the 13 fatal accidents, 2 were due to explosions of gas, 4 were caused by windy shots, 6 were due to falls of roof in the rooms, and 1 was caused by the fall of roof in the gangway. Falls of roof in rooms were responsible for 12 of the nonfatal accidents, and falls of roof in the gangway injured 6. Only 1 man was injured by explosion of gas. The death rate per thousand in Arkansas in 1906 was 3.02, as against 1.91 in

1905, and the number of tons of coal mined for each life lost was 143,405 in 1906 against 241,834 tons in the preceding year.

No machines have been used in the production of coal in Arkansas in the last four years.

Only one company reported efforts to improve the quality of the coal by washing. This company has 4 Stewart jigs in operation. It washed 36,309 tons of coal and obtained 27,711 tons of washed coal and 8,598 tons of refuse.

The statistics of production, by counties, for the last two years, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Arkansas in 1905 and 1906, by counties, in short tons.

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.
1905.								
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
1906.								
Franklin and Johnson	468,992	2,955	17,487	489,434	$840,084	$1.72	150	1,388
Logan	23,727	2,051	869	26,647	62,704	2.35	126	138
Pope	30,205	390	4,181	34,776	121,960	3.51	149	250
Sebastian	1,240,166	6,854	31,477	1,278,497	1,921,018	1.50	177	2,454
Scott and Washington	29,152	2,112	3,650	34,914	54,573	1.56	207	68
Total	1,792,242	14,362	57,664	1,864,268	3,000,339	1.61	165	4,298

A statement of the production of coal in Arkansas, by counties, for the last five years, with the increases and decreases in 1906, as compared with 1905, is shown in the following table:

Coal production of Arkansas, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−) in 1906.
Franklin	338,013	394,884	408,494	[b] 634,618	[b] 489,434	− 145,184
Johnson	193,258	198,999	217,667	....	....	....
Logan	21,751	27,286	35,300	26,090	26,647	+ 557
Pope	34,966	48,836	51,488	39,685	34,776	− 4,909
Sebastian	1,325,181	1,528,888	1,234,794	1,189,455	1,278,497	+ 89,042
Other counties and small mines	30,763	[a] 30,279	61,708	44,825	34,914	− 9,911
Total	1,943,932	2,229,172	2,009,451	1,934,673	1,864,268	− 70,405
Total value	$2,539,214	$3,360,831	$3,102,660	$2,880,738	$3,000,339	+$119,601
Average price per ton	$1.31	$1.51	$1.54	$1.49	$1.61	....

[a] Includes also production of Perry County. [b] Includes Johnson County.

According to the United States census for 1840, a small quantity of coal (220 short tons) was mined in Arkansas during that year. With the exception of 9,972 short tons mined in Missouri and 400 tons from Iowa mines, this was the only coal produced west of the Mississippi River in that year, and for the next twenty years these were the only States west of the Mississippi from which any coal production was reported. The industry in Arkansas did not develop rapidly during the earlier years, as the census of 1860 shows a production of only 200 tons and that of 1880 a total of 14,778 short tons. During the last twenty years, except the last three, the production has increased rapidly, there being but three 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.

A statement of the annual production of coal in Arkansas, from 1840 to the close of 1906, will be found in the table on a preceding page, giving the statistics of production of coal from the earliest times.

CALIFORNIA.

Total production in 1906, 25,290 short tons; spot value, $60,710.

The increase in the production of petroleum in California has grown from 4,324,484 barrels in 1900 to 33,098,598 barrels in 1906, and although there was a slight falling off in the production of oil in the State in 1906 as compared with the preceding year, the use of this product as fuel in locomotives and in the manufacturing industries of the State has resulted in the suspension of operations at several of the lignite-producing properties. In consequence the returns for 1906 show a decline from 77,050 short tons in 1905 to 25,290 tons in 1906, a decrease of 51,760 tons or 67.2 per cent. The value exhibits a decrease in even greater proportion—from $382,725 to $60,710—a decrease of $322,015 or 84 per cent; but this apparently large decrease in value was due to the fact that in 1905, as in 1904, the value of the production was seemingly large because the price of the briquetted fuel at Stockton was based on the manufactured product and not on the raw fuel. The plant at Stockton was burned in the fall of 1905 and has not been rebuilt. The value in 1906 is for the raw fuel only, as the briquetting plants of the Western Fuel Company, at Oakland, and of the Pittsburg Coal Mining Company, at Antioch, were operated on screenings from the coal yards in San Francisco and not from raw coal mined in the State.

An additional briquetting plant, which is being erected at Stege by the United States Briquetting Company, has for its object the utilization of peat and heavy California oil. The sample briquettes heretofore made are composed of 50 per cent of peat and 50 per cent of crude oil, the idea being in this way to utilize the petroleum for domestic fuel.

The briquetting plant of the Ajax Coal Company, of San Francisco, which is mentioned in the report for 1905, was destroyed by the earthquake and fire of April, 1906, and has not been rebuilt. The plants at Oakland and Antioch are described in a paper[a] by the writer contributed to Bulletin 316 of the United States Geological Survey.

The largest production of coal in California in recent years was obtained in 1900, when the production amounted to 171,708 tons. It has decreased each year since then with the exception of 1903.

The production of coal and lignite in California during the last five years, with the distribution of the product for consumption, is shown in the following table:

Distribution of the coal product of California, 1902–1906, in short tons.

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.
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
1906	7,040	15,250	3,000	[a] 25,290	60,710	2.40	284	41

[a] In addition to this total there were 6,910 tons of bituminous coal mined in Monterey County, but not shipped during the year. This particular mine is located 25 miles from a railroad, and until transportation facilities are obtained the market for the product is limited to a restricted local demand.

All of the coal produced in California is lignitic or subbituminous in character. There are in California a number of rather widely separated coal areas, the chief of them being the Mount Diablo and Corral Hollow fields in Alameda and Contra Costa counties. Small quantities are mined also in Kern, Monterey, Riverside, and Siskiyou counties. The Corral Hollow field is located in Alameda County, and Mount Diablo is in Contra Costa County. Two other areas which have produced small quantities 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, San Diego, and other counties have produced small quantities 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 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.

The history of the coal-mining industry in California from 1861 to the close of 1906 is exhibited in a table on a preceding page, which shows the production of coal in the United States from the earliest times.

COLORADO.

Total production in 1906, 10,111,218 short tons; spot value, $12,735,616.

With the exception of 1904, Colorado's coal production has increased each year since 1894. The output of 10,111,218 tons in 1906 exceeded any previous record in the history of the State, and compared with that of 1905, when the previous maximum production was recorded, it showed an increase of 1,284,789 short tons, or 14.6 per cent, while the value increased $1,924,638, or 17.8 per cent. The output of 1906 was nearly double that of 1900, and was considerably more than 3 times that of 1896, ten years earlier.

The rapid growth of the coal-mining industry in Colorado in 1905 and 1906 has been due, in large part, to the growing iron industries of the State. The gold and silver smelting companies are also large consumers of coal, and as this and the other Rocky Mountain States are rapidly increasing in population and manufacturing industries the production of coal will continue to increase. Every State in the Rocky Mountain region showed substantial increases in the production of coal in 1906 with the exception of North Dakota. The production of Wyoming, to the north of Colorado, increased 9.5 per cent; that of Utah, to the west, increased 33 per cent; the production of New Mexico, to the south, increased 19 per cent, and that of Montana increased 11.3 per cent. It is probable that some of this increased production in the Rocky Mountain region in 1906 was due to the suspension of operations in the unionized regions to the east during the settlement of the wage scale. Arkansas, Indian Territory, Kansas, and Missouri all showed decreased production, and as a result of this suspension some Rocky Mountain coal found markets, particularly for railroad consumption, which had previously been supplied by these more easterly States. Notwithstanding the prolonged suspension of mining in the Mississippi Valley States, no strikes were reported as having occurred in Colorado during 1906, which was the second year of this rather unusual condition.

Returns to the United States Geological Survey for 1906 show that there were 11,368 men employed in the coal mines of Colorado in 1906 and that they worked for an average of 268 days, as compared with 11,020 men working an average of 255 days in 1905, and of 8,123 men for 261 days in 1904. The average production per man in 1906 was 889.4 tons for the year and 3.32 tons per day, as compared with 801 tons per man per year and 3.14 per man per day in 1905.

Most of the larger mines in the State work on a 10-hour basis, there being 48 mines employing 5,222 men that worked 10 hours, 9 mines working 655 men 9 hours, and 59 mines employing 2,973 men worked 8 hours.

The statistics relating to the use of mining machines in 1906 showed that there were 141 machines employed in the mines of Colorado, and that 1,337,006 tons of coal were undercut by them, as compared with 121 machines and 1,247,687 tons of machine-mined coal in 1905. Of the total number of machines in use in 1906, 80 were of the pick or puncher type, 51 were chain machines, and 10 were long-wall.

Mr. John D. Jones, State inspector of mines, reports that there was a total of 55 accidents during the year, which resulted in the death of 88 men and the injury of 160. Of the injured men, 16 were seriously hurt and 144 suffered accidents of a minor character. Of the 88 fatalities, 15 were due to explosions of gas, 20 men were suffocated by afterdamp following an explosion of dust and gas, 28 resulted from falls of roof in rooms, 16 from falls of roof in gangways and entries, 4 from premature blast, and 5 were due to other causes. There were

40 wives made widows. The number of children left fatherless was not reported. Of the total number of men injured, 57 were hurt from falls of coal, and 48 from falls of rock. Only 11 men were injured as a result of gas or dust explosions. Nine were injured by premature blast, and 35 from other causes. The death rate per 1,000 employees was 7.7, and the number of tons mined for each life lost was 114,900.

The statistics of production in Colorado, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Colorado in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Boulder	963,810	25,398	32,888	....	1,022,096	$1,578,579	$1.54	220	1,147
Delta	....	6,717	95	....	6,812	11,688	1.72	197	14
El Paso	159,105	44,150	7,538	....	210,793	285,433	1.35	278	488
Fremont	632,033	7,661	26,340	....	666,034	1,264,590	1.90	241	1,085
Garfield	190,203	1,800	1,060	....	193,063	239,929	1.24	257	279
Gunnison	475,499	5,438	12,743	89,495	583,175	855,341	1.47	269	565
Huerfano	1,754,800	7,444	41,547	....	1,803,791	2,502,924	1.39	272	2,090
La Plata	156,137	9,711	3,005	4,867	173,720	295,519	1.70	272	254
Las Animas	2,960,686	38,940	102,332	1,666,924	4,768,882	4,856,949	1.02	287	4,727
Mesa	24,008	13,688	....	....	37,696	50,874	1.35	201	53
Routt	....	5,247	50	....	5,297	7,974	1.51	190	8
Weld	67,907	24,478	3,035	....	95,420	147,194	1.54	232	137
Other counties [b]	313,293	9,987	21,482	197,757	542,519	635,507	1.17	255	521
Small mines	....	1,920	....	....	1,920	3,115	1.62	......	....
Total	7,697,481	202,579	252,115	1,959,043	10,111,218	12,735,616	1.26	268	11,368

[a] Adams, Jefferson, Larimer, and Pitkin.
[b] Adams, Archuleta, Jefferson, Larimer, Montezuma, Pitkin, and Rio Blanco.

In the following table is exhibited the total production of the State, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905:

Coal production of Colorado, 1902-1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), in 1906.
Boulder	806,371	803,924	736,824	839,804	1,022,096	+ 182,292
Delta	9,350	13,029	21,683	9,497	6,812	− 2,685
El Paso	218,549	207,797	248,013	188,775	210,793	+ 22,018
Fremont	695,999	633,858	256,200	512,002	666,034	+ 154,032
Garfield	207,262	176,354	198,545	172,563	193,063	+ 20,500
Gunnison	364,874	436,604	494,545	513,317	583,175	+ 69,858
Huerfano	1,189,313	1,319,666	1,187,905	1,426,640	1,803,791	+ 377,151
Jefferson	....	....	129,168	189,235	212,037	+ 22,802
La Plata	155,029	143,637	146,080	168,669	173,720	+ 5,051
Las Animas	3,245,271	3,213,743	2,808,953	4,297,599	4,768,882	+ 471,283
Pitkin	414,244	342,054	269,006	342,804	319,529	− 23,275
Routt	3,180	2,775	5,568	3,643	5,297	+ 1,654
Weld	73,681	94,492	118,862	101,812	95,420	− 6,392
Other counties	18,220	35,669	37,003	60,069	50,569	− 9,500
Total	7,401,343	7,423,602	6,658,355	8,826,429	10,111,218	+ 1,284,789
Total value	$8,397,812	$9,150,943	$8,751,821	$10,810,978	$12,735,616	+$1,924,638

The coal-producing areas of Colorado may be divided into three groups—the Eastern, the Park, and the 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 the 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 coal 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 19 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 Adams, Archuleta, Boulder, Delta, El Paso, Fremont, Garfield, Gunnison, Jefferson, La Plata, Larimer, Mesa, Montezuma, 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 3 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.

The growing demand by the public for information regarding the Western coal fields, and also the need of the Government itself for data upon which to properly classify the coal lands of the public domain, have made it necessary to give more attention to the study of the geology and of the chances for development of these fields than had been done heretofore. Accordingly, during 1906 a large amount of geologic work was done in the States of Colorado, Montana, Wyoming, Utah, and the Territory of New Mexico. In Colorado a survey was made of the western edge of the Durango-Gallup coal field of Colorado and New Mexico from Durango to the southern point of the field near the Zuñi Salt Lake. A survey was also made of the eastern part of the Book Cliffs coal field from Grand River, Colo., to Sunnyside, Utah, where it connected with the work that had been done during the previous year. The survey of the Yampa field, begun in 1905, was continued southward in 1906, and included the Danforth Hills and Grand Hogback as far as Newcastle, on Grand River.

Coal mining as an industry in Colorado began in 1864, a production of 500 short tons being recorded for that year. In 1876 the production reached for the first time a total exceeding 100,000 tons, and six years later, in 1882, had reached the million-ton mark. Since that date the increase has been almost uninterrupted, there being only 3 instances, ten years apart (in 1884, 1894, and 1904), when the production showed a decrease of any importance, and only 4 altogether in thirty-five years. The largest decrease was made in the "hard-times" year of 1894. The coal production of the State exceeded 3,000,000 tons in 1890; ten years later it had grown to over 5,000,000 tons, and it amounted to over 10,000,000 tons in 1906. The record by years will be found in a table on a preceding page, giving the statistical history of coal production in each State from the earliest times to the close of 1906.

GEORGIA.

Total production in 1906, 332,107 short tons; spot value, $424,004.

If the record for the last four years may be taken as an indication of what the future will bring forth, the coal-mining industry of

Georgia is on the decline, for the production has decreased each year since 1903, in which year the maximum output of 416,951 short tons was obtained. Compared with this, the production of 332,107 short tons in 1906 shows a decrease of 84,844 tons, or 20.3 per cent. The decrease from 1905 was 19,884 short tons, or 5.65 per cent, with a decline of $29,844, or 6.6 per cent, in value.

The number of men employed in the coal mines of the State decreased from 801 in 1905 to 737 in 1906, while the average number of days worked increased from 270 to 279. The average production per man during 1906 was 450.6 tons, while the average daily production was 1.62 tons for each employee. The apparently low average of efficiency is explained by the fact that State convicts are employed to a considerable extent under lease, and these in the large majority of cases have for experience as coal miners only the periods of their incarceration. Coal-mining machines are not employed, and little interference by reason of labor troubles is experienced. One plant in the State washes the coal used in coke making, and 106,850 tons of coal were washed in 1906, producing 101,563 tons of washed coal and 5,287 tons of refuse.

The statistics of production for the last five years, with the distribution of the product for consumption, are presented in the following table:

Coal production of Georgia since 1902, in short tons.

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.
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
1906	194,881	850	8,324	128,052	332,107	424,004	1.28	279	737

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, not all of it being 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 State 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. The statistics for each year since 1860 will be found in the statement on a preceding page giving the production of coal by States from the earliest times to the close of 1906.

IDAHO.

Total production in 1906, 5,365 short tons; spot value, $18,538.

There are several somewhat restricted areas in Idaho in which lignite beds occur, but until the last four or five 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 the 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 and 1906 was from the Salmon district, in Lemhi County, 4,380 short tons having been mined there in 1905, and 4,285 tons in 1906.

The production of coal in Idaho for the last five years has been as follows:

Coal production of Idaho, 1902–1906, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	2,030	$5,180	1905	5,782	$16,346
1903	4,250	13,250	1906	5,365	18,538
1904	3,330	12,230			

ILLINOIS.

Total production in 1906, 41,480,104 short tons; spot value, $44,763,062.

During the year 1906 the coal production of Illinois showed an increase over 1905 of 3,045,741 short tons, or 7.9 per cent, with an increase in value of $4,185,470, or 10.3 per cent. In spite of this increase, West Virginia displaced Illinois as second among the coal-producing States, the greater relative increase in West Virginia being due in all probability to the suspension of operations in the other coal-mining States. Under ordinary conditions the increase in Illinois might have been somewhat greater, but taking into consideration the history of the coal production of the State in recent years, the increase in 1906 was a normal one.

In anticipation of the suspension of operations which took place on April 1, the Illinois mines were operated to their fullest capacity for several months prior to that date, and the shortage due to the suspension was, to a great extent, provided for. After operations were resumed in June the intensity of labor among the mine workers was considerably greater than usual. In West Virginia the suspension affected only a small portion of the mines, and these only for about 30 days, while in Illinois practically all of the mines were shut down from April 1 to June 18. In West Virginia there were only 4,101 men (out of a total of 50,960) idle for, as stated, an average of 30 days, while in Illinois 49,792 men out of a total of 61,988 were idle for an average of 58 days. The amount of time lost by these suspensions in West Virginia was only about 1.1 per cent of the total time made, while in Illinois it was about 25 per cent. In the course of the increased work in West Virginia, due to the idleness which prevailed in the other States, much new development work was done, and it seems reasonable to predict that that State will retain the position it took as second in rank in 1906.

Illinois contains more coal-producing counties than any other State in the Union, there being 51 counties which in 1906 produced more than 1,000 tons each. Of these there was three whose output exceeded 4,000,000 tons, namely, St. Clair County, with 4,578,372 tons; Sangamon, with 4,543,849 tons; and Williamson, with 4,417,987 tons. Madison County produced 3,651,296 tons; Macoupin, 3,637,827 tons. and Vermilion, 2,389,285 tons; and Grundy, La Salle, Bureau, Fulton, Marion, and Perry counties each produced over 1,000,000 tons.

The 61,988 men employed in the coal mines of Illinois during 1906 worked an average of 192 days each, as compared with 58,053 men working an average of 201 days in 1905, and 54,685 men for 213 days in 1904. It appears from this that notwithstanding the suspension of operations in the spring of the year, the average working time in 1906 was only 9 days less than that of the preceding year. Considering these figures with the statistics of production, it is seen that the average production by each man in 1906 was 669.2 tons against 662.1 tons in 1905 and 667 tons in 1904. The average daily tonnage per man was 3.49 tons in 1906, 3.29 in 1905, and 3.13 tons in 1904, confirming the statement previously made regarding the increased intensity of labor last year. A part of the increased efficiency in labor was probably due to the growth in the use of machines for undercutting coal. In 1906 there were in the coal mines of Illinois 1,048 machines in use, with a machine-mined product of 11,585,419 short tons, compared with 882 machines and a machine-mined production of 8,697,547 tons in 1905, and with 643 machines and with 7,110,902 short tons won by them in 1904. From this it appears that the increase in the machine-mined tonnage was nearly 3,000,000 tons, equivalent to almost the entire increase in the total production of the State. Of the machines in use in 1906, 874 were of the pick or puncher type, 171 of the chain-breast, and 3 of the long-wall type.

The coal-mine workers of Illinois are probably better organized than those of any other of the bituminous coal-mining States, and by far the larger number of the mines in this State work 8 hours a day. In 1906, out of the total of 61,988 men employed, 60,056 worked 8 hours per day, 610 worked 9 hours, and the mines reporting other working hours were of little importance.

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, 1906, there were 155 fatalities, against 199 in the preceding fiscal year. The total number of men injured in 1906 was 480, against 535 in 1905. Of the total number of men killed during 1906, 103 were married, and there were 333 children left fatherless. There were no explosions of gas which resulted fatally, although 7 men were injured from this cause. Two deaths were due to explosions of a mixture of dust and gas. By far the greater number of deaths and injuries from any one cause were those which resulted from falls of roof, 84 fatalities, or 54 per cent, and 258 injuries, the same percentage, having resulted from this cause. Twelve deaths and 24 injuries resulted from powder explosions, and 57 deaths and 191 injuries were due to miscellaneous causes.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Illinois in 1905 and 1906, by counties, in short tons.

1905.

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.
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
Grundy	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, Greene, Hancock, Jefferson, Kankakee, Macon, Morgan, Schuyler, Washington, and Woodford.

Coal production of Illinois in 1905 and 1906, by counties, in short tons.

1906.

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.
Bureau	1,488,032	47,149	44,904	....	1,580,085	$2,399,498	$1.52	185	4,412
Christian	798,503	89,718	46,231	....	934,452	1,045,449	1.12	172	1,578
Clinton	467,661	14,118	34,017	....	515,796	510,351	.99	146	811
Franklin	530,849	14,927	23,424	....	569,200	607,834	1.07	257	655
Fulton	1,508,594	37,949	32,681	....	1,579,224	1,909,349	1.21	208	2,468
Gallatin	59,430	20,728	2,500	10,073	92,731	93,953	1.01	185	177
Grundy	1,072,922	44,918	44,179	....	1,162,019	1,764,597	1.52	207	3,001
Henry	75,258	67,185	6,745	....	149,188	238,653	1.60	236	293
Jackson	551,937	32,352	61,907	....	646,196	819,174	1.27	156	1,228
Knox	13,086	38,168	400	....	51,654	85,393	1.65	161	138
Lasalle	1,130,149	293,109	44,414	....	1,467,672	2,366,626	1.61	200	3,513
Livingston	220,853	45,077	7,901	....	273,831	408,255	1.49	180	595
Logan	355,121	56,538	23,900	....	435,559	440,058	1.01	176	686
McDonough	32,431	11,143	200	....	43,774	81,262	1.86	178	123
Macoupin	3,415,475	85,827	136,525	....	3,637,827	3,372,863	.93	193	4,615
Madison	3,453,599	98,141	99,556	....	3,651,296	3,283,826	.90	186	4,633
Marion	955,934	48,996	37,936	....	1,042,866	1,077,333	1.03	227	1,289
Marshall	378,685	21,711	18,508	....	418,904	663,842	1.58	223	977
Menard	383,551	30,256	16,164	....	429,971	477,547	1.11	183	741
Mercer	374,154	22,656	15,355	....	412,165	540,804	1.31	201	750
Montgomery	673,259	31,419	15,737	....	720,415	736,011	1.02	192	752
Peoria	757,758	137,607	19,498	....	914,863	1,066,034	1.17	212	1,210
Perry	1,394,176	41,566	73,974	....	1,509,716	1,408,789	.93	197	2,174
Randolph	591,612	27,682	14,976	....	634,270	582,580	.92	186	875
Rock Island	13,900	47,341	1,080	....	62,321	102,333	1.64	178	127
St. Clair	4,150,400	286,926	141,046	....	4,578,372	3,975,717	.87	198	4,958
Saline	944,494	15,863	20,507	....	980.864	997,015	1.02	171	1,385
Sangamon	4,166,324	228,702	148,823	....	4,543,849	4,568,143	1.01	181	6,009
Scott	7,723	4,214	500	....	12,437	21,797	1.75	224	42
Shelby	93,225	42,443	2,589	....	138,257	193,207	1.40	174	269
Stark	9,166	8,420	75	....	17.661	29,372	1.66	200	37
Tazewell	108,691	76,599	4,592	....	189 882	234,123	1.23	186	296
Vermilion	2,108,309	219,967	61,009	....	2,389,285	2,430,586	1.02	193	3,338
Will	129,788	17,792	7,375	....	154,955	247,917	1.60	175	527
Williamson	4,224,650	52,878	140,459	....	4,417,987	4,341,788	.98	190	5,232
Other counties [a] and small mines.	633,994	418,056	68,510	....	1,120,560	1,640,983	1.46	208	2,074
Total	37,273,693	2,778,141	1,418,197	10,073	41,480,104	44,763,062	1.08	192	61,988

[a] Bond, Calhoun, Greene, Hancock, Jefferson, Jersey, Kankakee, McLean, Macon, Morgan, Putnam Schuyler, Warren, Washington, White, and Woodford.

The increase or decrease in each county in 1906, as compared with 1905, and the production of each county during the last five years are shown in the following table.

Coal production of Illinois, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−) 1906.
Bond	100,000	176,342	158,116	126,231	132,325	+ 6,094
Brown	1,230	....	....	....	....	....
Bureau	1,769,642	1,846,642	1,821,867	1,701,255	1,580,085	− 121,170
Calhoun	3,000	5,300	6,500	4,727	5,045	+ 318
Cass	....	1,768	810	....	....	....
Christian	936,036	1,024,392	838,943	879,360	934,452	+ 55,092
Clinton	834,318	920,391	854,719	579,281	515,796	− 63,485
Fulton	953,607	1,105,930	1,247,215	1,529,249	1,579,224	+ 49,975
Gallatin	30,911	72,205	92,908	82,682	92,731	+ 10,049
Greene	6,000	6,639	5,986	4,435	2,206	− 2,229
Grundy	1,414,479	1,392,427	1,334,422	1,310,892	1,162,019	− 148,873
Hamilton	....	1,200	....	....	....	....
Hancock	13,400	7,380	7,923	3,300	4,498	+ 1,198
Henry	138,312	156,870	149,259	146,995	149,188	+ 2,193
Jackson	930,487	913,283	889,607	818,841	646,196	− 172,645
Jefferson	25,090	28,245	32,788	25,925	7,600	− 18,325
Jersey	3,520	....	....	....	1,397	+ 1,397
Johnson	3,850	2,333	700	....	....	....
Kankakee	48,439	74,226	....	700	39,499	+ 38,799
Knox	85,851	105,055	73,806	58,972	51,654	− 7,318
Lasalle	1,846,236	1,882,589	1,542,518	1,772,988	1,467,672	− 305,316
Livingston	395,083	122,773	186,638	284,984	273,831	− 11,153
Logan	268,707	469,578	350,037	445,546	435,559	− 9,987
McDonough	34,636	28,104	26,211	19,496	43,774	+ 24,278
McLean	175,000	198,100	198,513	159,921	145,000	− 14,921
Macon	100,000	110,000	180,851	231,235	292,884	+ 61,649
Macoupin	2,185,325	2,414,499	2,170,292	3,177,484	3,637,827	+ 460,343
Madison	2,374,684	2,950,496	3,341,989	3,434,399	3,651,296	+ 216,897
Marion	922,656	1,095,952	1,010,508	1,009,759	1,042,866	+ 33,107
Marshall	458,186	479,641	467,724	499,672	418,904	− 80,768
Menard	471,958	483,447	463,985	415,266	429,971	+ 14,705
Mercer	640,141	642,746	566,801	532,854	412,165	− 120,689
Montgomery	619,448	458,987	499,218	598,064	720,415	+ 122,351
Morgan	4,780	4,358	4,737	4,565	9,100	+ 4,535
Peoria	852,375	958,982	912,422	897,946	914,863	+ 16,917
Perry	991,344	1,236,368	1,296,962	1,298,572	1,509,716	+ 211,144
Putnam	....	....	....	....	156,928	+ 156,928
Randolph	456,984	535,895	531,465	440,991	634,270	+ 193,279
Rock Island	83,418	69,641	86,219	68,383	62,321	− 6,062
St. Clair	2,822,248	3,464,069	3,417,632	3,329,914	4,578,372	+ 1,248,458
Saline	297,571	433,328	568,670	675,701	980,864	+ 305,163
Sangamon	4,172,722	4,470,962	4,219,199	4,324,263	4,543,849	+ 219,586
Schuyler	18,457	12,927	11,673	2,880	3,090	+ 210
Scott	27,435	24,776	19,409	13,423	12,437	− 986
Shelby	87,112	108,508	129,846	104,216	138,257	+ 34,041
Stark	29,043	43,166	27,657	22,725	17,661	− 5,064
Tazewell	173,018	253,653	194,891	231,373	189,882	− 41,491
Vermilion	2,585,291	2,955,071	2,792,046	2,342,238	2,389,285	+ 47,047
Warren	16,077	14,989	10,784	10,354	9,520	− 834
Washington	56,835	91,766	97,069	87,913	85,812	− 2,101
White	....	....	....	....	8,000	+ 8,000
Will	40,792	49,240	76,538	137,957	154,955	+ 16,998
Williamson	2,325,942	2,881,653	3,395,397	4,167,952	4,417,987	+ 250,035
Woodford	101,567	[a] 123,501	[b] 105,185	[b] 348,707	[b] 717,566	+ 368,859
Small mines	6,130	46,711	56,405	69,777	69,290	− 487
Total	32,939,373	36,957,104	36,475,060	38,434,363	41,480,104	+ 3,045,741
Total value	$33,945,910	$43,196,809	$39,941,993	$40,577,592	$44,763,062	+$4,185,470

[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 southwestern 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 exceed it.

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 work already done by it in cooperation with the United States Geological Survey give promise of soon placing our knowledge of the coals of the State on a more exact basis.

During 1906 the geologic work in the coal fields of Illinois consisted in the starting of a survey of the southern Illinois fields, the field work being completed in the Eldorado and New Haven quadrangles which cover parts of Illinois, Indiana, and Kentucky. The preliminary report on the Saline-Gallatin coal field of Illinois was submitted for publication and is printed in Bulletin No. 316, "Contributions to Economic Geology, 1906."

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 for this 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 are from 5 to 6 feet thick in the northern 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 Crevecoeur, near the site of the present city of Ottawa. Father Hennepin marked the location of the occurrence on the map which illustrates his journal. It is also probable that, outside of anthracite mining in Pennsylvania and the operations in the Richmond basin of Virginia, Illinois holds the record for priority of 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 quantity is 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 geological reports published by the State government. The production of coal in Illinois since 1833 will be found in the table on a preceding page giving the history of coal production in the United States from the earliest times to the close of 1906.

INDIANA.

Total production in 1906, 12,092,560 short tons; spot value, $13,116,261.

Indiana ranks sixth among the coal-producing States, and its production has increased with marked rapidity during the last decade. The output in 1906 was almost exactly double that of 1899, and was more than 3 times that of 1896. The increase in 1906 over 1905, from 11,895,252 short tons to 12,092,560 short tons, was not large comparatively (197,308 tons, or 1.7 per cent), but when the loss of time is considered, due to the suspension of operations at nearly all of the important mines for from two to three months during the settlement of the wage scale, the increase is significant.

Out of the 20,970 men employed in the coal mines of Indiana in 1906 15,875 were idle an average of 63 days, the time lost being equivalent to 27 per cent of the total time worked, so that, other things being equal, the production of coal in Indiana in 1906 would have amounted to over 15,000,000 tons.

The average price per ton at the mines for Indiana coal in 1906 was $1.08, against $1.05 in 1905. The total value increased from $12,492,255 in 1905 to $13,116,261 in 1906, a gain of $624,006, or 5 per cent. The most important increase both in production and value in 1906 was made in Clay County, whose output showed a gain of 319,654 short tons in quantity and of $419,025 in value. Of the total production of the State, 799,891 tons were "Indiana block," and 25,475 tons were classed as cannel.

The statistics of the labor employed in the coal mines of Indiana show that the apparently large increase in the number of men noted in the report for 1905 was wiped out, and that the cause assigned for the reported unusually large number of employees in that year was reasonable. The aggregate number of employees in 1906 was 20,970, who worked an average of 175 days. In 1905 the number of men reported was 25,323 working an average of 151 days, the large number of men and small number of working days being due to an unusually large number of changes in ownership which took place in 1905, because of which certain men were reported twice, but for two different periods, thus reducing the average time but apparently increasing the number of employees. Dividing the total quantity of coal produced in 1906 by the number of men employed, it is found that the average tonnage per man was 576.7, as compared with 469.7 tons in 1905 and with 553.5 tons in 1904. The average production per day per man for the last three years has been 3.3 tons in 1906, 3.11 tons in 1905, and 3.13 tons in 1904.

The same conditions which in 1905 indicated an apparently large number of men employed are probably also responsible for a number of mining machines in excess of those actually in use, some machines being reported twice. In 1905 the number of mining machines in use was reported as 506, against 403 machines in 1904. The reports for 1906 show a total of 471 machines in use, a decrease of 31 in the number reported in 1905. The machine-mined product, however, increased from 4,207,246, or 35.37 per cent of the total production in 1905, to 4,251,740 short tons, or 35.16 per cent, the proportion of the machine-mined product to the total being therefore the same in both years. In 1904 there were 3,613,532 tons of machine-mined coal, or 33.66 per cent of the total product.

The coal-mining industry of Indiana may be said to be operated on an 8-hour basis, 19,842 men out of a total of 20,970 being reported in 1906 as working on 8-hour time. The mines which worked 9 or 10 hours are principally local and unimportant plants.

The statistics of the production of coal in Indiana in 1905 and 1906, by counties, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Indiana in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Clay	990,156	57,740	53,332	1,101,228	$1,486,418	$1.35	193	2,454
Daviess	90,899	41,940	3,146	135,985	178,772	1.31	184	274
Dubois and Martin	200	14,400	100	14,700	19,875	1.35	300	10
Fountain and Warren	75,664	6,754	2,051	84,469	104,342	1.24	209	119
Gibson	123,694	15,350	3,400	142,444	168,354	1.18	203	224
Greene	2,197,906	37,956	71,624	2,307,486	2,474,681	1.72	170	3,938
Knox	284,370	38,464	10,999	333,833	382,253	1.15	184	489
Parke	654,100	13,690	39,237	707,027	969,090	1.37	197	1,347
Perry	9,821	3,228	212	13,261	18,991	1.43	233	33
Pike	462,365	27,100	8,492	497,957	556,184	1.12	180	946
Spencer		19,256		19,256	26,529	1.38	143	63
Sullivan	2,308,103	51,863	55,881	2,415,847	2,551,670	1.06	143	4,515
Vanderburg	152,794	142,264	7,861	302,919	337,594	1.11	243	437
Vermilion	1,314,703	7,202	20,573	1,342,478	1,115,196	.83	164	1,975
Vigo	2,038,472	105,240	53,747	2,197,459	2,268,750	1.03	193	3,589
Warrick	403,506	36,769	7,720	447,995	426,478	.95	166	557
Small mines		28,216		28,216	31,084	1.10		
Total	11,106,753	647,432	338,375	12,092,560	13,116,261	1.08	175	20,970

In the following table is shown the production of coal in Indiana, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905:

Coal production of Indiana, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Clay	1,315,046	1,242,958	960,094	781,574	1,101,228	+ 319,654
Daviess	234,983	183,692	143,877	101,429	135,985	+ 34,556
Dubois	10,094	[a] 8,546	[a] 13,833	[a] 7,200	[a] 14,700	+ 7,500
Fountain	17,099	18,660	41,452	[b] 79,995	[b] 84,469	+ 4,474
Gibson	105,468	81,946	98,257	99,322	142,444	+ 43,122
Greene	1,663,785	2,303,512	2,440,420	2,458,665	2,307,486	− 151,179
Knox	119,225	177,046	173,406	293,480	333,833	+ 40,353
Parke	1,155,457	989,983	924,001	750,314	707,027	− 43,287
Perry	21,577	24,941	26,218	17,018	13,261	− 3,757
Pike	510,017	505,564	408,391	452,396	497,957	+ 45,561
Spencer	16,274	19,948	17,511	16,935	19,256	+ 2,321
Sullivan	1,268,945	1,788,358	2,061,212	2,571,818	2,415,847	− 155,971
Vanderburg	218,112	241,088	258,254	300,112	302,919	+ 2,807
Vermilion	718,102	915,171	1,068,427	1,302,667	1,342,478	+ 39,811
Vigo	1,652,798	1,826,393	1,756,250	2,189,603	2,197,459	+ 7,856
Warren	3,380	5,250	6,545	....	....	....
Warrick	416,062	435,797	416,311	447,576	447,995	+ 419
Small mines	([c])	25,839	27,730	25,148	28,216	+ 3,068
Total	9,446,424	10,794,692	10,842,189	11,895,252	12,092,560	+ 197,308
Total value	$10,399,660	$13,244,817	$12,004,300	$12,492,255	$13,116,261	+$624,006

[a] Includes Martin County. [b] Includes Warren County. [c] Included in county distribution.

The eastern edge of the eastern interior, or central, 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 18 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 very pure, dry, noncoking 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 now mined have a clay floor, and a still larger percentage have 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 about 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 1880 the production had grown to 1,454,327 short tons, and in 1890 it amounted to 3,305,737 tons. In the closing year of the last century the production had nearly doubled again, amounting to 6,484,086 short tons, and this output was again nearly doubled by the tonnage of 1906.

The statistics of production of coal in Indiana since 1840 will be found in the table on a preceding page, giving the statistical history of the coal production of the United States from the earliest time to the close of 1906.

INDIAN TERRITORY.

Total production in 1906, 2,860,200 short tons; spot value, $5,482,366.

The conditions affecting the coal-mining industry of Arkansas and Indian Territory during the last three years have been treated in the discussion of the production of Arkansas and need not be repeated at length in this section. It suffices to say that the statistics of Arkansas, Kansas, Missouri, and Indian Territory, forming what is known as the Southwestern District, all experienced a decreased production in 1906. This decrease was due in part to the suspension of operations which, beginning on April 1, extended into June or July, and in some cases into August, but chiefly to the unfavorable conditions under which the industry in this region is carried on, and which are discussed in connection with the statistics of Arkansas production. For Indian Territory, as for Arkansas, the record of production marked the third successive year in which the output decreased. In 1904 and 1905 the decreased production was due to the heavy production and keen competition with fuel oil in Texas, which cut off important markets for the coals of the region. The demand for coal in 1906 was much better than in either of the two preceding years because of the decline in the production and of the increased price of Texas oil, as is indicated by the fact that while the output in the Territory decreased 64,227 tons, or 2.2 per cent, there was an increase in the value of $337,008, or 6.5 per cent. The average price, which had declined from $1.82 in 1903 and 1904 to $1.76 in 1905, advanced to $1.92 in 1906, this being, as was the case in many other States, the highest figure reached in recent years.

The total number of men employed in the coal mines of Indian Territory in 1906 was 8,251, and of these 7,372 were idle during the period of suspension, which lasted an average of 72 days. The total number of working days lost by reason of the strike was 535,504, which was equivalent to nearly 40 per cent of the total time made. The average number of working days for the 8,251 men employed was 166, against 7,712 men and 188 days in 1905. From this it appears that the average output per man amounted in 1906 to 346.6, against 379.2 in 1905. The average daily production per man was 2.09 in 1906 and 2.02 in 1905. Practically all of the mines were operated on an 8-hour basis and have been so operated since the unionizing of the southwestern district three or four years ago.

The steady decline in the use of mining machinery in the Territory, which was referred to in the report for 1905, continued in 1906. This decrease has been continuous since 1899, when over a quarter of a million tons of coal, or 17 per cent of the total product of the Territory, was undercut by machinery. In 1905 the machine-mined product was only 40,203 tons, or less than 1.4 per cent of the total, and this was further decreased in 1906 to 33,357 tons, or less than 1.2 per cent of the total.

The casualty record for Indian Territory as reported by Mr. William Cameron, Territorial mine inspector, for the fiscal year ending June 30, 1906, shows that there were 92 accidents during the year. Forty-four men were killed and 48 injured. Twenty-six wives were made widows and 51 children left fatherless. The death rate per thousand of employees was 5.33, and the number of tons mined for each life lost was 65,005. Six deaths and injuries to 12 men were caused by explosions of gas, while falls of roof killed 3 men in rooms and injured 7, and killed 4 men and injured 6 in gangways and entries. Explosions of powder claimed more victims than any other cause, 14 deaths and injuries to 6 men being due to this cause. Seventeen deaths were reported as due to other causes not specified.

The statistics of the production of coal in Indian Territory 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 Indian Territory, 1902–1906, in short tons.

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.
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
1906	2,629,731	38,535	122,299	69,635	2,860,200	5,482,366	1.92	166	8,251

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 10 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 quantity of coal was mined in Arkansas as early as 1840 it is probable that some was produced in the Territory earlier than 1880. The maximum production was obtained in 1903, when a total of 3,517,388 tons was mined.

The statistics of production of coal in Indian Territory since 1880 will be found in the table on a preceding page, giving the total production of coal, by States, to the close of 1906.

IOWA.

Total production in 1906, 7,266,224 short tons; spot value, $11,619,455.

Iowa was less affected, comparatively, by the suspension of work in the spring of 1906 than any of the States of the Mississippi Valley region, and it was the only one of these States west of the river whose production in 1906 exceeded that of the preceding year. Iowa has, in fact, shown an uninterrupted period of ten years in each of which its coal production has made some gain over the year before. None of these has been of an exceptional character, but the increases have been normal and regular, indicating a steady and healthy growth in the population and industries of the State. Compared with 1905, when the production amounted to 6,798,609 short tons, valued at $10,586,381, the output in 1906 exhibited an increase of 467,615 short tons, or 6.9 per cent, in quantity, and of $1,033,074, or 9.8 per cent, in value. The average price per ton advanced from $1.56 to $1.60. In the ten years from 1896 the production has increased 3,312,196 tons, or 83.8 per cent.

The number of men employed in the coal mines of Iowa increased from 15,113 in 1905 to 15,260 in 1906, while the average working time inceased from 209 to 224 days. The average production for each man employed in 1906 was 476.2 short tons, against 449.9 in 1905. The average tonnage per day per man was 2.15 in 1905 and 2.13 in 1906.

The use of coal-mining machinery has not made any material progress in this State. During 1906 there were 34 machines used, and 193,666 tons, or less than 3 per cent of the total output, were machine-mined. Of the total number of machines in use 14 were chain-breast, 9 were long-wall, and 11 were puncher shearing machines.

As already stated, there was less interruption to mining operations in Iowa by the suspension of operations in the spring of 1906, pending the adjustment of the wage scale, than in any other State of the interior coal fields. In Iowa 7,969 men, or 52 per cent of the total, were idle an average of 28 days, while in Illinois 80 per cent of the total were idle an average of 58 days, in Indiana 75 per cent were idle an average of 63 days, in Kansas 80 per cent were idle an average of 59 days, and Arkansas, Missouri, and Indian Territory showed proportionate percentages in loss of time. Iowa's mines worked an average of 224 days, while with the exception of Illinois none of the other States mentioned above averaged as many as 190 days. The average time made in Illinois was 192 days.

As in the other coal-mining States in which operations are carried on under agreements with the mine workers' union, the mines of Iowa are for much the greater part worked on the basis of an 8-hour day, 195 mines in 1906 employing 14,869 men, or 95 per cent of the total, having reported 8 hours as the length of the working day. Exceptions to the rule were reported by a few comparatively unimportant operations.

In 1905 Iowa had the lowest death rate of all the coal-producing States, and in 1906 only three States—Missouri, Maryland, and Michigan—showed a better record. The total number of men killed in the coal mines of Iowa was 37, against 24 in 1905. Of the total fatal casualties last year 24 were due to falls of roof in rooms, 3 were due to powder explosions, and 10 to other causes. There were no explosions of gas or dust reported. The death rate per 1,000 was 2.42 and the number of tons mined for each life lost was 196,384. The nonfatal accidents numbered 116.

The statistics of production in Iowa in 1905 and 1906, by counties, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Iowa in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Adams	200	11,488	36	11,724	$27,154	$2.32	150	67
Appanoose	1,039,610	47,842	14,143	1,101,595	2,112,169	1.92	199	3,254
Boone	213,677	14,767	4,666	233,110	436,497	1.87	179	844
Greene	2,400	16,306	1,110	19,816	40,377	2.04	178	62
Guthrie	2,128	9,895	40	12,063	31,307	2.60	140	68
Jasper	353,914	16,193	18,475	388,582	627,653	1.62	224	835
Keokuk	1,000	15,504	640	17,144	32,067	1.87	174	46
Mahaska	551,392	31,167	19,928	602,487	876,041	1.45	229	1,126
Marion	339,445	22,894	10,411	372,750	530,847	1.42	208	640
Monroe	2,369,445	37,458	51,570	2,458,473	3,345,264	1.36	248	3,712
Polk	1,095,573	238,410	35,523	1,369,506	2,363,393	1.73	252	2,793
Taylor	12,255	6,777	20	19,052	40,909	2.15	177	82
Van Buren	9,825	2,209	103	12,137	24,418	2.01	174	39
Wapello	166,757	72,443	4,056	243,256	378,072	1.55	198	578
Wayne	117,850	18,744	100	136,694	260,178	1.90	214	433
Webster	98,118	8,868	2,536	109,522	218,180	1.99	224	323
Other counties[b] and small mines	87,619	62,687	8,007	158,313	274,929	1.74	209	358
Total	6,461,208	633,652	171,364	7,266,224	11,619,455	1.60	224	15,260

[a] Dallas, Jefferson, Lucas, and Page.

[b] Dallas, Jefferson, Lucas, Page, Scott, and Warren.

The production by counties during the last five years, with the increases and decreases in 1906 as compared with 1905, is shown in the following table:

Coal production of Iowa, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Adams	19,751	22,570	12,970	13,071	11,724	− 1,347
Appanoose	900,337	893,021	872,920	884,248	1,101,595	+ 217,347
Boone	254,324	291,321	285,157	292,659	233,110	− 59,549
Dallas	18,845	15,467	13,086	5,000	5,522	+ 522
Davis	3,953	3,160	....	....	....	....
Greene	11,573	14,971	27,704	20,058	19,816	− 242
Jasper	233,440	270,804	258,098	306,164	388,582	+ 82,418
Jefferson	10,610	6,844	9,810	3,379	3,744	+ 365
Keokuk	106,103	62,875	41,512	16,460	17,144	+ 684
Lucas	246,400	295,554	189,895	147,093	97,147	− 49,946
Mahaska	723,567	698,166	675,113	714,945	602,487	− 112,458
Marion	315,425	324,859	314,908	338,812	372,750	+ 33,938
Monroe	1,406,905	1,768,054	1,987,450	2,225,677	2,458,473	+ 232,796
Page	10,070	16,343	18,302	14,013	11,235	− 2,778
Polk	1,023,860	1,032,164	1,130,668	1,210,320	1,369,506	+ 159,186
Scott	10,358	12,653	9,930	6,222	24,778	+ 18,556
Taylor	14,207	16,933	16,273	22,345	19,052	− 3,293
Van Buren	14,816	13,561	8,005	6,192	12,137	+ 5,945
Wapello	340,762	382,398	379,560	303,360	243,256	− 60,104
Warren	20,127	12,760	11,290	9,876	2,850	− 7,026
Wayne	65,374	105,170	98,879	112,549	136,694	+ 24,145
Webster	149,615	138,296	134,538	113,393	109,522	− 3,871
Other counties and small mines	4,344	21,867	23,865	32,773	25,100	− 7,673
Total	5,904,766	6,419,811	6,519,933	6,798,609	7,266,224	+ 467,615
Total value	$8,660,287	$10,563,910	$10,504,406	$10,586,381	$11,619,455	+$1,033,074

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. The production of coal in Iowa since 1840 will be found in the table on a preceding page, giving the history of coal production in the United States from the earliest times to the close of 1906.

KANSAS.

Total production in 1906, 6,024,775 short tons; spot value, $8,979,553.

In 1906, for the first time in ten years, the production of coal in Kansas was less than it had been in the preceding year. From 1896 to 1905 both Kansas and Iowa showed an unbroken series of years of increased production. This was continued for Iowa into 1906, but Kansas, with all of the other Mississippi Valley States west of the river, except Iowa, had a decreased production last year, this decrease being due in each case, partly at least, to the suspension of operations during the spring of the year pending the adjustment of the wage scale. In Kansas the coal-mining industry was also adversely affected by the increased production and use of petroleum and natural gas. The output in Kansas decreased from 6,423,979 short tons in 1905 to 6,024,775 short tons in 1906, a loss of 399,204 short tons, or 6.2 per cent. Prices were advanced somewhat on account of the shortage during the idle weeks of April, May, and June, and the value decreased somewhat less in proportion from $9,350,542 to $8,979,553, a loss of $370,989, or 4 per cent. Except for the time lost by reason of the suspension, provided that the same rate of production had continued, the output of Kansas in 1906 would have amounted to more than 7,000,000 tons, as the time lost during the period of idleness was equivalent to over one-fourth of the actual time made. During 1906 14,355 men were employed in the coal mines of Kansas, of whom 11,827 were idle an average of 59 days. The average time made by the 14,355 men employed was 165 days. In 1905, when the production amounted to 6,423,979 short tons, 11,926 men were employed an average of 212 days. From this it appears that the total tonnage per man in 1906 was 419.7, against 538.7 in 1905, while the production per man per day was the same in both years—2.54 tons. There were two mines in the State in which machines were employed in 1906. The machine-mined product amounted to 30,450 tons, compared with 19,101 tons of machine-mined coal in 1905.

Of the total number of men employed in the coal mines of Kansas in 1906, 12,606, or nearly 90 per cent, were employed in 141 mines, which worked 8 hours per day. Seven mines, employing 94 men, reported working 9 hours a day, and 3 mines, having 399 men, worked 10 hours. There were 8 mines employing 995 men, which reported 7 hours as the length of the working day, the latter probably referring only to the time made by the miners and not including day men.

The statistics of production in 1905 and 1906 are shown in the following tables:

Coal production of Kansas in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Cherokee	1,930,359	38,072	46,676		2,015,107	$2,906,332	$1.44	188	3,702
Crawford	3,227,409	131,776	55,883		3,415,068	4,833,087	1.42	151	8,163
Leavenworth	250,978	76,747	48,950	1,171	377,846	723,491	1.91	216	1,221
Linn	18,810	12,797	1,045		32,652	56,708	1.74	192	146
Osage	117,457	20,012	277		137,746	361,517	2.62	133	956
Other counties [b]	2,200	23,045	10,410		35,655	73,927	2.07	121	167
Small mines		10,701			10,701	24,491	2.29		
Total	5,547,213	313,150	163,241	1,171	6,024,775	8,979,553	1.49	165	14,355

[a] Bourbon, Cloud, Franklin, Jewell, and Labette.
[b] Atchison, Bourbon, Cloud, Franklin, Jewell, and Labette.

The production by counties during the last five years, with the increases and decreases in 1906 compared with those in 1905, is shown in the following table:

Coal production of Kansas, 1902–1906, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Atchison	(a)				(a)	
Cherokee	1,849,896	2,062,897	2,378,624	2,132,589	2,015,107	− 117,482
Cloud	7,524	2,400	3,000	3,000	3,000	
Crawford	2,881,274	3,132,595	3,399,334	3,729,953	3,415,068	− 314,885
Franklin	4,999	4,900	4,740	1,950	2,300	+ 350
Leavenworth	291,681	382,828	333,419	348,322	377,846	+ 29,524
Linn	29,780	47,617	29,657	30,673	32,652	+ 1,979
Osage	192,781	194,727	171,454	157,327	137,746	− 19,581
Other counties and small mines	8,130	12,012	13,079	20,165	41,056	+ 20,891
Total	5,266,065	5,839,976	6,333,307	6,423,979	6,024,775	− 399,204
Total value	$6,862,787	$8,871,953	$9,640,771	$9,350,542	$8,979,553	−$370,989

[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 quantity 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.

Some of the coal beds lie very near the surface, and mining operations are carried on by removing the overburden and stripping the coal. Some of this strip-pit coal is used raw in the smelting of zinc, for which purpose its absolute noncoking qualities make it especially adaptable. This fuel is known locally as "dead coal." An analysis in the chemical laboratory of the United States Geological Survey's fuel-testing plant of the sample submitted to the writer shows the following results:

Analysis of "dead coal" from Cherokee County, Kans.

Moisture	27.51
Volatile matter	25.09
Fixed carbon	42.67
Ash	4.73
Total	100.00
Sulphur	.57

This sample shows a calorific value of 8,248 British thermal units.

The second district of importance is that adjacent to Leavenworth and Atchison, in the northeastern portion of the State, where, at a depth of from 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 the 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, as shown in the table on a preceding page giving the history of coal production in the United States from the earliest times to the close of 1906.

KENTUCKY.

Total production in 1906, 9,653,647 short tons; spot value, $9,809,938.

With the close of 1906 Kentucky, like Iowa, completed a record of ten years of unbroken increase in her production of coal and attained the maximum output in the history of the State. Compared with that of 1905 last year's production showed an increase of 1,221,124 short tons, or 14.5 per cent, with a gain in value of $1,424,706, or 17 per cent. It showed an increase of over 76 per cent, as compared with the production of 1901, five years earlier, and was nearly three times the production of 1896, ten years earlier.

A total of 15,272 men was employed in the coal mines of Kentucky, working an average of 212 days each, against 14,685 men working an average of 200 days in 1905. Owing to the fact that comparatively few of the mines in this State are operated under agreements made with the United Mine Workers of America, the industry was not seriously affected by the general suspension of operations which occurred in the other States during the spring of the year. In Kentucky there were only 1,242 out of the 15,272 men employed that stopped work because of any disaffection, and in two cases these suspensions lasted but one day. In two other cases the mines were idle for a week. The average time lost by the 1,242 men was 36 days, and the total time lost was equivalent to 1.3 per cent of the total time worked, whereas in the States more seriously affected the time lost was from 25 to 35 per cent of the total working time. This fact accounts for the large increase in the production of the State in 1906.

The statistics of the labor employed in the coal mines of Kentucky, taken with the statistics of production, show that there were 632.1 tons of coal produced in 1906 for each man employed as against 574.2 tons in 1905 and 532.2 tons in 1904. The average tonnage per man per day was 2.98 in 1906, 2.87 in 1905, and 2.7 in 1904. In 1903 the average daily production per man was 2.54, and in 1902 it was 2.35. These figures indicate a steady improvement in the productive capacity per employee, due in part, at least, to the growth in the use of undercutting machines, Kentucky being one of the most progressive States in this regard. In 1903 there were 308 mining machines in use; in 1904 there were 453; in 1905, 527, and in 1906, 600. The machine-mined coal produced in these 4 years has been, in 1903, 2,843,805 tons; in 1904, 3,595,513 tons; in 1905, 4,409,054 tons, and in 1906, 5,175,950 tons. A little over 50 per cent of the total product in 1905 and 53.62 in 1906 was machine-mined.

A large proportion—over two-thirds—of the mines in Kentucky are operated on the "open shop" or nonunion basis, and in consequence the eight-hour day is not so generally observed as in some of the other coal-mining States. In 1906, out of a total of 15,272 men, 4,171, or about 27 per cent, worked 8 hours; 4,002, or 26 per cent, worked 9 hours; and 5,941, or 39 per cent, worked 10 hours. Seven mines employing 312 men reported 9½ hours as the working day, and a few operators did not report the hours per day.

The St. Bernard Mining Company, of Earlington, is the only company which reported having installed a washing plant for improving the quality of its product. This company reported having washed 92,612 short tons of coal, which yielded 82,322 tons of washed product and 10,290 tons of refuse.

The accident statistics, as reported by Mr. C. J. Norwood, chief mine inspector of Kentucky, show that in 1906 there were 40 men killed and 139 men injured in the coal mines of the State. The number of wives made widows and of children left fatherless was not reported. Of the total number of deaths 2 were due to explosions of dust, 18 were due to falls of roof in rooms, entries, or gangways, and 1 to explosions of powder.

The statistics of production in 1905 and 1906, by counties, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Kentucky in 1905 and 1906, by counties, in short tons.

1905.

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.
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.

Coal production of Kentucky in 1905 and 1906, by counties, in short tons—Continued.

1906.

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.
Bell	911,430	23,615	17,806	36,257	989,108	$1,122,526	$1.13	212	1,737
Boyd	46,322	2,500			48,822	38,540	.79	235	74
Carter	154,482	3,666	600		158,748	144,899	.91	222	323
Daviess		51,421	1,222		52,643	64,948	1.23	228	84
Hancock	22,600	6,387	58		29,045	34,537	1.19	225	73
Henderson	130,818	59,651	10,538		201,007	222,957	1.11	204	383
Hopkins and Christian	2,019,015	49,728	84,052	92,612	2,245,407	1,884,034	.84	250	2,389
Johnson	86,854	1,936	661		89,451	96,817	1.08	178	285
Knox	532,805	8,730	8,191		549,726	609,001	1.11	184	927
Laurel	388,558	7,540	6,275		402,373	430,069	1.07	211	849
Lee	80,318	1,000	500		81,818	107,617	1.32	204	138
McLean	163,469	2,791	2,165		168,425	157,969	.94	224	217
Morgan	55,206	3,110	920		59,236	135,996	2.30	229	192
Muhlenberg	1,450,651	13,759	27,921		1,492,331	1,371,283	.92	227	2,053
Ohio	672,116	14,697	20,772		707,585	649,226	.92	204	1,053
Pike	298,585	5,225	4,949		308,759	281,082	.91	158	684
Pulaski	176,582	1,878	3,260		181,720	242,254	1.33	185	453
Union	350,802	43,695	14,862	6,654	416,013	453,577	1.09	231	562
Webster	436,148	44,556	20,726		501,430	456,297	.91	206	635
Whitley	748,648	18,795	13,911		781,354	1,075,212	1.38	194	1,787
Other counties [a]	104,092	24,134	7,505		135,731	163,130	1.20	181	374
Small mines		52,915			52,915	67,967	1.28		
Total	8,829,501	441,729	246,894	135,523	9,653,647	9,809,938	1.02	212	15,272

[a] Breathitt, Butler, Clay, Floyd, Greenup, Harlan, Knott, Lawrence, Leslie, Letcher, Menifee, Owsley, Rockcastle, and Wayne.

In the following table is presented a statement of the production of coal in Kentucky, by counties, during the last five years, with the increases and decreases in 1906 as compared with the preceding year:

Coal production of Kentucky, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (—), 1906.
Bell	461,768	392,016	521,662	757,413	989,108	+ 231,695
Boyd	242,021	245,491	69,095	48,304	48,822	+ 518
Breathitt and Lee	60,524	80,301	110,303	126,937	119,168	— 7,769
Butler	12,868	3,600	1,647	18,199	15,735	— 2,464
Carter	281,401	265,226	245,030	145,169	158,748	+ 13,579
Christian, Daviess, and Hancock	125,708	180,544	185,922	199,363	161,753	— 37,610
Greenup		3,167	2,742	1,543	719	— 824
Henderson	158,471	178,871	151,103	175,226	201,007	+ 25,781
Hopkins	1,555,084	1,743,721	1,691,675	2,013,715	2,165,342	+ 151,627
Johnson	126,473	77,100	41,120	57,310	89,451	+ 32,141
Knox	481,819	543,557	577,778	579,386	549,726	— 29,660
Laurel	402,997	392,288	380,667	445,958	402,373	— 43,585
Lawrence	57,387	66,826	69,036	37,481	47,279	+ 9,798
McLean	54,568	127,869	117,616	109,429	168,425	+ 58,996
Muhlenberg	700,700	798,892	934,048	1,050,501	1,492,331	+ 441,830
Ohio	541,226	586,072	514,126	542,327	707,585	+ 165,258
Pulaski	159,497	196,287	197,796	184,319	181,720	— 2,599
Rockcastle	3,660	56,901	139,340	114,356	13,358	— 100,998
Union	315,786	349,625	368,194	382,956	416,013	+ 33,057
Webster	278,042	371,560	298,715	347,817	501,430	+ 153,613
Whitley	687,831	710,747	788,836	793,902	781,354	— 12,548
Other counties and small mines	59,153	167,371	170,031	300,912	442,200	+ 141,288
Total	6,766,984	7,538,032	7,576,482	8,432,523	9,653,647	+ 1,221,124
Total value	$6,666,967	$7,979,342	$7,868,192	$8,385,232	$9,809,938	+$1,424,706

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 the western districts, by counties, during the last five years, with the increases and decreases in 1906. It will be noted that nearly 80 per cent of the increased production in 1905 was in the western district, which shows a gain of 959,070 short tons, compared with an increase of 262,054 short tons in the eastern district.

Coal production of the eastern district of Kentucky, 1902–1906, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Bell	461,768	392,016	521,662	757,413	989,108	+231,695
Boyd	242,021	245,491	69,095	48,304	48,822	+ 518
Breathitt	23,873	32,730	42,355	32,340	37,350	+ 5,010
Carter	281,401	265,226	245,030	145,169	158,748	+ 13,579
Greenup	....	3,167	2,742	1,543	719	− 824
Johnson	126,473	77,100	41,120	57,310	89,451	+ 32,141
Knox	481,819	543,557	577,778	579,386	549,726	− 29,660
Laurel	402,997	392,288	380,667	445,958	402,373	− 43,585
Lawrence	57,387	66,826	69,036	37,481	47,279	+ 9,798
Lee	36,651	47,571	67,948	94,597	81,818	− 12,779
Pulaski	159,497	196,287	197,796	184,319	181,720	− 2,599
Rockcastle	3,660	56,901	139,340	114,356	13,358	−100,998
Whitley	687,831	710,747	788,836	793,902	781,354	− 12,548
Other counties and small mines	40,000	129,065	68,013	214,519	386,825	+172,306
Total	3,005,378	3,158,972	3,211,418	3,506,597	3,768,651	+262,054

Coal production of the western district of Kentucky, 1902–1906, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Butler	12,868	3,600	1,647	18,199	15,735	− 2,464
Christian	87,353	99,226	91,943	89,766	80,065	− 9,701
Daviess	20,518	44,286	44,125	61,780	52,643	− 9,137
Hancock	17,837	37,032	49,854	47,817	29,045	− 18,772
Henderson	158,471	178,871	151,103	175,226	201,007	+ 25,781
Hopkins	1,555,084	1,743,721	1,691,675	2,013,715	2,165,342	+151,627
McLean	54,568	127,869	117,616	109,429	168,425	+ 58,996
Muhlenberg	700,700	798,892	934,048	1,050,501	1,492,331	+441,830
Ohio	541,226	586,072	514,126	542,327	707,585	+165,258
Union	315,786	349,625	368,194	382,956	416,013	+ 33,057
Webster	278,042	371,560	298,715	347,817	501,430	+153,613
Other counties and small mines	19,153	38,306	102,018	86,393	55,375	− 31,018
Total	3,761,606	4,379,060	4,365,064	4,925,926	5,884,996	+959,070

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 Kentucky 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. Up to the close of 1906 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 great bulk of the area of this field (11,180 square miles) 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 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 5 coals, in the southeastern corner of the State is about 5,000 feet thick and carries nearly 50 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 coal field the Jellico and the 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 geological survey of Kentucky. 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 8 counties, including all of the field except its eastern portion and the southern or southwestern edge and a few other places, 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, and the mining is 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 mined 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 beside these three are mined in the district, notably what is supposed to be No. 6 and also No. 5, near Dekoven, in Union County.

During 1906 the work of the geological branch of the United States Geological Survey in Kentucky consisted of the completion of the

Kenova quadrangle and of a reconnaissance study of the Elkhorn coal field. The results of this work are published in Bulletin No. 316.

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 regular 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 table on a preceding page giving the history of coal production in the United States from the earliest times to the close of 1906.

MARYLAND.

Total production in 1906, 5,435,453 short tons; spot value, $6,474,793.

The coal production of Maryland in 1906 exceeded that of 1905 by 326,914 short tons, or 6.4 per cent, and reached the highest figure in the history of the State. Prior to 1906 the maximum output was 5,271,609 short tons, made in 1902, when the anthracite mines of Pennsylvania were idle from the great strike which made that year notable in the annals of coal mining. Compared with 1902, the output in 1906 exhibits an increase of 163,844 short tons, or a little more than 3 per cent. It is not to be expected that the coal production will in the future show any material increases over the present record. The coal-producing area is of comparatively limited extent and confined entirely to Allegany and Garrett counties in the western part of the State, and from this area, estimated at 510 square miles, there has been mined up to the close of 1906 over 142,000,000 short tons. The output has not varied materially in the last ten years, having ranged from a minimum of 4,024,688 in 1900 to a maximum of 5,435,453 tons in 1906, and averaging 4,853,761 short tons during the decade. Hence, on account of the restricted area and the fact that the field is already well developed, it is not probable that any marked increase in production will be obtained. The somewhat unusually large tonnage in 1906 was due to an extra demand created by shortage in other States. This shortage was also responsible for an advance in price of Maryland coal, from $1.14 per ton in 1905 to $1.19 in 1906. The total value increased from $5,831,760 to $6,474,793, a gain of $643,033, or 11 per cent, as compared with an increase of 6.4 per cent in tonnage. The maximum value was obtained in 1903, when the highest average price in recent years was recorded. In that year, with a product of 4,846,165 tons, the value amounted to $7,189,784, an average of $1.48 per ton.

The total number of men employed in the coal mines of Maryland in 1906 was 6,438, who worked an average of 250 days, against 5,948 men working an average of 252 days in 1905. The average production per man was 844.3 tons in 1906 and 858.9 tons in 1905. The daily average production per man was 3.41 tons in 1905 and 3.38 tons in 1906. Practically all of the mines in Maryland are operated 10 hours per day. In 1906, 45 mines, employing 6,358 men, out of a total of 6,438 for the State, reported 10 hours as the working day.

The statistics relating to the use of mining machines show that while the number of machines in use has increased from 38 in 1904 to 42 in 1905 and to 45 in 1906, the quantity of machine-mined coal decreased from 484,373 tons in 1904 to 468,822 tons in 1905 and to 427,450 tons in 1906.

According to Mr. Thomas Murphy, State mine inspector, there were 59 casualties in the coal mines of Maryland in 1906. Of these 7 were fatal and 52 nonfatal. Six wives were made widows and 28 children were left fatherless. The death rate per thousand of employees was 1.09 and the number of tons to each life lost was 776,693.

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, 1902–1906, in short tons.

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.
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
1906	5,331,321	50,306	53,826	5,435,453	6,474,793	1.19	250	6,438

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, a little over 100 years before the date covered by this report. The first shipment recorded by the Cumberland Coal Trade was 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 1906 will be found in the table giving the history of coal production in the United States from the earliest times on a preceding page.

Total shipments from the Cumberland coal fields in Maryland

Year.	Frostburg region.						
	Cumberland and Pennsylvania R. R.				Cumberland Coal and Iron Company's R. R.		
	By Baltimore and Ohio R. R.	By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Total.	By Baltimore and Ohio R. R.	By Chesapeake and Ohio Canal.	Total.
1842	757	....	....	757	951	....	951
1843	3,661	....	....	3,661	6,421	....	6,421
1844	5,156	....	....	5,156	9,734	....	9,734
1845	13,738	....	....	13,738	10,915	....	10,915
1846	11,240	....	....	11,240	18,555	....	18,555
1847	20,615	....	....	20,615	32,325	....	32,325
1848	36,571	....	....	36,571	43,000	....	43,000
1849	63,676	....	....	63,676	78,773	....	78,773
1850	73,783	3,167	....	76,950	119,023	875	119,898
1851	70,893	51,438	....	122,331	103,808	31,540	135,348
1852	128,534	46,357	....	174,891	139,925	19,362	159,287
1853	150,381	84,060	....	234,441	155,278	70,535	225,813
1854	148,953	63,731	....	212,684	173,580	92,114	265,694
1855	93,691	77,095	....	170,786	97,710	100,691	198,401
1856	86,994	80,387	....	167,381	121,945	105,149	227,094
1857	80,743	55,174	....	135,917	88,573	54,000	142,573
1858	48,018	166,712	....	214,730	66,009	87,539	153,548
1859	48,415	211,639	....	260,054	72,423	86,203	158,626
1860	70,669	232,278	....	302,947	80,500	63,600	144,100
1861	23,878	68,303	....	92,181	25,983	29,296	55,279
1862	71,745	75,206	....	146,951	41,096	23,478	64,574
1863	117,796	173,269	....	291,065	111,087	43,523	154,610
1864	287,126	194.120	....	481,246	67,676	64,522	132,198
1865	384,297	285,295	....	669,592	104,651	57,907	162,558
1866	592,938	291,019	....	883,957	52,251	52,159	104,410
1867	623,031	385,249	....	1,008,280	40,106	72,904	113,010
1868	659,115	424,406	....	1,083,521	100,345	57,919	158,264
1869	1,016,777	573,243	....	1,590,020	130,017	78,908	208,925
					2,092,660	1,192,224	3,284,884
					Eckhart Branch R. R.		
1870	909,511	520,196	....	1,429,707	114,404	83,941	198,345
1871	1,247,279	656,085	....	1,903,364	69,864	194,254	264,118
1872	1,283,956	612,537	22,021	1,918,514	26,586	203,666	230,252
1873	1,509,570	641,220	114,589	2,265,379	89,765	137,582	227,347
1874	1,295,804	631,882	67,671	1,995,357	113,670	135,182	248,852
1875	1,095,880	715,673	160,213	1,971,766	52,505	164,165	216,670
1876	939,262	443,435	131,866	1,514,563	15,285	189,005	204,290
1877	755,278	473,646	170,884	1,399,808	63,181	111,350	174,531
1878	823,801	486,038	145,864	1.455,703	99,455	123,166	222,621
1879	933,240	397,009	154,264	1,484,513	141,907	104,238	246,145
1880	1,055,491	471,800	213,446	1,740,737	197,525	131,325	328,850
1881	1,113,263	270,156	153,501	1,536,920	271,570	151,526	423,096
1882	576,701	115,344	91,574	783,619	199,183	76,140	275,323
1883	851,985	302,678	217,065	1,371,728	197,235	141,390	338,625
1884	1,193,780	150,471	199,138	1,543,389	289,884	124,718	414,602
1885	1,091,904	171,460	206,227	1,469,591	289,407	117,829	407,236
1886	1,131,949	115,531	141,520	1,389,000	243,321	113,791	357,112
1887	1,584,114	132,177	176,241	1,892,532	332,798	125,305	458,103
1888	1,660,406	155,216	193,046	2,008,668	374,888	95,191	470,079
1889	1,430,381	26,886	177,152	1,634,419	368,497	26,407	394,904
1890	1,511,418	....	291,704	1,803,122	522,334	....	522,334
1891	1,628,574	9,070	289,232	1,926,876	463,142	39,294	502,436
1892	1,426,994	93,705	214,011	1,734,710	349,207	170,116	519,323
1893	1,332,634	135,409	360,807	1,828,850	341,321	201,947	543,268
1894	1,068,739	95,523	372,205	1,536,467	436,216	208,914	645,130

and West Virginia from 1842 to 1906, inclusive, in long tons.

Frostburg region. Georges Creek and Cumberland R. R. By Chesapeake and Ohio Canal	Frostburg region. Georges Creek and Cumberland R. R. By Pennsylvania R. R.	Frostburg region. Georges Creek and Cumberland R. R. Local and Baltimore and Ohio R. R.	Frostburg region. Georges Creek and Cumberland R. R. Total.	Piedmont region. Georges Creek R. R.	Piedmont region. Hampshire R. R. by Baltimore and Ohio R. R.	Total. Baltimore and Ohio R. R. and local.	Total. Chesapeake and Ohio Canal.	Total. Pennsylvania R. R.	Aggregate.
....	....	....	....	....	....	1,708	....	....	1,708
....	....	....	....	....	....	10,082	....	....	10,082
....	....	....	....	....	....	14,890	....	....	14,890
....	....	....	....	....	....	24,653	....	....	24,653
....	....	....	....	....	....	29,795	....	....	29,795
....	....	....	....	....	....	52,940	....	....	52,940
....	....	....	....	....	....	79,571	....	....	79,571
....	....	....	....	....	....	142,449	....	....	142,449
....	....	....	....	....	....	192,806	4,042	....	196,848
....	....	....	....	....	....	174,701	82,978	....	257,679
....	....	....	....	....	....	268,459	65,719	....	334,178
....	....	....	....	73,725	....	376,219	157,760	....	533,979
....	....	....	....	181,303	....	503,836	155,845	....	659,681
....	....	....	....	227,245	65,570	478,486	183,786	....	662,272
....	....	....	....	269,210	42,765	502,330	204,120	....	706,450
....	....	....	....	252,368	51,628	465,912	116,574	....	582,486
....	....	....	....	218,318	63,060	395,405	254,251	....	649,656
....	....	....	....	257,740	47,934	426,512	297,842	....	724,354
....	....	....	....	289,298	52,564	493,031	295,878	....	788,909
....	....	....	....	85,554	36,660	172,075	97,599	....	269,674
....	....	....	....	69,482	36,627	218,950	98,684	....	317,634
....	....	....	....	266,430	36,240	531,553	216,792	....	748,345
....	....	....	....	....	44,552	399,354	258,642	....	657,996
....	....	....	....	....	71,345	560,293	343,202	....	903,495
....	....	....	....	....	90,964	736,153	343,178	....	1,079,331
....	....	....	....	....	72,532	735,669	458,153	....	1,193,822
....	....	....	....	....	88,658	848,118	482,325	....	1,330,443
....	....	....	....	....	83,724	1,230,518	652,151	....	1,882,669
				2,190,673					
				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
....	....	....	....	....	....	818,459	584,996	170,884	1,574,339
....	....	....	....	....	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

Total shipments from the Cumberland coal fields in Maryland

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.
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)
1906	3,235,501	199,505	430,328	3,865,334	(a)	(a)	(a)
Total	62,667,202	12,988,897	7,033,812	82,689,911	8,609,691	4,219,351	12,829,042

[a] Merged in Cumberland and Pennsylvania Railroad figures.

and West Virginia from 1842 to 1906, inclusive, in long tons—Continued.

Frostburg region.				Piedmont region.		Total.			Aggregate.
Georges Creek and Cumberland R. R.									
By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Local and Baltimore and Ohio R. R.	Total.	Georges Creek R. R.	Hampshire R. R. by Baltimore and Ohio R. R.	Baltimore and Ohio R. R. and local.	Chesapeake and Ohio Canal.	Pennsylvania R. R.	
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	....	5,111,968	175,947	938,769	6,226,684
....	399,327	111,675	[b] 512,162	[c]2,810,541	....	[d]4,995,879	199,505	1,019,272	7,188,037
585,001	14,373,171	4,602,289	19,561,621	29,970,121	1,475,969	104,225,646	19,088,699	28,390,330	[e]152,678,056

[b] Includes 1,160 tons from the Western Maryland Railroad in 1906.
[c] Includes 972,221 tons from the Western Maryland Railroad in 1906.
[d] Includes 213,205 tons used on line of Cumberland and Pennsylvania Railroad and its branches, and at Cumberland and Piedmont; also 361,270 tons used by the Baltimore and Ohio Railroad Company in locomotives, rolling mills, etc.
[e] Includes 973,381 tons from the Western Maryland Railroad in 1906.

MICHIGAN.

Total production in 1906, 1,346,338 short tons; spot value, $2,427,404.

Of the 3,971 men employed in the coal mines of Michigan in 1906, 3,340, or 84 per cent, were idle during the period of suspension of operations following the 1st of April. The average number of days lost by these 3,340 men was 88, and the total time lost was equivalent to about 43 per cent of the total time worked. As a result of this loss of time the coal production of the State decreased from 1,473,211 short tons, valued at $2,512,697, in 1905 to 1,346,338 short tons, worth $2,427,404, in 1906. The decrease in production was 126,873 short tons, or 8.6 per cent, and the value decreased $85,293, or 3.4 per cent. The average price per ton advanced from $1.71 in 1905 to $1.80 in 1906.

The average time made by the 3,971 men in 1906 was 173 days, against an average of 186 days made by 3,696 men in 1905. The average production per man in 1906 was 339 tons, against 398.6 tons in 1905, and the average daily production per man decreased from 2.14 to 1.96.

There were no labor troubles of any kind in the coal mines of Michigan in 1905.

The falling off in the average productive capacity was probably due, in part at least, to a decrease in the quantity of coal won by the use of mining machines. In 1905 there were 106 machines reported as in use in the coal mines of Michigan, while the statistics for 1906 show that there were 110 machines in use. The quantity of machine-mined coal, however, decreased from 432,266 short tons in 1905 to 417,073 tons in 1906. Of the machines in use in 1906, 88 were of the pick or puncher type, 20 undercutting machines, and 2 chain shearing machines.

Mr. W. J. McLeod, commissioner of labor and industrial statistics, reports that in 1906 there were 16 mines in which accidents occurred. The total number of accidents was 33, of which 6 were fatal and 27 nonfatal. The causes of the accidents are not reported to the commissioner, but in the 16 mines where accidents occurred it is stated that due diligence had been observed for the safety of the employees. The death rate per thousand of employees was 1.51, the lowest record with one exception made in any coal-mining State in 1906. The quantity of coal mined for each life lost was 224,398 short tons, a figure exceeded only by Illinois, Maryland, Missouri, Utah, Wyoming, and Pennsylvania (bituminous). No report is made of the men killed who were married, or of the children left fatherless.

The statistics of the production of coal in Michigan by counties during 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Michigan in 1905 and 1906, by counties, in short tons.

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.
1905.								
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
1906.								
Bay	423,697	40,508	17,193	481,398	$860,371	$1.79	172	1,413
Eaton, Jackson, and Shiawassee [a]		28,030	1,435	29,465	63,954	2.17	155	101
Saginaw	766,275	38,000	31,200	835,475	1,503,079	1.80	175	2,457
Total	1,189,972	106,538	49,828	1,346,338	2,427,404	1.80	173	3,971

[a] Including the output of small mines.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Coal production of Michigan, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (–), 1906.
Bay	248,645	325,021	410,634	544,154	481,398	– 62,756
Eaton	8,080	7,393	9,057	4,058	18,507	+ 14,449
Huron	5,400					
Jackson	23,889	23,307	16,860	9,196	8,658	– 538
Saginaw	670,304	1,011,898	906,289	915,803	835,475	– 80,328
Shiawassee	8,400				[a] 2,300	+ 2,300
Total	964,718	1,367,619	1,342,840	1,473,211	1,346,338	–126,873
Total value	$1,653,192	$2,707,527	$2,424,935	$2,512,697	$2,427,404	–$85,293

[a] Including the output of small mines.

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 seven 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 variety. 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 seventy 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 and in 1906 by the suspension previously referred to.

The record of production since 1860 will be found in the table on a preceding page giving the production of coal in the United States from the earliest times to the close of 1906.

MISSOURI.

Total production in 1906, 3,758,008 short tons; spot value, $6,118,733.

Attention has already been called to the fact that owing to the suspension of mining operations in the spring of 1906 production decreased in all of the States contained in the interior coal fields west of the Mississippi River, with the exception of Iowa. Missouri was one of the chief sufferers, the production in this State showing, with one exception, the largest decrease of any of the bituminous coal-producing States. Compared with 1905, the production of coal in Missouri in 1906 shows a decrease of 225,370 short tons, or 5.7 per cent in quantity, and of $172,928, or 2.7 per cent, in value. Owing to the shortage caused by the suspension of mining operations, prices were advanced during a portion of 1906, and the average price for the year increased 5 cents a ton over 1905.

The coal mines of Missouri gave employment in 1906 to 9,557 men, who worked an average of 185 days, as compared with 8,962 men working an average of 194 days in 1905. Considering these figures with the tonnage for the 2 years, it is found that in 1906 the average output for each man employed was 393.2 short tons, against 444.5 tons in 1905. The average daily production per man was 2.29 tons in 1905 and 2.13 tons in 1906. Practically all of the coal-mining business in Missouri is conducted on the basis of an 8-hour day, as 134 mines, employing 8,645 of the 9,557 men in 1906, worked 8 hours. Six mines employing 58 men reported 9 hours as the working day, and 6 mines employing 80 men worked 10 hours.

The use of mining machines for undercutting coal in Missouri is almost entirely restricted to the thin beds where machines of the long-wall type can be used to advantage. In 1906 there were 48 machines in use, and of these 44 were long wall. The machine-mined coal amounted to 419,288 tons, as compared with 375,194 tons in 1905, when 30 machines, of which 28 were long wall, were reported.

The amount of time lost by the miners during the suspension of operations following the shut down on April 1 amounted to 483,790 working days, 6,212 men being idle for an average of 78 days each. The lost time was equivalent to 28 per cent of the total time worked.

Mr. J. W. Marstellar, secretary of the Bureau of Mines, reports, in 1906, 16 fatal and 27 nonfatal accidents. Four of the nonfatal accidents were serious and 23 were of a minor character. Falls of roof were responsible for the greater number of both deaths and injuries, 9 men being killed and 13 injured from this cause in rooms, and 4 killed and 4 injured by falls in gangways and entries. Two were injured by powder explosions. There were no explosions of either gas or dust reported. The death rate per thousand was 1.68, the third lowest reported by any State during the year. The quantity of coal mined for each life lost was 233,221 tons, a rate exceeded only by Illinois, Maryland, Pennsylvania (bituminous), Utah, and Wyoming.

The statistics of production of coal in Missouri, by counties, during 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Missouri in 1905 and 1906, by counties, in short tons.

1905.

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.
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	8,962

[a] Benton, Caldwell, Cass, Clay, Dade, Howard, Johnson, Monroe, Montgomery, Pettis, St. Clair, and Vernon.

Coal production of Missouri in 1905 and 1906, by counties, in short tons—Continued.

1906.

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.
Adair	426,901	5,222	9,912	442,035	$642,471	$1.45	131	1,285
Audrain	23,607	9,622	1,004	34,233	63,097	1.84	239	110
Barton	198,013	14,910	5,700	218,623	306,444	1.40	187	504
Bates	175,065	31,891	3,262	210,218	313,510	1.49	199	483
Boone	10,950	29,302	374	40,626	77,929	1.92	222	127
Callaway	....	41,058	104	41,162	75,596	1.84	251	100
Henry	93,757	20,762	1,160	115,679	197,204	1.70	158	350
Lafayette	628,892	41,106	9,681	679,679	1,277,915	1.88	200	2,062
Linn	74,896	19,281	1,149	95,326	207,346	2.18	204	345
Macon	748,589	7,379	14,316	770,284	1,149,697	1.49	188	1,516
Putnam	100,375	2,949	1,575	104,899	201,771	1.92	199	325
Ralls	17,310	200	....	17,510	31,388	1.79	218	55
Randolph	338,889	24,297	8,200	371,386	498,430	1.34	201	591
Ray	232,860	38,224	5,257	276,341	488,372	1.77	166	961
Other counties [a]	230,763	46,734	9,380	286,877	487,478	1.70	202	743
Small mines	....	53,130	....	53,130	100,085	1.91	....	....
Total	3,300,867	386,067	71,074	3,758,008	6,118,733	1.63	185	9,557

[a] Benton, Caldwell, Chariton, Clay, Dade, Grundy, Howard, Johnson, Livingston, Moniteau, Monroe, Morgan, Pettis, St. Clair, Schuyler, and Vernon.

The statistics of production during the last five years, by counties, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Coal production in Missouri, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−) 1906.
Adair	331,159	526,975	615,607	603,699	442,035	− 161,664
Audrian	26,208	26,835	44,179	53,123	34,233	− 18,890
Barton	200,346	193,816	230,875	241,113	218,623	− 22,490
Bates	354,707	149,963	139,026	167,872	210,218	+ 42,346
Boone	27,006	19,752	37,920	40,786	40,626	− 160
Caldwell	16,000	11,485	15,366	15,000	14,000	− 1,000
Callaway	26,422	25,837	12,058	17,306	41,162	+ 23,856
Grundy	34,936	25,565	15,597	....	7,990	+ 7,990
Henry	98,831	59,710	134,651	125,988	115,679	− 10,309
Jackson	21,000	8,500	4,050	....	....	....
Johnson	5,540	1,458	1,572	1,712	2,383	+ 671
Lafayette	543,801	639,480	682,419	667,023	679,679	+ 12,656
Linn	81,108	66,319	111,095	95,175	95,326	+ 151
Livingston	2,138	4,095	2,959	2,825	2,000	− 825
Macon	1,064,726	1,180,653	914,303	799,513	770,284	− 29,229
Montgomery and Morgan	[a] 4,101	7,583	8,146	....	....	....
Putnam	127,983	112,740	71,266	79,162	104,899	+ 25,737
Ralls	19,372	17,185	16,572	14,557	17,510	+ 2,953
Randolph	424,167	604,240	585,135	491,404	371,386	− 120,018
Ray	235,066	296,922	244,707	236,598	276,341	+ 39,743
Vernon	218,339	181,358	178,006	195,201	140,570	− 54,631
Other counties and small mines	27,198	78,115	102,799	135,321	173,064	+ 37,743
Total	3,890,154	4,238,586	4,168,308	3,983,378	3,758,008	− 225,370
Total value	$5,374,642	$6,834,297	$6,801,751	$6,291,661	$6,118,733	−$172,928

[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 Caboniferous 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, 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, 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 in Missouri began in 1840, the United States census for that year recording a production of 9,972 tons. The statistics of production will be found in the table on a preceding page, giving the production of coal in the United States from the earliest times to the close of 1906.

MONTANA.

Total production in 1906, 1,829,921 short tons; spot value, $3,240,357.

The coal-mining industry in Montana, which had shown comparatively little change from 1895 to 1905, experienced a considerable improvement in 1906, and the production increased from 1,643,832 short tons, valued at $2,823,350, in 1905, to 1,829,921 short tons, valued at $3,240,357, in 1906, a gain of 186,089 tons, or 11.3 per cent, in quantity, and of $417,007, or 14.8 per cent, in value. There were only 6 other States whose production in 1906 showed a greater percentage of increase, and of these, 4—Colorado, New Mexico, Utah, and Washington—were west of the Mississippi River. The other two were Kentucky and West Virginia. All of these, including Montana, were States not seriously affected by the suspension of work on April 1, and the larger rate of increased production in these States was due to the shortage caused by the idleness of from 2 months to 10 weeks in the other coal-mining regions.

The number of men employed in the coal mines of Montana increased from 2,181 in 1905 to 2,394 in 1906; the average number of working days being the same (243) in both years. The average production per man in 1906 was 764.4 short tons against 753.7 tons in

1905, and the average daily production per man was 3.15 tons in 1906, against 3.10 tons in 1905.

Most of the mines in Montana are worked 8 hours a day. In 1906 23 mines, employing 1,290 men, reported 8 hours to the working day; 5 mines, employing 913 men, reported 8 hours for miners and 10 hours for day men. One mine, employing 85 men, worked 9 hours.

The statistics relating to the use of mining machinery show that in 1906 there were 76 machines in use as compared with 58 in 1905 and 57 in 1904. The machine-mined product in 1906 amounted to 974,306 short tons, or over 53 per cent of the total, against 752,665 short tons, or 46 per cent of the total, in 1905 and 482,924 short tons, or 35.5 per cent of the total, in 1904.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Montana in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Carbon	509,798	16,463	30,887		557,148	$998,862	$1.79	219	877
Cascade	986,061	15,066	26,796		1,027,923	1,664,256	1.62	277	971
Chouteau	2,960	9,245	100		12,305	27,602	2.24	245	21
Fe gus	8,000	20,232	950		29,182	88,889	3.05	185	55
Park	25,171	1,026	7,097	69,045	102,339	287,520	2.81	196	345
Other counties [a]	89,301	923	7,897		98,121	165,218	1.68	298	125
Small mines		2,903			2,903	8,010	2.76		
Total	1,621,291	65,858	73,727	69,045	1,829,921	3,240,357	1.77	243	2,394

[a] Deerlodge, Gallatin, and Meagher.

In the following table is presented a statement of the coal production of Montana, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905:

Production of coal in Montana, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Carbon	604,954	589,997	544,976	588,414	557,148	− 31,266
Cascade	761,572	733,064	599,158	826,026	1,027,923	+ 201,897
Chouteau	10,772	9,875	5,764	6,500	12,305	+ 5,805
Fergus	5,200	9,734	19,109	15,228	29.182	+ 13,954
Gallatin	88,000	58,696	109,556	123,006	97,926	− 25,080
Park	89,640	86,044	78,646	81,807	102,339	+ 20,532
Other counties and small mines	685	1,400	1,710	2,851	3,098	+ 247
Total	1,560,823	1,488,810	1,358,919	1,643,832	1,829,921	+ 186,089
Total value	$2,443,447	$2,440,846	$2,194,548	$2,823,350	$3,240,357	+$417,007

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 the northeastern portion 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 is 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, 56.2 per cent of the total production of the State in 1906 was 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 1906.

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 short 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 in 1889. 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 table on a preceding page, giving the production of coal in the United States from the earliest times to the close of 1906.

NEW MEXICO.

Total production in 1906, 1,964,713 short tons, spot value, $2,638,986.

Compared with 1905, when the coal production of New Mexico amounted to 1,649,933 short tons, valued at $2,190,231, the output in 1906 exhibits an increase of 314,780 short tons, or 19.1 per cent, in quantity, and of $448,755, or 20.5 per cent, in value. As was the case in 1905, the county showing the largest increase was Colfax, this county alone increasing its output by 260,412 short tons. It is also worthy of note that of the total increase, 127,396 short tons, or a little over 40 per cent, was in the coal made into coke, this factor having increased from 161,711 short tons in 1905 to 289,107 tons in 1906. All of the coal made into coke is mined in Colfax County. A part of the coal made into coke is washed before being charged into the oven. The quantity of coal washed in 1906 was 160,347 short tons. The washed coal product was 139,728 short tons, while the refuse amounted to 20,619 tons.

The coal mines of New Mexico gave employment in 1906 to 2,070 men, who worked an average of 242 days, against 2,108 men working an average of 234 days in 1905. Most of the mines of the Territory worked 10 hours a day, 16 operators with a total of 1,856 employees having reported 10 hours as the length of working day in 1906. Two mines, employing 24 men, worked 9 hours, and 8 mines, with 78 men, worked 8 hours. The productive capacity of the miners in New Mexico compares favorably with that of miners in any of the coal-producing States. The average daily tonnage per man in New Mexico was 3.92, a figure equaled only by Utah, where the same average was recorded. In 1905 the daily production per man in New Mexico was 3.34, which was exceeded only by Ohio, Pennsylvania (bituminous), Utah, West Virginia, and Wyoming. The total production per man in New Mexico in 1906 was 949.1 tons, which was exceeded only by Utah, with 1,127.6, and Wyoming, with 1,033.7 tons. With the exception of North Dakota all of the Rocky Mountain States, including New Mexico, made high records both in total production and in the average output per man in 1906, this being due to the suspension of work in the mines of those States in which the operations are carried on under agreement with the United Mine Workers of America. This was the only manner in which coal mining in New Mexico was affected by the suspension of operations of last year, there being no strikes or other labor troubles reported in New Mexico during the year.

According to Mr. J. E. Sheridan, Territorial mine inspector, there were 9 fatal accidents in the coal mines of the Territory in 1906. Eight of the fatalities were due to falls of slate or rock, and one man was run over by a mine car. The number of wives made widows or children left fatherless was not reported. The death rate per thousand of employees as 3.82. The number of tons won for each life lost was 199,359. These figures are for the fiscal year ending June 30, 1906, the portion covered by Mr. Sheridan's official report.

The statistics of production, by counties, during 1905 and 1906, with the distribution of the product for consumption, are shown in the following table:

Coal production of New Mexico in 1905 and 1906, by counties, in short tons.

1905.

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.
Colfax	838,518	14,449	17,151	161,711	1,031,829	$1,232,412	$1.19	256	1,087
McKinley	465,175	1,852	13,463		480,490	677,217	1.41	216	633
Other counties [a]	118,436	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.

Coal production of New Mexico in 1905 and 1906, by counties, in short tons—Continued.

1906.

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.
Colfax	962,345	21,057	19,732	289,107	1,292,241	$1,576,636	$1.22	240	1,253
McKinley	542,407	4,984	13,526	....	560,917	807,067	1.44	264	602
Other counties [a]	101,046	7,156	1,448	....	109,650	251,068	2.29	195	215
Small mines	....	1,905	....	....	1,905	4,215	2.21	....	....
Total	1,605,798	35,102	34,706	289,107	1,964,713	2,638,986	1.34	242	2,070

[a] Johnson, Rio Arriba, Sandoval, San Juan, Santa Fe, and Socorro.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1906, as compared with 1905, are shown in the following table:

Coal production of New Mexico, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (—), 1906.
Colfax	346,373	723,786	788,955	1,031,829	1,292,241	+260,412
Lincoln	99,000	97,229	70,964	19,143	....	−19,143
McKinley	432,108	569,362	441,865	480,490	560,917	+80,427
Rio Arriba	47,600	35,500	40,825	31,700	43,600	+11,900
Santa Fe	90,895	75,535	60,090	69,832	3,938	−65,894
Other counties	32,787	40,369	49,626	16,939	64,017	+47,078
Total	1,048,763	1,541,781	1,452,325	1,649,933	1,964,713	+314,780
Total value	$1,500,230	$2,105,785	$1,904,499	$2,190,231	$2,638,986	+$448,755

During 1906 a survey was made of the western edge of the Durango-Gallup coal field of Colorado and New Mexico, from Durango to the southern point of the fields near the Zuni salt lake. The details of this survey are published in Bulletin No. 316 of the United States Geological Survey.

Like 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 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, the Monero-Lumberton, and the 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 initial volume of Mineral Resources of the United States, covering the calendar year 1882. In that year the production was reported as 157,092 tons, about 8 per cent of what it was in 1906, indicating that in twenty-five years the production of New Mexico has increased twelve and a half times. The annual production since 1882 is given in the table on a preceding page showing the production of coal in the United States from the earliest times to the close of 1906.

NORTH CAROLINA.

No coal production was reported from North Carolina in 1906. The output from the Cumnock mines, which had decreased from 23,000 short tons in 1902 to 17,309 tons in 1903, to 7,000 tons in 1904, and to 1,557 tons in 1905, ceased entirely in 1906.

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 geologic age as the Richmond coal basin of Virginia. The two areas are known as the Deep River and the Dan River fields, being named from the two rivers which drain them. The only productive beds in recent years are those in the Deep River district in Chatham and Moore counties.

The production during the five years from 1901 to 1905, inclusive, with the distribution of the product for consumption, will be found in the following table:

Distribution of the coal product of North Carolina, 1901–1905, in short tons.

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.
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 until 1906.

NORTH DAKOTA.

Total production in 1906, 305,689 short tons; spot value, $451,382.

All of the mineral fuel produced in North Dakota is brown lignite, extensive beds of which underlie the greater part of the western half of the State. This lignite is not a high-grade fuel for heating purposes, and until 1896 mining operations were carried on principally by ranchmen who had no other fuel. Since that date, however, the production has been stimulated considerably by reason of an act of legislature, which compelled the use of North Dakota lignite in all of the State buildings and institutions. The wisdom of this legislation is open to question, and may be partly responsible for the fuel famine which caused the distress among the inhabitants of the State during the severe winter of 1906 and 1907. It has been said that lignite burns without heat, and the compulsory use of this fuel among the State institutions may have been responsible for the insufficient stock of coal among the dealers to supply the demands made by the severe weather of last winter.

The production of lignite in North Dakota in 1906 was 11,853 tons, or 3.7 per cent less than that of 1905, while the value increased $26,604, or 6.3 per cent. North Dakota was the only one of the Rocky Mountain States in which the production of 1906 was less than that of 1905. Efforts to improve the quality of the lignite fuel of North Dakota, particularly for domestic purposes, by briquetting have not achieved the success hoped for by the projectors. It is hoped, however, that some method may yet be developed by which this fuel may be utilized more satisfactorily.

The number of men employed in the lignite mines of North Dakota in 1906 was 488, who worked an average of 209 days, as against 626 men working 187 days in 1905. The average production per man was 626.4 tons in 1906 and 507.3 tons in 1905, the daily production per man increasing from 2.71 tons in 1905 to 3 tons in 1906. The number of mining machines in use increased from 9 in 1905 to 11 in 1906, and the machine-mined product increased in about the same proportion in both years, 97,035 tons in 1906 against 97,789 tons in 1905. Most of the mines are operated on the 10-hour basis.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of North Dakota in 1905 and 1906, by counties, in short tons.

1905.

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.
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	56
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.

Coal production of North Dakota in 1905 and 1906, by counties, in short tons—Continued.

1906.

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.
Morton	16,289	6,855	50	23,194	$37,099	$1.60	175	50
Stark	56,535	6,250	1,000	63,785	80,900	1.27	254	74
Ward	38,820	79,704	2,438	120,962	202,402	1.67	201	195
Other counties [a]	78,095	17,784	824	96,703	129,058	1.33	249	169
Small mines	....	1,045	....	1,045	1,923	1.84	....	....
Total	189,739	111,638	4,312	305,689	451,382	1.54	209	488

[a] Burleigh, Emmons, McLean, and Williams.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Coal production of North Dakota, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Burleigh	76,258	104,835	92,970	74,357	83,267	+ 8,910
McLean	3,150	3,925	13,100	15,515	8,005	− 7,510
Morton	18,317	13,500	10,663	26,100	23,194	− 2,906
Stark	35,000	46,764	52,744	49,417	63,785	+ 14,368
Ward	93,786	98,081	87,766	137,542	120,962	− 16,580
Williams	....	8,935	9,185	9,268	4,431	− 4,837
Emmons Mercer	....	....	2,100	4,000	....	− 4,000
Small mines	....	2,605	3,400	1,343	[a] 2,045	+ 702
Total	226,511	278,645	271,928	317,542	305,689	− 11,853
Total value	$325,967	$418,005	$389,052	$424,778	$451,382	+$26,604

[a] Includes Emmons County.

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. The production since 1884 is given in the table on a preceding page showing the production of coal in the United States from the earliest times to the close of 1906.

OHIO.

Total production in 1906, 27,731,640 short tons; spot value, $30,346,580.

Although the time lost by the miners in the suspension of work, beginning on April 1, amounted to more than 30 per cent of the actual time made during the year, the production of coal in Ohio showed a normal increase over that of the preceding year. In Ohio, as in the other States of the competitive district, the operators had anticipated a period of idleness following the termination of the wage agreement on March 31, and for several months prior to that date production was pushed to the full capacity of the mines. This, together with the fact that many of the mines were kept in operation or were closed down a short time only, provided a supply of fuel practically sufficient for the emergency, and with a year of continued prosperity among the manufacturing and transportation interests of Ohio, the production of that State increased from 25,552,950 short tons, valued at $26,486,740, in 1905, to 27,731,640 short tons, valued at $30,346,580, in 1906, a gain of 2,178,690 tons, or 8.5 per cent in quantity, and of $3,859,840, or 14.6 per cent in value.

Of the 29 coal-producing counties in the State, 17 reported increased production in 1906; in 12 the production decreased. The principal increase was in Jefferson County, whose output showed a gain of 1,246,044 short tons, or nearly 40 per cent, following an increase of 853,254 short tons, or about 35 per cent, in 1905 over 1904. Athens County increased 401,626 tons; Belmont, 308,885 tons, and Guernsey, 354,134 tons. Jackson County sustained the heaviest loss, the production decreasing from 1,888,932 short tons to 1,369,800 short tons, a loss of 519,132 tons, or 27.5 per cent.

The number of men employed increased from 43,389 in 1905 to 45,438 in 1906. The average number of working days in 1906 was 167, as compared with 176 in 1905 and 175 in 1904, so that it appears that notwithstanding the time lost during the suspension of operations (averaging 71 days for the 37,636 men affected), the actual time lost as compared with the records made in the two preceding years was not material. It is doubtful if Ohio's production would have shown any more of an increase in 1906 had the mines been operated normally during the year.

As a result of the conditions which obtained, the average production for each man employed increased from 588.9 tons in 1905 to 610.3 tons in 1906, and the average daily production per man increased from 3.35 to 3.65 short tons.

As in the other States where coal mining has been carried on during the last few years under agreement with the miners' union, the mines of Ohio, with only a few exceptions, are operated 8 hours a day. In 1906 there were 461 mines, employing 44,003 men, out of a total for the State of 45,438 men, which operated on the 8-hour basis. Eight mines, employing 174 men, worked 9 hours, and 3 mines, employing 76 men, worked 10 hours. There were 1,185 men whose time was not reported. There were 201 mining firms and companies which reported their mines shut down during the suspension period pending the adjustment of the wage-scale in the spring of 1906. These companies employed 37,636 of the 45,438 men in the coal mines of Ohio. Consequently, over 80 per cent of the mine workers were idle some portion of the year. The time lost was equal to 35 per cent of the total time made, and the average time lost for each man idle was 71 days.

Ohio leads all the other coal-producing States in the percentage of the total product that is mined by the use of machines. The statistics for 1906 show that there were 1,255 machines in use, an increase of 214 as compared with 1905, when 1,041 machines were in use. The machine-mined product increased from 16,888,417 short tons, or 66.1 per cent of the total, in 1905, to 20,004,416 short tons, or 72.14 per cent of the total product, in 1906. In 1904, 57.3 per cent of Ohio's total production was undercut by the use of machines, and in 1903 the percentage of machine-mined coal to the total was 56.39. It would appear that this increased use of machinery for undercutting coal is responsible in large part for the increased efficiency in the productive capacity of the mine workers, the average daily output for each of whom has increased from 3.05 tons in 1903 to 3.2 tons in 1904, 3.35 tons in 1905, and to 3.65 tons in 1906.

The statistics of the accidents in the coal mines of Ohio, as compiled by Mr. George Harrison, State mine inspector, show that while the production in 1906 was considerably larger than in the preceding year, and that there was a corresponding increase in the number of men employed, there was a gratifying decrease in the number of fatal accidents, from 131 in 1905 to 127 in 1906. Fifty-nine per cent of the deaths in 1906, or 75 out of a total of 127, were due to falls of roof, and 4 per cent to falls of coal. Falls of slate, rock, and coal claim more lives than any other of the many dangers to which the coal miner is subjected. Five deaths were due to falls of coal, 12 to being crushed or run over by mine cars and motors, 7 were caused by electric wires, and 3 were electrocutions by shocks from mining machines. Seven deaths were due to premature blasts and to powder explosions. There were only 3 deaths due to explosions of fire damp.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Ohio in 1905 and 1906, by counties, in short tons.

1905.

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.
Athens	3, 532, 268	28, 781	40, 399		3, 601, 448	$3, 543, 297	$0. 99	163	6, 359
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	1, 890, 096	27, 619	13, 302		1, 931, 017	1, 929, 479	1. 00	194	2, 605
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, 419	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, 389

1906.

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.
Athens	3, 892, 410	28, 121	82, 543		4, 003, 074	$4, 334, 369	$1. 08	161	6, 914
Belmont	4, 032, 647	198, 201	36, 017		4, 266, 865	4, 046, 491	. 95	173	6, 490
Carroll	151, 868	38, 535	5, 310		195, 713	237, 544	1. 21	154	483
Columbiana	546, 915	50, 375	10, 127		607, 417	681, 163	1. 12	176	1, 306
Coshocton	334, 398	29, 722	3, 480		367, 600	449, 168	1. 22	181	665
Gallia	41, 205	6, 130	160		47, 495	52, 767	1. 11	214	111
Guernsey	3, 216, 485	11, 542	45, 811		3, 273, 838	3, 157, 251	. 96	190	3, 700
Harrison	263, 494	12, 187	4, 551		280, 232	268, 619	. 91	154	490
Hocking	1, 763, 255	17, 780	12, 077		1, 793, 112	1, 992, 363	1. 11	179	2, 917
Holmes	5, 000	34, 465			39, 465	65, 556	1. 66	194	69
Jackson	1, 256, 084	86, 397	27, 319		1, 369, 800	2, 172, 237	1. 59	174	3, 332
Jefferson	4, 185, 476	266, 746	61, 174	2, 024	4, 515, 420	4, 508, 922	1. 00	164	5, 241
Lawrence	140, 672	36, 073	400		177, 145	240, 040	1. 36	162	484
Mahoning	78, 400	37, 164	2, 425		117, 989	173, 411	1. 47	211	248
Medina	59, 650	12, 674	795		73, 119	99, 636	1. 36	225	159
Meigs	365, 453	60, 177	3, 805		429, 435	467, 518	1. 09	245	686
Muskingum	245, 930	35, 518	900		282, 348	293, 354	1. 04	182	493
Perry	2, 468, 704	48, 138	40, 746		2, 557, 588	2, 841, 113	1. 11	127	5, 532
Scioto	6, 900	1, 200	300		8, 400	12, 036	1. 43	108	48
Stark	431, 554	105, 985	42, 101		579, 640	1, 072, 243	1. 85	143	1, 571
Summit	88, 736	9, 645	5, 835		104, 216	186, 671	1. 79	139	322
Tuscarawas	1, 258, 124	139, 199	16, 428		1, 413, 751	1, 493, 903	1. 06	182	2, 271
Vinton	182, 784	20, 725	7, 475		210, 984	246, 590	1. 17	167	432
Wayne	201, 031	11, 000	3, 000		215, 031	354, 975	1. 65	203	469
Other counties[b] and small mines.	697, 997	94, 651	9, 315		801, 963	898, 640	1. 12	165	1, 005
Total	25, 915, 172	1, 392, 350	422, 094	2, 024	27, 731, 640	30, 346, 580	1. 09	167	45, 438

[a] Morgan, Noble, Portage, Trumbull, and Washington.

[b] Morgan, Noble, and Portage.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Coal production of Ohio, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Athens	3,319,597	3,424,958	3,324,115	3,601,448	4,003,074	+ 401,626
Belmont	1,997,956	2,725,849	3,172,350	3,957,980	4,266,865	+ 308,885
Carroll	225,379	254,440	235,010	227,517	195,713	− 31,804
Columbiana	793,858	907,325	802,667	811,125	607,417	− 203,708
Coshocton	437,784	454,008	340,344	381,752	367,600	− 14,152
Gallia	21,470	48,948	29,642	25,845	47,495	+ 21,650
Guernsey	2,655,610	2,776,829	3,124,702	2,919,704	3,273,838	+ 354,134
Harrison	361,492	259,047	264,519	358,478	280,232	− 78,246
Hocking	2,641,141	2,506,410	2,458,402	1,931,017	1,793,112	− 137,905
Holmes	14,785	41,338	30,528	20,975	39,465	+ 18,490
Jackson	2,412,509	2,411,145	1,936,451	1,888,932	1,369,800	− 519,132
Jefferson	1,812,801	2,479,211	2,416,122	3,269,376	4,515,420	+ 1,246,044
Lawrence	183,369	228,251	183,604	179,546	177,145	− 2,401
Mahoning	127,747	123,206	87,515	116,138	117,989	+ 1,851
Medina	90,718	132,823	98,433	56,646	73,119	+ 16,473
Meigs	339,639	316,888	185,396	349,191	429,435	+ 80,244
Morgan	86,821	93,675	83,800	173,766	223,625	+ 49,859
Muskingum	225,413	281,649	257,498	198,304	282,348	+ 84,044
Perry	2,743,997	2,731,282	2,437,824	2,299,419	2,557,588	+ 258,169
Portage	100,266	109,794	101,050	84,178	96,467	+ 12,289
Stark	1,080,429	910,865	768,113	598,061	579,640	− 18,421
Summit	67,442	42,118	89,985	113,443	104,216	− 9,227
Trumbull	12,030	10,652	12,900	1,875	....	− 1,875
Tuscarawas	1,578,610	1,279,636	1,552,065	1,364,043	1,413,751	+ 49,708
Vinton	92,441	192,069	206,622	226,417	210,984	− 15,433
Washington	3,604	3,600	9,550	1,424	....	− 1,424
Wayne	78,390	69,870	81,369	190,537	215,031	+ 24,494
Noble Scioto	14,596	[a] 8,681	90,963	178,050	401,316	+ 223,266
Small mines	([b])	13,536	18,681	27,763	88,955	+ 61,192
Total	23,519,894	24,838,103	24,400,220	25,552,950	27,731,640	+ 2,178,690
Total value	$26,953,789	$31,932,327	$26,579,738	$26,486,740	$30,346,580	+$3,859,840

[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 this 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, 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 furnace. 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. The production since 1838 is given in the table on a preceding page, showing the production of coal in the United States from the earliest times to the close of 1906.

OREGON.

Total production in 1906, 79,731 short tons; spot value, $212,338.

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 field, in Columbia County; the Lower Nehalem, 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 been developed to the point of production. Another field has been located in the basin of the John Day River, east of the Cascade Range, but little is known concerning it. All of the fields west of the range, with the exception of the Coos Bay, are of limited area, the largest, outside of the Coos Bay, being the Upper Nehalem, which has an area of less than 20 square 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 6 portions—4 basins and 2 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.

Coal production in Oregon during the last two years has been adversely affected by the great increase in the production of petroleum in California and its use for fuel purposes. All of the product from Coos Bay has been shipped by water, principally to San Francisco. The increased use of fuel oil in that city has decreased the consumption of coal to a marked degree, and the effect upon Oregon's production is shown in a decrease from 109,641 short tons in 1905 to 79,731 tons in 1906, a loss of 29,910 tons, or 27.3 per cent. The value declined $70,157, or 24.8 per cent, from $282,495 in 1905 to $212,338 in 1906.

The statistics of production, with the distribution of the product for consumption, for the last five years are shown in the following table:

Distribution of the coal product in Oregon, 1902–1906, in short tons.

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 worked.	Average number of employees.
1902	42,591	11,232	11,825	65,648	$160,075	$2.44	234	265
1903	67,192	9,848	14,104	91,144	221,031	2.43	258	235
1904	79,293	13,968	18,279	111,540	243,588	2.18	284	334
1905	84,258	7,883	17,500	109,641	282,495	2.58	242	316
1906	55,232	7,398	17,101	79,731	212,338	2.66	209	224

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 1895, 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.

PENNSYLVANIA.

Total production in 1906, 200,575,617 short tons; spot value, $262,208,345.

Anthracite: Total production in 1906, 63,645,010 long tons (equivalent to 71,282,411 short tons); spot value, $131,917,694.

Bituminous: Total production in 1906, 129,293,206 short tons; spot value, $130,290,651.

In the combined production of anthracite and bituminous coal in 1906 Pennsylvania exceeded any previous record. The total number of men employed in the coal mines of Pennsylvania in 1906 was 314,454, of whom 162,355 were in the anthracite mines and 152,099 were in the bituminous mines. The anthracite workers averaged

195 days and the bituminous men 231 days. The average production per man in the anthracite mines was 439.1 short tons and in the bituminous mines 850.1 tons. The daily average per man was 2.25 tons of anthracite and 3.68 tons of bituminous. In 1905 the average daily production was 2.18 tons of anthracite and 3.57 tons of bituminous coal.

Mr. James E. Roderick, chief of the department of mines of Pennsylvania, reports that in 1906 there were 557 men killed and 1,212 injured in the anthracite mines and 477 killed and 1,160 injured in the bituminous mines. The number of wives made widows was 314 in the anthracite region and 269 in the bituminous districts. The children left fatherless were, respectively, 728 and 566. The death rate per thousand in the anthracite mines was 3.43 and in the bituminous mines 3.14. In the production of anthracite 127,976 short tons were mined for each life lost and 271,055 tons of bituminous coal were mined for each death. In the anthracite region 43 fatalities were due to explosions of dust and gas, 214 to falls of roof, 28 to explosions of powder, and 171 to other causes inside the mines. One hundred and one fatal accidents occurred outside the mines. In the bituminous region 10 deaths were due to explosions of dust and gas, 305 to falls of roof, 1 to an explosion of powder, and 139 to other causes inside the mines. Twenty-two fatalities occurred outside the mines.

Compared with 1905, when the total production amounted to 196,073,487 short tons, the output last year exhibits an increase of 4,502,130 short tons, or 2.3 per cent in quantity, and of $6,938,838, or 2.7 per cent in value. All of the increase was in the production of bituminous coal, which, in spite of the loss of time in the spring of the year, showed a gain over 1905 of 10,879,569 short tons. Anthracite production, however, lost 5,694,142 long tons, or 6,377,439 short tons, the difference between this gain and loss representing a net increase of 4,502,130 short tons.

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 31 years, from 1876 to 1905 and for 1906. It will be seen from this table that the average production of anthracite during the 5 years from 1901–1905 was 2.59 times the average yearly production from 1876 to 1880, and that the bituminous production for the later period was nearly 7.5 times that of the earlier. The total production of bituminous coal in 1906 was 9.4 times and the anthracite production 2.76 times that of the average production of each, respectively, from 1876 to 1880.

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 bituminous coal, coke, and gas are competing more and more with anthracite in the markets of larger cities and towns. Add to this the constantly increasing cost 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, in 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	272,503,363
1906	71,282,411	342,874,867

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 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 temporarily reinstated Pennsylvania in this respect with almost exactly 50 per cent of the total output of the United States, but the comparatively small net increase of 2.3 per cent in 1906, when the total production increased 5.5 per cent, reduced the State's percentage to 48.4. It is doubtful if Pennsylvania will in the future contribute more than half of the country's total. In 1880 Pennsylvania produced 66 per cent of the entire output of the United States, and although the percentage has shown a decreasing tendency since that time, the average for the last 25 years has been about 53 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, 1880–1906, in short tons.

Year.	Total United States.	Pennsylvania.	Percentage of Pennsylvania to total.	Year.	Total United States	Pennsylvania.	Percentage of Pennsylvania to total.
1880	71,481,570	47,074,975	66	1894	170,741,526	91,833,584	54
1881	85,881,030	54,320,018	63	1895	193,117,530	108,216,565	56
1882	103,285,789	57,254,507	55	1896	191,986,357	103,903,534	54
1883	115,212,125	62,488,190	54	1897	200,223,665	107,029,654	53
1884	119,735,051	62,404,488	52	1898	219,976,267	118,547,777	54
1885	110,957,522	62,137,271	56	1899	253,741,192	134,568,180	53
1886	112,743,403	62,857,210	56	1900	269,684,027	137,210,241	51
1887	129,975,557	70,372,857	54	1901	293,299,816	149,777,613	51
1888	148,659,402	77,719,624	52	1902	301,590,439	139,947,962	46
1889	141,229,514	81,719,059	58	1903	357,356,416	177,724,246	49.7
1890	157,770,963	88,770,814	56	1904	351,816,398	171,094,996	49
1891	168,566,668	93,453,921	55	1905	392,722,635	196,073,487	49.9
1892	179,329,071	99,167,080	55	1906	414,157,278	200,575,617	48.4
1893	182,352,774	98,038,267	54				

PENNSYLVANIA ANTHRACITE.

By William W. Ruley.

Compared with the exceptionally large tonnage of 1905, the production and consumption of anthracite in the year 1906 showed a material decrease. This falling off in the tonnage is, however, easily accounted for. As noted in the report for 1905, the weather conditions during the winter of 1904–5 were such as to drain heavily on the accumulated stocks of anthracite, and the demand during the first three months of 1905 was especially large. The depleted stocks naturally stimulated production, and to this was added the fear of a strike at the termination of the three years' agreement ending April 1, 1906.

The winter of 1905–6 was exceptionally mild, and the large stocks which had accumulated were not drawn upon heavily, so that the 1st of April, 1906, found a large stock of coal in first hands as well as in the cellars of consumers. It was the general opinion of the trade that if a strike of some length should not occur the unconsumed stocks would act as a drag on the market for the entire year and that there was little likelihood of a satisfactory market until the cold weather should stimulate the demand. This seemed at the time to be a reasonable diagnosis of the conditions and prospects of the anthracite trade, but the actual results were surprising and at the same time satisfactory.

The suspension of mining, beginning April 1 and lasting until May 16, resulted for the time being in a loss of about 7,500,000 tons, based upon a monthly production of 5,000,000 tons. Part of this loss had been anticipated by the increased production during the first three months of 1906, in the expectation of a strike, with the result that at the end of May the shipments were only about one month's production less than for the corresponding period of 1905, although the suspension lasted six weeks. During the remainder of the year the shipments about averaged those of 1905, there being a net loss of only 548,444 tons from June 1, 1906, as compared with the corresponding period of 1905.

These comments may be best illustrated by a comparison of the monthly shipments during the two years in question.

Monthly shipments of anthracite coal, 1905 and 1906, in long tons.

Month.	1905.	1906.	Increase or decrease.
January	4,408,578	5,458,084	Inc. 1,049,506
February	3,922,601	4,712,099	Inc. 789,498
March	5,258,567	5,797,167	Inc. 538,600
April	5,278,041	488,203	Dec. 4,789,838
May	6,005,158	3,254,230	Dec. 2,750,928
June	5,844,052	5,676,018	Dec. 168,034
July	4,546,743	4,981,448	Inc. 434,705
August	5,041,838	5,400,511	Inc. 358,673
September	5,082,232	4,527,886	Dec. 554,346
October	5,205,694	5,384,768	Inc. 179,074
November	5,421,584	5,182,153	Dec. 239,431
December	5,395,113	4,836,028	Dec. 559,085
Total	61,410,201	55,698,595	Dec. 5,711,606

The following extract from the report for the year 1905 indicates what might have been reasonably expected for 1906:

An investigation made among the retailers in the large eastern cities—Boston, New York, Philadelphia, and Baltimore—indicates that the unsold stocks in dealers' yards at the close of December, 1905, were about 25 per cent greater than on December 31, 1904, and that the coal burned by consumers was correspondingly less; that is, the average householder had on hand more coal than usual at this time of year, and, instead of being compelled to renew his stock, would probably be able to do without any further purchasing of coal until well along in spring. In fact, the general expression from the retailers was to the effect that there had been unusually little restocking, which they attributed to the mild weather and the comparatively large quantities of coal taken by their customers in the fall.

This review is not intended to indicate abnormal or unsound conditions in the anthracite trade, but simply to point out the conditions governing the business of 1905 and their probable effects on the current year's trade.

In view of this reported condition at the close of 1905 the results during the year 1906 should be regarded as much better than had been anticipated.

In the report for 1905 the question of the distribution and consumption of anthracite was discussed at some length, and the reader is referred to the pages of that report for the statistics and the inferences to be drawn therefrom.

The general conclusions reached were to the effect that the anthracite consuming territory was a comparatively circumscribed one, being practically confined to the States along the Atlantic seaboard, but that in this territory the consumption of anthracite had kept pace relatively with the increase of population, although it had not increased to the same extent as the consumption of bituminous.

The production for the year 1905 was the largest on record, amounting to 69,339,152 long tons. Of this, 61,654,432 tons (including 244,231 tons from Sullivan County) 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 1906 this production decreased 5,694,142 tons—to 63,645,010 tons—of which 55,986,425 tons (including 287,830 tons from Sullivan County) were shipped to market, 1,369,094 tons were sold to the local trade, and 6,289,491 tons were used at the mines for steam and heat. In connection with this total product and the quantity shipped, it should be noted that 3,846,501 long tons were reclaimed from the culm banks. This amount is relatively and actually larger than in any previous year. Nearly all of it is, of course, 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 1906, inclusive, compared with the total shipments:

Shipments of anthracite from washeries and total shipments, 1890–1906, in 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	2,644,045	61,410,201	4.31
1906	3,846,501	55,698,595	6.91

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 be seen from the following table, which includes washery coal:

Shipments of anthracite, according to sizes, 1890–1906, in 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
1906	32,894,124	59.1	22,804,471	40.9	55,698,595

In this table, which shows separately from 1890 to 1906, inclusive, both 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 40.9 per cent in 1906. This increase can not be altogether accounted for by the increase in the washery product, and it is probable that the two main contributing causes are, first, that many of the seams of coal now mined are of an inferior quality and are therefore producing a greater proportion of small-sized coal in their breaking down and preparation, and, second, that the present limited demand for lump coal makes it necessary to break this size down, resulting in the production of a corresponding quantity of small sizes in the operation.

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, 1902–1906.

Year.	Quantity (long tons).	Value.	Average price per ton.	Average number of men employed.	Average number of days worked.
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
1906	63,645,010	131,917,694	2.30	162,355	195

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 not marketable.

In the following table 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 1905 and 1906, by counties, in long tons.

1905.

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

1906.

County.	Shipments.	Sold to local trade and employees.	Used at mines for steam and heat.	Total.
Susquehanna	456,967	8,542	36,369	501,878
Lackawanna	15,015,345	370,577	1,141,797	16,527,719
Luzerne	20,636,738	550,661	2,259,890	23,447,289
Carbon	1,744,229	64,164	214,130	2,022,523
Schuylkill	12,512,308	229,125	1,722,600	14,464,033
Columbia	736,816	14,548	107,939	859,303
Sullivan	287,830	4,548	27,825	320,203
Northumberland	4,143,877	106,361	595,818	4,846,056
Dauphin	452,315	20,568	183,123	656,006
Total	55,986,425	1,369,094	6,289,491	63,645,010

In order to continue the record of anthracite shipments from the earliest date to the close of 1906, 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, nor the shipments from the Sullivan County mines.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1906, in 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
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
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

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1906, in long tons—Continued.

Year.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.
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
1906	16,011,285	28.75	7,046,617	12.65	32,640,693	58.60	55,698,595
Total	484,512,816	32.50	241,207,379	16.18	765,026,113	51.32	1,490,746,308

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	
	Panther Creek	
Southern	East Schuylkill	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.[a]
New York, Susquehanna and Western Railroad Company.[b]

PENNSYLVANIA BITUMINOUS COAL.

Total production in 1906, 129,293,206 short tons; spot value, $130,290,651.

In the production of bituminous coal alone, Pennsylvania far outranks any of the other coal-producing States, the output in 1906 being nearly three times that of West Virginia, which was the second coal-producing State, and exceeding that of West Virginia, Illinois, Ohio, and Alabama combined. Compared with 1905, which was in itself a record-breaking year, the production of bituminous coal in Pennsylvania shows an increase of 10,879,569 tons, or 9.2 per cent, in quantity, and of $16,900,144, or 14.9 per cent, in value. As in 1905, the two counties of Fayette and Westmoreland, which embrace the Connellsville coking district, were responsible for a large part of the gain in production, their combined increase amounting to 7,368,156 tons, or nearly 70 per cent of the total. The production of Allegheny County increased 3,160,417 tons, and that of Washington County 2,105,354 tons. These and some other less important increases were in part offset by losses in some of the other counties. The largest decreases were sustained by Clearfield County, whose production decreased 1,303,560 short tons, and Jefferson County, whose output decreased 1,233,790 tons. The combined production of Fayette and Westmoreland counties in 1906 amounted to 54,617,871 short tons, an amount larger by over 11,000,000 tons than the total production of West Virginia, and nearly twice as large as that of Ohio. Each of these counties produced over 27,000,000 tons, Westmoreland having a slight advantage in tonnage, while Fayette took the honor in respect to value. Of the 25 coal-producing counties in the State, 16 reported increased production in 1906 and 9 showed decreases.

Of the total production in 1906, 54,146, 314 tons, or 41.88 per cent, were undercut by machines. The total number of machines reported was 4,515, of which 3,103 were of the pick or puncher type, 1,393 were chain, and 19 were long-wall machines. In 1905 there were 4,254 machines in use, and the machine-mined product was 49,335,660 short tons, or 41.7 per cent.

The total number of men employed in the bituminous coal mines of Pennsylvania in 1906 was 152,099, who worked an average of 231

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[a] Part of Lehigh Valley system. [b] Part of Erie system.

days, against 143,629 men working the same number of days in 1905. The average production per man was 850.1 tons for the year and 3.68 tons per day, against 824.4 tons and 3.57 tons, respectively, in 1905.

The majority of the bituminous mines in Pennsylvania are operated on the basis of an 8-hour day. In 1906, 731 mines, employing 89,801 men, worked 8 hours; 233 mines, employing 25,695 men, worked 9 hours; and 190 mines, employing 30,895 men, worked 10 hours. A few mines reported less than 8 hours and a few more reported "8 to 9," "8 to 10," and "9 to 10" hours.

The time lost by the bituminous coal miners during the eleven weeks' suspension of work, from April 1 to June 18, and by other strikes during the year, was equivalent to 3,941,835 working days, 59,593 men being idle for an average of 66 days each. The number of men idle represented 39 per cent of the total bituminous mine workers, and the aggregate time lost was equal to 11 per cent of the total time made by the 152,099 men employed. To designate this period of idleness as "time lost" is probably a misapplied figure of speech, for the average time made by the bituminous mine workers in 1906—231 days—was the same as that recorded in 1905, when the loss of time due to labor disaffections was a negligible factor. It is doubtful if the production of bituminous coal in Pennsylvania in 1906 would have been much larger, if any at all, had mining operations been carried on uninterruptedly during the year, for in anticipation of the suspension, production had been pushed to the utmost for several months prior to April 1 and stocks were accumulated, which to a great extent tided over the emergency, and the shortage which occurred was made up by a greater intensity of labor when operations were resumed in June.

The casualty record among the bituminous mine workers, as reported by Mr. James E. Roderick, chief of the department of mines at Harrisburg, shows that in 1906 there were 477 men killed and 1,160 injured, as compared with 479 men killed and 1,076 injured in 1905. Of the men killed in 1906, 269 were married, and they left fatherless a total of 566 children. The death rate per thousand in 1906 was 3.14 and the number of tons mined for each life lost was 271,055, against a death rate of 3.33 and 247,210 tons for each death in 1905. Of the total deaths, only 10 were due to dust of gas explosions, while a total of 305 fell victims to falls of roof either in rooms or gangways.

The statistics of production, by counties, during 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Bituminous coal production of Pennsylvania in 1905 and 1906, by counties, in short tons.

1905.

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.
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	86,018,241	2,236,728	2 232,386	27,926,282	118,413,637	113,390,507	.96	231	143,629

1906.

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.
Allegheny	16,190,981	389,151	242,895	....	16,823,027	$17,288,960	$1.03	236	19,754
Armstrong	2,433,082	51,182	81,900	8,594	2,574,758	2,488,887	.97	230	3,891
Beaver	48,415	31,525	1,591	....	81,531	110,091	1.35	214	180
Bedford	561,866	7,249	10,129	155,611	734,855	744,011	1.01	175	1,515
Blair	134,540	184,735	4,544	78,619	402,438	451,692	1.12	244	624
Butler	784,939	7,101	11,459	....	803,499	805,698	1.00	220	1,326
Cambria	10,758,269	227,938	247,454	1,205,491	12,439,152	13,334,190	1.07	203	19,902
Center	884,115	8,468	1,849	1,002	895.434	842,076	.94	145	1,766
Clarion	679,980	21,969	17,599	....	719,548	697,866	.97	159	1,569
Clearfield	5,484,154	69,582	138,595	252,414	5,944,745	5,746,030	.97	170	11,556
Elk	864,581	5,194	17,258	57,334	944,367	944,682	1.00	161	2,119
Fayette	7,638,901	277,991	519,098	18,608,461	27,044,451	27,141,727	1.00	269	21,239
Huntingdon	613,334	7,044	9,777	....	630,155	697,543	1.11	252	1,028
Indiana	4,317,122	27,957	86,289	226,089	4,657,457	4,292,656	.92	211	7,179
Jefferson	3,873,829	17,754	103,014	1,165,598	5,160,195	4,608,049	.89	189	6,795
Lawrence	221,673	24,510	11,533	....	257,716	304,882	1.18	237	450
Mercer	805,869	5,289	31,490	....	842,648	914,019	1.08	222	1,410
Somerset	6,417,721	32,113	183,050	41,307	6,674,191	7,237,817	1.08	248	8,529
Tioga	785,849	34,702	6,374	....	826,925	1,230,072	1.49	176	2,106
Washington	12,174,377	66.726	284,431	188,871	12,714,405	12,929,442	1.02	243	13,539
Westmoreland	17,771,320	244.390	551,243	9,006,467	27,573,420	26,828,203	.97	278	24,768
Other counties [a] and small mines	459,887	49,319	8,747	30,336	548,289	652,058	1.19	216	854
Total	93,904,804	1,791,889	2,570,319	31,026,194	129.293,206	130,290,651	1.00	231	152,099

[a] Cameron, Clinton, Greene, and Lycoming.

The increase or decrease in each county in 1906 as compared with 1905 is shown in the following table, which exhibits also the production, by counties, during the last five years:

Bituminous coal production of Pennsylvania, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Allegheny	11,919,569	12,689,225	12,291,261	13,662,610	16,823,027	+ 3,160,417
Armstrong	1,793,179	1,920,584	1,996,661	2,497,314	2,574,758	+ 77,444
Beaver	225,162	180,102	67,923	82,676	81,531	− 1,145
Bedford	797,248	926,334	54[illegible],850	752,715	734,855	− 17,860
Blair	338,204	309,736	244,932	348,749	402,438	+ 53,689
Butler	454,166	649,033	497,316	550,589	803,499	+ 252,910
Cambria	10,561,835	10,942,496	10,845,560	12,600,891	12,439,152	− 161,739
Center	1,000,598	759,458	712,036	810,441	895,434	+ 84,993
Clarion	458,221	531,630	551,532	714,478	719,548	+ 5,070
Clearfield	7,334,785	7,462,682	5,746,870	7,248,305	5,944,745	− 1,303,560
Clinton	365,732	403,543	341,967	296,988	233,674	− 63,314
Elk	756,182	1,339,281	1,129,231	1,249,337	944,367	− 304,970
Fayette	18,988,058	19,613,161	19,231,011	24,250,989	27,044,451	+ 2,793,462
Greene	25,550	153,000	80,646	105,000	144,251	+ 39,251
Huntingdon	460,485	500,647	487,223	559,039	630,155	+ 71,116
Indiana	1,655,281	2,043,140	2,683,951	4,477,431	4,657,457	+ 180,026
Jefferson	6,083,494	6,474,764	6,043,564	6,393,985	5,160,195	− 1,233,790
Lawrence	212,445	232,992	182,662	267,470	257,716	− 9,754
Lycoming	112,820	57,030	78,837	33,844	44,425	+ 10,581
Mercer	628,713	704,747	619,648	707,964	842,648	+ 134,684
Somerset	5,911,326	5,957,751	5,317,161	6,412,672	6,674,191	+ 261,519
Tioga	1,149,849	905,688	616,828	706,723	826,925	+ 120,202
Washington	8,529,954	9,216,267	8,900,254	10,609,051	12,714,405	+ 2,105,354
Westmoreland	18,811,511	19,127,904	18,688,974	22,998,726	27,573,420	+ 4,574,694
Small mines	(a)	[b] 15,983	[b] 41,389	[b] 75,650	[b] 125,939	+ 50,289
Total	98,574,367	103,117,178	97,938,287	118,413,637	129,293,206	+ 10,879,569
Total value	$106,032,460	$121,752,759	$94,428,219	$113,390,507	$130,290,651	+$16,900,144

[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 6 or more of these troughs, and they lie at successively lower levels in going toward the 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; 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 Pennsylvanian 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 the 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 7 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 of 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 the 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 11 of the counties. The Middle and the 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 forth 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 the territory this seam is either worthless or of too low 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 6 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. Although not of as high a grade as the best of the Allegheny coals to the east, and although 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 southwestern 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 occurs 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.

During 1906 detailed areal and economic surveys of the Johnstown, Clarion, and Sewickley quadrangles in Pennsylvania were nearly or quite completed. Additional work was done on the Punxsutawney, Curwensville, and Houtzdale quadrangles. At the end of the year manuscripts for the folios and economic bulletins on the Newcastle and Johnstown quadrangles of Pennsylvania were nearing completion.

Folios and economic bulletins are in preparation on the Punxsutawney, Curwensville, Houtzdale, Barnesboro, and Patton quadrangles of Pennsylvania, and folios on the Claysville, Burgettstown, Sewickley, and Clarion quadrangles have been started.

The work in Pennsylvania was done by the United States Geological Survey in cooperation with the State.

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 table on a preceding page, has been estimated from the best information obtainable. Since 1871 the records are official. The total production of bituminous coal, as shown by the above-mentioned table, has amounted to 1,695,926,076 short tons. The anthracite production from 1814 to 1906 amounted to 1,845,906,009 short tons, showing that the total production of the State has been nearly evenly divided between the two grades.

TENNESSEE.

Total production in 1906, 6,259,275 short tons; spot value, $7,667,415.

The coal production of Tennessee in 1906 was the largest in the history of the State. As compared with 1905, which was a year of unprecedented activity and of maximum production up to that time, the output in 1906 increased 492,585 short tons, or 8.5 per cent, in quantity, and $1,089,534, or 16.6 per cent, in value. The average price per ton advanced from $1.14 in 1905 to $1.22 in 1906.

Notwithstanding this increased production, the number of men employed in the coal mines of Tennessee in 1906 was 11,452, as compared with 11,928 in 1905. The average number of days worked, however, increased from 221 to 229, but the actual number of working days was slightly less in 1906 than in 1905, notwithstanding the increased production. Considering the tonnage with the total number of men employed and the average number of days worked, it is shown that the productive efficiency in 1906 exhibits a marked improvement over the preceding year. In 1905 the average production per man was 483.5 short tons, and in 1906 it was 546.6 tons. The average daily production per man increased from 2.29 to 2.39 tons.

There was a decided increase in the use of mining machines in the State during 1906 as compared with the preceding year, but the total quantity of machine-mined coal was scarcely sufficient to affect the statistics of labor efficiency. In 1906 there were 128 machines in use, as compared with 89 in 1905 and 85 in 1904. The machine-mined product in 1906 was 747,500 short tons, against 479,471 short tons in 1905 and 440,618 short tons in 1904. The total quantity of machine-mined coal in 1906 represented 12 per cent of the total production. Of the 128 machines in use, 112 were of the pick or puncher type, 14 were chain-breast machines, and 2 were long wall.

The statistics relating to the length of working days show that about 60 per cent of the total number of men employed in the coal mines of Tennessee worked 9 hours a day. In 1906, 6,938 out of a total of 11,452 men worked 9 hours. These 6,938 men were distributed among 79 mines. There were 30 mines, employing a total of 4,034 men, that worked 10 hours. These included 775 convicts employed at the State mines at Petros, in Morgan County. These mines worked 310 days in the year. There were 4 mines, employing a total of 246 men, that worked 8 hours a day.

Compared with the loss of time due to labor troubles in many of the coal-producing States in 1906, the coal-mining industry in Tennessee was not seriously affected. There were only 3 mines in which suspensions from strikes occurred in 1906. The time lost was represented by the idleness of 180 men for an average of 7 days apiece. None of the suspensions was of any duration, the longest amounting to 10 days. In 1905 there were 150 men idle for an average of 32 days each, and the comparative freedom from labor troubles in both of the last two years is probably responsible for the increased production in the State.

According to Mr. J. W. Allen, statistician for the commissioner of labor, there were 33 fatal accidents in the coal mines of Tennessee in 1906, against 29 in 1905. Of the men killed in 1906, 16 were married, leaving 44 children fatherless. The death rate per thousand of employees in 1906 was 2.88 against 2.38 in 1905. The number of tons mined for each life lost was 189,675 against 205,634 tons in 1905.

The statistics of production, by counties, during 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Tennessee in 1905 and 1906, by counties, in short tons.

1905.

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.
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
Clairborne	1,002,063	7,540	7,389	3,461	1,020,453	1,054,562	1.03	203	1,718
Grundy	414,205	5,925	1,080	....	421,210	448,545	1.06	233	597
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	133,521	3,818	2,891	....	140,230	194,601	1.39	240	288
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	4,807,684	87,543	93,625	777,838	5,766,690	6,577,881	1.14	221	11,928

1906.

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.
Anderson	745,790	8,845	9,199	....	763,834	$913,572	$1.20	187	1,488
Campbell	1,056,928	26,594	30,507	168,078	1,282,107	1,719,498	1.34	209	2,344
Claiborne	1,062,527	8,517	14,865	13,838	1,099,747	1,101,700	1.00	205	1,639
Grundy	417,572	5,315	1,125	25,355	449,367	571,005	1.27	243	704
Hamilton	219,966	3,014	5,739	87,813	316,532	391,685	1.24	260	600
Marion	311,178	4,894	4,843	68,610	389,525	615,211	1.58	270	674
Morgan	484,274	7,369	15,569	108,493	615,705	770,286	1.25	264	1,379
Overton	79,752	50	1,801	....	81,603	102,770	1.26	199	178
Scott	162,159	3,864	2,180	....	168,203	242,179	1.44	210	361
Other counties [a]	667,908	17,673	32,223	373,648	1,091,452	1,237,661	1.13	253	2,085
Small mines	....	1,200	....	....	1,200	1,848	1.54	....	....
Total	5,208,054	87,335	118,051	845,835	6,259,275	7,667,415	1.22	229	11,452

[a] Bledsoe, Cumberland, Fentress, Franklin, Rhea, Roane, Sequatchie, and White.

Statistics of the production of coal, by counties, during the last five years, with the increases and decreases in 1906, as compared with 1905, are shown in the following table:

Coal production of Tennessee, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Anderson	759,276	655,721	630,109	845,778	763,834	− 81,944
Campbell	654,165	700,368	804,750	1,080,540	1,282,107	+ 201,567
Claiborne	748,765	784,628	961,255	1,020,453	1,099,747	+ 79,294
Cumberland	109,582	134,093	91,718	35,052	64,247	+ 29,195
Grundy	332,550	466,642	357,219	421,210	449,367	+ 28,157
Hamilton	250,526	264,268	252,735	296,445	316,532	+ 20,087
Marion	312,446	439,784	388,605	416,768	389,525	− 27,243
Morgan	469,642	524,485	484,232	620,587	615,705	− 4,882
Overton		83,340	106,403	84,493	81,603	− 2,890
Rhea	239,697	231,689	204,992	240,590	264,918	+ 24,328
Roane	152,947	129,480	98,519	122,403	158,421	+ 36,018
Scott	98,529	142,424	123,478	140,230	168,203	+ 27,973
White	182,501	167,900	149,286	309,233	438,602	+ 129,369
Other counties and small mines	72,342	73,182	128,910	132,908	166,464	+ 33,556
Total	4,382,968	4,798,004	4,782,211	5,766,690	6,259,275	+ 492,585
Total value	$5,399,721	$5,979,830	$5,642,393	$6,577,881	$7,667,415	+$1,089,534

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, 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 is shown in the table on a preceding page, giving the production of coal in the United States from the earliest times to the close of 1906.

TEXAS.

Total production in 1906, 1,312,873 short tons; spot value, \$2,178,901.

A decrease of over 60 per cent in the production of petroleum in Texas in 1906, as compared with the preceding year, gave an additional impetus to coal mining in the State. As a result the production increased from 1,200,684 short tons in 1905, valued at \$1,968,558, to 1,312,873 short tons in 1906, valued at \$2,178,901, a gain of 112,189 short tons, or 9.3 per cent, in quantity, and of \$210,343, or 10.7 per cent, in value. Most of the increase in 1906 was in the production of lignite, which advanced from 391,533 short tons, valued at \$284,031, to 472,888 short tons, valued at \$399,011, a gain of 81,355 short tons in quantity, and of \$114,980 in value. The average price per ton advanced from 73 to 84 cents. The production of bituminous coal increased also, but not in the same proportion as did lignite. The output of bituminous coal in 1906 amounted to 839,985 short tons, valued at \$1,779,890, against 809,151 short tons, valued at \$1,684,527, a gain of 30,834 short tons in quantity, and of \$95,363 in value. The average price of bituminous coal in the State advanced from \$2.08 to \$2.12.

There was employed in the bituminous and lignite mines of Texas in 1906 a total of 3,048 men who made an average of 227 working days. The bituminous mines employed 2,333 men an average of 233 days, and the lignite mines employed 715 men 210 days. Of the total number of men employed in 1906, 1,817, or nearly 60 per cent, worked 8 hours per day, and 703 men worked 10 hours. No regular time was reported for the other employees. The average production per man in 1906 was 430.7 tons, against 399.2 tons in 1905. The average daily production per man was 1.90 tons in 1906, compared with 1.68 tons in 1905.

There were 4 mines in 1906 (a gain of 2 over 1905) in which mining machines were used, and the number of mining machines increased from 8 to 12. There was not, however, any appreciable increase in the output of machine-mined coal, which amounted in 1906 to 22,682 tons, against 22,400 tons in 1905.

There were 3 mines in which labor troubles occurred in 1906, but in none of these instances was the suspension of work of sufficient length of time to affect the production. One strike lasted 6 days, one lasted 9 days, and one 10 days. The total number of men idle was 1,260, and the average time lost was 7 days.

There were 13 counties which produced coal or lignite in 1906, an increase of 1, compared with 1905. Bituminous coal was produced in 7 counties, namely, Erath, McCullough, Maverick, Palo Pinto, Parker, Webb, and Wise; and lignite was produced in 6 counties, namely, Bastrop, Hopkins, Houston, Medina, Milam, and Wood.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following table. Owing to the fact that there are only one or two mines in each county, the production of the bituminous and the lignite producing counties, respectively, are combined.

Coal production of Texas in 1905 and 1906, by counties, in short tons.

1905.

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: 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, Medina, 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

1906.

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: Erath, McCullough, Maverick, Palo Pinto, Parker, Webb, Wise	799,974	18,428	21,583	839,985	$1,779,890	$2.12	233	2,333
Lignite: Bastrop, Hopkins, Houston, Medina, Milam, Wood	464,244	3,958	4,686	472,888	399,011	.84	210	715
Total	1,264,218	22,386	26,269	1,312,873	2,178,901	1.66	227	3,048

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 United States 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 table on a preceding page, which gives the production of coal in the United States from the earliest times to the close of 1906.

UTAH.

Total production in 1906, 1,772,551 short tons; spot value, $2,408,381.

The total production in Utah, which had shown a decreasing tendency in 1904 and 1905, felt as did the other Rocky Mountain States, the influence of the shortage created by the suspension of work during the spring of 1906 in the States of the Mississippi Valley. All of the States in the Rocky Mountain district, with the exception of North Dakota, showed increased production in 1906. Utah's output increased from 1,332,372 short tons, valued at $1,793,510, in 1905, to 1,772,551 short tons, valued at $2,408,381, in 1906, a gain of 440,179 short tons, or 33 per cent, in quantity, and of $614,871, or 34.3 per cent, in value. The percentage of increase in Utah was larger than in any of the other coal-producing States. There was no material change in price, the average for 1906 being $1.36 per short ton, against $1.35 in 1905.

The number of men employed in the coal mines of Utah in 1906 was 1,572, against 1,361 in 1905 and 1,374 in 1904. The average working time in 1906 was 288 days, against 247 days in 1905 and 294 days in 1904. Utah enjoys another distinction besides the largest percentage of increase for the year, and that is in having the highest average production for each man employed. In 1906 the average production per man in Utah was 1,127.6 tons, the nearest approach to which was 1,033.7 tons, the average made in Wyoming. In 1905 Utah's average production per man was 979, against 937.3 tons for Wyoming. The average daily production for each man in Utah in 1906 was 3.92, against 3.96 in 1905.

The coal-mining industry of Utah was not in the least disturbed by the labor troubles in the spring of 1906, there having been no strikes or suspensions at any of the mines in this State.

According to the statistics of Mr. Gomer Thomas, State mine inspector, there was a total of 28 accidents in the mines of Utah in 1906. Of these, 7 resulted fatally. Of the nonfatal accidents, 15 were serious and 6 were of a minor character. Of the men killed, 2 were married and left 5 children fatherless. Explosions of gas were responsible for 4 of the deaths, and falls of roof in the mining chambers were responsible for the other 3. Seventeen of the injured men were hurt by falls of roof, 8 of which were in rooms and 9 in gangways and entries. The death rate per thousand employees was 4.45. The number of tons mined for each life lost was 253,222. In the preceding year Mr. Thomas reported the same number of fatal accidents, but the death rate per thousand in 1905 was 5.14 and the number of tons for each life lost was 190,339.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Utah in 1905 and 1906, by counties, in short tons.

1905.

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.
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	2.04		
Total	1,011,914	22,522	50,351	247,585	1,332,372	1,793,510	1.35	247	1,361

1906.

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.
Carbon	1,082,660	5,778	52,235	552,408	1,693,081	$2,291,171	$1.35	295	1,420
Emery		4,954			4,954	7,356	1.48	169	30
Morgan Sanpete	3,112	3,137	20		6,269	14,233	2.27	190	25
Summit Uinta	56,355	5,931	4,757		67,043	94,232	1.41	266	97
Small mines		1,204			1,204	1,389	1.15		
Total	1,142,127	21,004	57,012	552,408	1,772,551	2,408,381	1.36	288	1,57[illegible]

The statistics, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table. It is interesting to note that of the total increase, 440,179 tons in 1906, 304,823 tons represented the coal made into coke at the mines. This factor increased from 247,585 to 552,408 tons.

Coal production of Utah, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Carbon	1,507,689	1,599,986	1,416,623	1,258,346	1,693,081	+ 434,735
Emery	4,718	8,178	4,031	3,692	4,954	+ 1,262
Iron	520	....	....	....	....	....
Morgan, Sanpete	8,531	7,296	7,733	6,136	6,269	+ 133
Summit, Uinta	53,063	64,054	61,320	61,966	67,043	+ 5,077
Small mines	....	1,895	3,320	2,232	1,204	− 1,028
Total	1,574,521	1,681,409	1,493,027	1,332,372	1,772,551	+ 440,179
Total value	$1,797,454	$2,026,038	$1,943,440	$1,793,510	$2,408,381	+$614,871

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 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, estimated 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 Henrys 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 Uinta 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 Uinta 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 o 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, over 550,000 tons of the total coal production in 1906 being consumed in the manufacture of coke. During 1906 a survey was made of the eastern part of the Book Cliffs field, from Grand River, Colorado, to Sunnyside, Utah, where it connected with the work which had been done during 1905.

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 in the table on a preceding page, giving the statistics of production of coal in the United States from the earliest times to the close of 1906.

VIRGINIA.

Total production in 1906, 4,254,879 short tons; spot value, $4,183,991.

Virginia is the only one of the important coal-producing States east of the Mississippi River whose production in 1906 was less than that of 1905. The decrease, however, was unimportant, amounting to 20,392 short tons, or one-half of 1 per cent. From the standpoint of value the year was an entirely satisfactory one to the operators, as the prices advanced 10 cents per ton, from 88 cents in 1905 to 98 cents in 1906, and the total value showed a gain of $406,666, or 10.8 per cent, notwithstanding the decrease in production. Of the two important coal-producing counties—Tazewell and Wise—the former had a decreased production of more than 50,000 tons, while Wise County increased almost exactly the same amount. There was a decrease in the production of other counties and of small mines of 20,177 short tons, which was within 215 tons of the total decrease of the State.

The number of men employed in 1906 was 5,131, against 5,730 in 1905. The average number of working days increased from 241 in 1905 to 250 days in 1906. The average production per man increased from 746.1 tons in 1905 to 829.2 tons in 1906, and the average daily production per man increased from 3.10 tons to 3.32 tons.

The larger number of miners in Virginia are unorganized, and the coal-mining operations are on the basis of a 10-hour day. In 1906, 31 mines, employing 4,294 men, worked 10 hours; 5 mines, employing 727 men, worked 9 hours, and 6 comparatively small operations, employing a total of 105 men, worked 8 hours.

The number of mining machines in use in the coal mines of Virginia increased from 35 in 1905 to 37 in 1906, and the machine-mined product increased from 399,029 short tons to 424,343 short tons, an increase of 25,314 tons, or a little over 6 per cent.

No strikes or other labor troubles have been reported in the coal mines of Virginia during the last three years.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following tables:

Coal production of Virginia in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Tazewell	687,958	10,441	17,126	195,113	910,638	$931,517	$1.03	241	1,098
Wise	971,959	29,329	62,636	1,977,301	3,041,225	2,915,914	.95	260	3,382
Other counties[a] and small mines	280,607	10,505	11,904	....	303,016	336,560	1.11	210	651
Total	1,940,524	50,275	91,666	2,172,414	4,254,879	4,183,991	.98	250	5,131

[a] Lee, Montgomery, Pulaski, and Russell.

The statistics of production, by counties, during the last 5 years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Coal production of Virginia, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Montgomery	12,786	20,288	....	....	....	....
Tazewell	723,753	840,195	871,720	961,380	910,638	− 50,742
Wise	2,422,417	2,563,285	2,359,661	2,990,698	3,041,225	+ 50,527
Chesterfield, Henrico	16,206	18,084	2,100	....	....	....
Pulaski, Russell	7,831	9,255	[a] 177,133	[b] 323,073	[b] 302,896	− 20,177
Small mines	....	200	300	120	120	....
Total	3,182,993	3,451,307	3,410,914	4,275,271	4,254,879	− 20,392
Total value	$2,543,595	$3,302,149	$2,921,911	$3,777,325	$4,183,991	+$406,666

[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 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. Development of what promises to be a formidable rival of the Tazewell and Wise county districts was begun in Lee County in 1905, and actively continued in 1906. This new district is chiefly contained in what is known as Black Mountain, a portion of the Cumberland range. No less than twelve separate coal beds of workable thickness have been located, and mining operations on several of them have been started. Most of the coal is of high grade steam and coking quality. Transportation to market is afforded by the Virginia and Southwestern (formerly the Black Mountain) Railroad to the Louisville and Nashville Railroad at Pennington Gap.

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" road. This will, if built, open valuable territory on the headwaters of Russell Fork of Sandy River.

As has been mentioned, the first coal mined in the United States was from the Richmond basin in Virginia, and Mr. W. J. Nicolls, in his Story of American Coals, states that mines were opened and worked on the James River, near Richmond, in 1750. This antedates by nineteen years the first reliable record of the use of anthracite in Pennsylvania; but, unfortunately, Mr. Nicolls does not give his authority for the statement. Whatever production there may have been, there is no record of the quantity 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 two since 1892, the second exception being noted in 1906. The maximum production, in 1905, was 4,275,271 short tons, as shown in the table on a preceding page giving the production of coal in the United States from the earliest times to the close of 1906.

WASHINGTON.

Total production in 1906, 3,276,184 short tons; spot value, $5,908,434.

As in 1905 the production of coal in Washington was restricted and fell below that of 1904 because of the largely increased use of petroleum for fuel purposes in California, so in 1906 the production of coal in Washington was stimulated by the falling off in the output of California oil. The statistics of petroleum production in 1906 in California showed a decrease of about 5,000,000 barrels, largely due, it is claimed, to the inability of the railroads to supply the necessary transportation facilities, and the production of coal in Washington was benefited accordingly, with an increase of 411,258 short tons, or 14.4 per cent, in quantity, and of $767,176, or 14.9 per cent, in value.

Notwithstanding the increased production in 1906, the average number of men employed in the coal mines of the State decreased from 4,765 to 4,529, but this was in part compensated for by an increase of from 227 to 266 in the average number of working days. The decrease in the number of men employed is explained by the falling off in demand for coal in 1905, with a corresponding decrease in the demand for labor, which caused the miner to seek other fields of employment. In 1904 there were 5,287 men who worked an average of 243 days. The increased demand in 1906 gave to the fewer number of men employed a greater amount of work. The average production per man in 1906 was 723.4 tons, against 601.2 tons in 1905. The average daily production per man increased from 2.65 tons in 1905 to 2.72 tons in 1906.

The majority of the mines operated 8 hours a day in 1906: 23 operations, employing 3,432 men, reported 8 hours a day; 4 mines, employing 106 men, reported 9 hours to the day; 6 mines, employing 747 men, reported 8 hours for the miners and 10 hours for the day men; 1 mine, with 231 men, reported 9 hours for the two different classes of employees; and 2 mines, employing 13 men, worked 10 hours.

There were no strikes or suspensions of labor at any of the Washington mines in 1906.

There was 1 mine in which mining machinery was employed in 1906. The equipment consists of 1 long wall machine which produced 12,521 short tons of coal. This is the only machine-mined coal reported in Washington since 1901, but while the use of mining machinery has not developed to any extent in the State, there has been a notable installation of coal-washing apparatus. There are 11 mines at which washing plants have been installed. The plants include 12 Luhrig and Robinson jigs, 13 Forester jigs, and 9 Robinson, or Robinson-Howe installations. The total quantity of coal washed was 784,817 tons, producing 657,030 tons of washed coal and 127,787 tons of refuse.

Mr. D. C. Botting, the State mine inspector, reports that the total number of accidents in the coal mines of Washington was 98, of which 22 were attended by fatal results. Of the 76 men injured, 40 were seriously and 36 slightly injured. The total number of wives made widows was 7, and the children left fatherless, 5. Of the number of fatal accidents, only 1 was due to the explosion of gas; 6 were due to falls of rock in rooms; 11 were killed by mine cars, and 4 deaths were due to miscellaneous causes. The death rate per thousand of employees was 4.86, and the number of tons mined for each life lost was 148,917, as compared with a death rate of 2.73 in 1905 and with a tonnage of 220,379 for each life lost.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following table:

Coal production of Washington in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
King	1,219,047	37,331	54,152	....	1,310,530	$2,148,055	$1.64	273	1,726
Kittitas	1,376,771	18,372	27,469	....	1,422,612	2,603,624	1.83	265	1,742
Lewis	23,693	275	1,912	....	25,880	61,382	2.37	188	70
Pierce	385,857	4,669	26,892	96,221	513,639	1,086,145	2.11	263	980
Other counties [b]	2,780	499	244	....	3,523	9,228	2.62	157	11
Total	3,008,148	61,146	110,669	96,221	3,276,184	5,908,434	1.80	266	4,529

[a] Cowlitz, Lewis, and Whatcom.

[b] Cowlitz and Whatcom.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Production of coal in Washington, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Cowlitz			1,800	a 3,706	a 3,523	− 183
King	1,017,888	1,229,560	1,219,230	1,099,163	1,310,530	+ 211,367
Kittitas	1,250,920	1,369,716	1,340,400	1,280,845	1,422,612	+ 141,767
Lewis	826	1,410	1,335	1,300	25,880	+ 24,580
Pierce	383,603	572,800	531,589	479,912	513,639	+ 33,727
Skagit	21,967	19,115	10,650			
Whatcom	6,010	672	1,837			
Other counties			30,840			
Total	2,681,214	3,193,273	3,137,681	2,864,926	3,276,184	+ 411,258
Total value	$4,572,295	$5,380,679	$5,120,931	$5,141,258	$5,908,434	+$767,176

a Includes Whatcom County.

The coal fields of Washington are confined to the western and central portions of the State. Four principal fields may be mentioned—the North Puget Sound field, including the coal mines of Skagit and Whatcom counties; the South Puget Sound field, containing the operations in King and Pierce counties; the Puget Sound basin, just east of Seattle; the Roslyn field, in Kittitas County, on the eastern slope of the Cascade Mountains; and the Southwestern field, embracing the counties of Lewis and Cowlitz.

The coals of Washington range from lignite to bituminous coking coals, and some natural coke 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 thirteen years later—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 5,374 tons. in 1905 Washington's output of coal was 3,276,184 short 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 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, is shown in the table on a preceding page, giving the statistics of coal production in the United States from the earliest times to the close of 1906.

WEST VIRGINIA.

Total production in 1906, 43,290,350 short tons; spot value, $41,051,939.

Since West Virginia passed Ohio and became in 1896 the third State in coal-producing importance, it has been steadily gaining on Illinois, and in 1906 (ten years later) surpassed Illinois and became the second coal-producing State of the Union. The production of coal in Illinois was almost entirely stopped during the eleven weeks following the suspension of mining operations pending adjustment of the wage scale. This suspension began on April 1 and continued until June 18, although there were some mines that resumed operations before the latter date and some that continued idle after that time. Notwithstanding this extensive period of idleness, however, the coal production of Illinois increased from 38,434,363 short tons in 1905 to 41,480,104 short tons in 1906, a gain of 3,045,741 short tons. This would have been a normal increase in a year of undisturbed labor conditions, and as West Virginia's production had in 1905 approached within 2 per cent of that of Illinois, the probability is that the latter would have been surpassed as the second coal-producing State, even had there been no suspension of mining operations. West Virginia's production in 1906 shows an increase of 5,498,770 short tons, or 14.6 per cent, in quantity, and of $8,710,149, or 26.9 per cent, in value. The increase in 1906 over 1905 was almost exactly equal to the total production of the State in 1888. The total production was 3 times what it was in 1897 and was nearly 50 per cent more than that of 1903. The greatest benefit to the coal-mining industry of West Virginia which resulted from the suspension of operations in the competitive States was in the enhancement of values, the average price per ton for coal advancing from 86 cents in 1905 to 95 cents in 1906, and increasing the total value from $32,341,790 in 1905 to $41,051,939 in 1906.

A large amount of railroad building and coal-mining development work has been carried on, particularly throughout the southern and central portions of West Virginia during the last two years, and the indications are that the ratio of increase in production in this State will equal if it does not exceed that of the other important coal-mining States, and there is every reason to believe that West Virginia will continue to hold second place in this important industry.

The total number of men employed in the coal mines of West Virginia in 1906 was 50,960, who worked an average of 220 days, against 48,389 men averaging 209 days in 1905, and 47,235 men averaging 197 days in 1904. The average production for each employee in 1906 was 849.5 tons, against 781 tons in 1905. The average daily production per man was 3.86 tons, against 3.74 tons in 1905; in 1904 the average production was 3.48 tons, and in 1903, 3.36 tons per man. It is probable that a large portion of this continued increase in productive efficiency is due to the increased use of machines for undercutting coal, as shown by the fact that in 1903 there were 788 machines used in the production of 8,193,840 tons; in 1904, 901 machines were reported with a machine-mined production of 9,526,749 tons; in 1905, 1,105 machines were reported with a machine-mined production of 12,504,301 tons; and in 1906 there were 1,322 machines in use, with a machine-mined production of 15,565,113 tons. The percentage of the machine-mined product to the total output in West Virginia was increased from 28 per cent in 1903 to 36 per cent in 1906.

The somewhat vigorous attempts which have been made from time to time to organize the coal miners of West Virginia have been only partly successful, and the majority of the mines continue to be operated either on the "open shop" or nonunion basis, and over 90 per cent of the miners worked either 9 or 10 hours. In 1906, 308 mines, employing 31,531 men, worked 10 hours; 190 mines, employing 15,208 men, worked 9 hours, and 42 mines, employing a total of 2,507 men, worked 8 hours. In 1905, 251 mines, employing 25,731 men, worked 10 hours; 161 mines, employing 14,387 men, worked 9 hours, and 49 mines, with 3,532 men, worked 8 hours.

The time lost by strikes or suspensions in West Virginia, when compared with the neighboring States of Pennsylvania, Ohio, Indiana, and Illinois, is insignificant. Out of a total of 50,960 men there were 4,101 on strike during the year, and these lost an average of 30 days. The total time lost was only 1.1 per cent of the total time made.

According to the statistics compiled by Mr. James W. Paul, State mine inspector, there were 268 men killed in the coal mines in the fiscal year ending June 30, 1906, and 299 men injured. There were 107 wives made widows, and 216 children were left fatherless. The death rate per thousand of employees was 5.65, and the number of tons mined for each life lost was 156,313. Of the total number of deaths, 4 were due to explosions of gas, 43 to explosions of dust, 23 to explosions of dust and gas, 23 to explosions of powder and dust, 12 to explosions of powder and gas, 99 to falls of roof, 2 to powder explosions, and 62 to other causes.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the product for consumption, are shown in the following table:

Coal production of West Virginia in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Barbour	766,075	4,500	15,159	207,947	993,681	$892,442	$0.90	245	962
Brooke	457,476	22,730	3,050	....	483,256	490,040	1.01	218	660
Clay	76,462	2,260	663	....	79,385	83,308	1.05	179	101
Fayette	7,060,063	86,906	137,926	1,000,567	8,285,462	8,267,968	1.00	206	11,117
Grant	282,112	2,593	12,321	....	297,026	292,273	.98	273	304
Harrison	3,569,339	13,184	32,432	11,382	3,626,337	3,134,689	.86	231	3,251
Kanawha	4,756,445	62,417	59,945	1,500	4,880,307	4,851,113	.99	202	6,891
Logan	576,443	8,211	8,241	....	592,895	576,972	.97	170	825
McDowell	6,002,513	71,353	105,218	2,528,593	8,707,677	8,259,449	.95	214	9,901
Marion	3,746,007	21,407	58,405	337,643	4,163,462	3,621,219	.87	245	3,216
Marshall	412,878	89,526	8,931	....	511,335	495,489	.97	219	644
Mason	72,286	37,375	2,999	....	112,660	109,264	.97	204	269
Mercer	1,651,501	16,134	27,676	504,519	2,199,830	2,039,501	.93	238	2,161
Mineral	656,386	4,250	1,302	....	661,938	664,334	1.00	234	698
Mingo	2,141,070	46,776	22,430	....	2,210,276	2,008,922	.91	246	2,418
Monongalia	136,668	9,965	8,272	173,503	328,408	286,837	.87	228	382
Nicholas	72,100	5,360	2,175	....	79,635	92,755	1.16	192	194
Ohio	93,909	26,472	1,083	....	121,464	125,014	1.03	146	239
Preston	773,940	12,095	30,544	312,765	1,129,344	936,635	.83	255	1,578
Putnam	540,523	3,330	4,872	....	548,725	580,347	1.06	239	988
Raleigh	1,054,960	14,134	11,069	....	1,080,163	1,138,687	1.05	223	1,798
Randolph	246,220	8,244	4,739	128,559	387,762	347,539	.89	241	415
Taylor	432,995	9,348	3,084	....	445,427	360,489	.81	195	442
Tucker	686,740	16,973	24,770	470,558	1,199,041	1,234,039	1.03	269	1,235
Other counties [b] and small mines	124,372	37,944	2,538	....	164,854	162,614	.99	188	272
Total	36,389,483	633,487	589,844	5,677,536	43,290,350	41,051,939	.95	220	50,960

[a] Gilmer, Lincoln, Logan, Ritchie, Upshur, and Wayne.
[b] Braxton, Gilmer, Hancock, Lewis, Lincoln, Ritchie, and Upshur.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1906 as compared with 1905, are shown in the following table:

Coal production of West Virginia, by counties, 1902–1906, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Barbour	512,725	742,928	666,019	615,437	993,681	+ 378,244
Brooke	40,372	35,025	67,706	239,396	483,256	+ 243,860
Clay	....	22,094	55,814	80,424	79,385	− 1,039
Fayette	4,775,112	6,092,193	7,222,247	7,985,327	8,285,462	+ 300,135
Grant	2,776	78,932	161,665	207,926	297,026	+ 89,100
Hancock	80,400	153,763	79,528	57,683	70,251	+ 12,568
Harrison	2,066,597	2,504,638	2,714,832	2,850,678	3,626,337	+ 775,659
Kanawha	1,848,617	3,034,912	3,134,256	3,973,717	4,880,307	+ 906,590
Lewis	540	....	....	....	....	....
Logan	....	....	326	223,319	592,895	+ 369,576
McDowell	5,459,655	6,103,800	6,755,138	8,245,167	8,707,677	+ 462,510
Marion	3,397,194	3,133,699	3,407,469	3,621,219	4,163,462	+ 542,243
Marshall	243,791	372,897	398,594	438,773	511,335	+ 72,562
Mason	144,727	127,646	117,437	95,786	112,660	+ 16,874
Mercer	1,248,279	1,375,780	1,761,265	2,269,076	2,199,830	− 69,246
Mineral	514,993	529,099	569,649	575,294	661,938	+ 86,644
Mingo	806,174	1,164,554	1,469,710	1,679,526	2,210,276	+ 530,750
Monongalia	153,474	161,912	200,567	218,360	328,408	+ 110,048
Nicholas	....	21,050	38,452	58,179	79,635	+ 21,456
Ohio	230,241	147,232	118,725	109,201	121,464	+ 12,263
Preston	590,436	805,060	665,626	837,666	1,129,344	+ 291,678
Putnam	184,259	298,499	386,840	548,767	548,725	− 42
Raleigh	281,817	417,459	591,794	827,868	1,080,163	+ 252,295
Randolph	400,145	458,401	379,622	517,078	387,762	− 129,316
Taylor	368,650	292,146	283,332	348,105	445,427	+ 97,322
Tucker	1,166,080	1,241,565	1,126,883	1,095,059	1,199,041	+ 103,982
Other counties and small mines	53,772	21,957	33,256	72,549	94,603	+ 22,054
Total	24,570,826	29,337,241	32,406,752	37,791,580	43,290,350	+ 5,498,770
Total value	$24,748,658	$34,297,019	$28,647,014	$32,341,790	$41,051,939	+$8,710,149

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 they contributed over 90 per cent of the total output of the State in 1906. Two of these districts are in the northern part of the State and 2 in the southern portion. The 2 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 of the State 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 2 rivers which drain it, the coal being shipped partly by the Chesapeake and Ohio Railway and 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 4 counties is drawn from 2 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 2 areas are considered as one district in this report.

Coal production of the principal districts of West Virginia, 1886–1906, in 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
1906	14,953,677	14,621,316	10,686,659	2,158,005

[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 26 years there has been only one exception to a steadily increasing output, and that during the period the average increase has exceeded 1,600,000 tons.

Annual increase in the coal production of West Virginia, 1881–1906, in 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	1906 over 1905	5,498,770
1893 over 1892	969,823		
1894 over 1893	919,179	Total increase in 26 years	41,610,350
		Average annual increase	1,600,398
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 about 90 per cent comes from 5 principal mining districts, and nearly all of the other 10 per cent comes from 3 smaller districts. The more important of these are the Fairmont, or Clarksburg, and the Piedmont, or Elk Garden, fields in the northern portion of the State, and the New River, Kanawha, and Pocahontas fields in the southern portion.

The Fairmont, or Clarksburg, region lies principally in Harrison and Marion counties, the beds from which the coal is mined here belonging to the Upper Productive Coal Measures. The most important bed is the Pittsburg, which has an average thickness of 8 feet 6 inches, of which 7 feet are usually mined. The Waynesburg and Sewickley coals, the former poor and the latter good, also occur in this district, and run from 5 to 10 feet in thickness, but are seldom mined. The field is penetrated by the Baltimore and Ohio Railroad, which furnishes transportation for the product.

The Piedmont, or Elk Garden, field was the first to be worked in West Virginia, coal having been mined in this district before the State was separated from the mother State of Virginia, and also contemporaneously with the opening of the Cumberland, or Georges Creek, field in Maryland. It is a part of the detached portion of the great coal fields lying in Mineral, Grant, and Tucker counties, where the coal beds are somewhat folded. The coal approaches semibituminous in character. Two coals belonging in the Lower Productive Measures are worked. They are known as the "E," or Upper Freeport, and the "B," or Lower Kittanning, and range from 4 to 11 feet in thickness. Transportation is afforded by the Baltimore and Ohio and the West Virginia Central and Pittsburg railroads, the latter being now a portion of the Wabash system.

The New River field, as at present outlined, is confined to the valley of the New River and its tributaries, the productive portions being in Fayette and Raleigh counties. The coals of this district occur in the Lower Pottsville series, which lies below the Kittanning and Upper Productive Measures of the northern part of the State. The two beds which furnish the larger part of the product are the Sewell, which runs from 2 feet 6 inches to 5 feet, and the Quinnimont, from 3 to 5 feet in thickness, the latter lying below and to the southeast of the former. The coal is of the "smokeless" coking variety, not unlike in quality that of the Piedmont field. One seam of coal, belonging properly to the Kanawha field, lies high in the hills in the New River district, and is extensively mined at Ansted, in Fayette County. The district is penetrated by the Chesapeake and Ohio Railroad, which follows the course of the New River and furnishes transportation for the product.

The Kanawha field lies immediately west of the New River field and includes the western portion of Fayette County, all of Kanawha County, 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 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 North Coalburg, the No. 5, the Belmont, the Coalburg, the Winifrede, the Cedar Grove, "No. 2, gas," and the Eagle. Transportation is furnished by the Chesapeake and Ohio, the Kanawha and Michigan, and the recently constructed Coal and Coke and Virginian (Deepwater-Tidewater) railroads. 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. During the last three years a large amount of development has been done on Pocahontas No. 4 and the Welch beds, and shipments from these beds have reached an important character. All of these occur near the bottom of the Pottsville series. All of the Pocahontas 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; of the Philippi field, in Preston, Barbour, and Randolph counties, which belongs to the Lower Productive Measures in the northern part of the State, and the Wheeling field, which includes the counties in the Panhandle along the Ohio River, where the Pittsburg coal is mined.

Mr. Neil Robinson, 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 two or three years, 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 Virginian, formerly the Deepwater-Tidewater Railway, from Sewells Point, near Norfolk, to the coal fields of the southern portion of West Virginia. This road penetrates 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, has opened up important fields in the center of the State, as has 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 statistics of production in West Virginia since 1863, when the State was formed out of Virginia, are shown in the table on a preceding page, giving the production of coal in the United States from the earliest times to the close of 1906.

WYOMING.

Total production in 1906, 6,133,994 short tons; spot value, $8,013,528.

The coal production of Wyoming has increased each year since 1902, the gain in each of the last three years being approximately 500,000 tons. The increase in 1906 over 1905 was 531,973 short tons, or 9.5 per cent in quantity, with a gain in value of $676,577, or 9.2 per cent. Since 1902 when the period of uninterrupted increase began, the coal production of Wyoming has increased from 4,429,491 to 6,133,994 short tons, or nearly 40 per cent. In the report for 1905 it was stated that this increase in production had been due to legitimate demand and not to any attempt to force production, it being observed that with the gain in output there has been an advance in value, the average price per ton having risen from $1.24 in 1903 to $1.30 in 1904 and to $1.31 in 1905. The price in 1906 was the same as in the preceding year.

Wyoming ranks second in the quantity of coal produced during the year per man employed. In 1906, 5,934 men were employed in the coal mines of the State, averaging 281 days each. The average production per man for the year was 1,033.7 tons, a rate exceeded only by Utah. In 1905 there were 5,977 men employed for an average of 236 days, and the average production for the year per man was 937.3 tons. This rate also was exceeded by the miners of Utah alone. The average daily production per man in 1906 in the coal mines of Wyoming was 3.68 tons against 3.97 tons in 1905. In 1904 the average tonnage per man per year was 914.9, and the average daily tonnage per man amounted to 3.49. Wyoming, Utah, New Mexico, and Colorado, of the Rocky Mountain division, and Maryland, Pennsylvania (bituminous), Virginia, and West Virginia, in the East, hold records for individual capacity among the mine workers.

In all but 2 of these States, Utah and Pennsylvania (bituminous), the majority of the miners work either 10 or 9 hours. In Wyoming in 1906 there were 29 mines employing 5,500 men out of a total of 5,934 that worked 10 hours. The mines reporting any other than 10 hours were unimportant operations.

Statistics relating to the use of mining machines show that there were, in 1906, 83 undercutting machines in use in the mines of Wyoming, compared with 81 in 1905, and with 72 in 1904. The machine-mined production has increased from 1,053,702 short tons in 1904 to 1,236,750 in 1905 and to 1,339,422 tons in 1906. Of the total number of machines in use in 1906, 48 were of the pick or puncher type· 33 were chain-breast machines; and 1 long wall and 1 shearing machine were used.

The casualty record for 1906, reported by Messrs. Noah Young and D. M. Elias, State mine inspectors, shows that there were 36 accidents, 15 of which resulted fatally. One wife was made a widow and one child left fatherless. The death rate per thousand was 2.53, and 408,933 tons of coal were mined for each life lost. No death was due to explosions of gas, dust, or powder. Falls of roof and coal claimed more victims than any other one cause, 6 deaths resulting therefrom. Three men were killed by a train of runaway mine cars, and 6 deaths resulted from miscellaneous causes.

The statistics of production, by counties, in 1905 and 1906, with the distribution of the production for consumption, are shown in the following tables:

Coal production of Wyoming, in 1905 and 1906, by counties, in short tons.

1905.

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.
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

1906.

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.
Converse	58,418	1,622	9,455	....	69,495	$122,241	$1.76	251	105
Sheridan	961,515	18,593	34,210	....	1,014,318	1,191,569	1.17	284	902
Sweetwater	2,035,601	11,705	74,240	....	2,121,546	2,911,316	1.37	274	2,229
Uinta	1,980,444	9,276	89,052	....	2,078,772	2,620,228	1.26	277	1,750
Other counties [a]	765,645	16,895	64,103	1,655	848,298	1,164,712	1.37	298	948
Small mines	....	1,565	....	....	1,565	3,462	2.21	....	....
Total	5,801,623	59,656	271,060	1,655	6,133,994	8,013,528	1.31	281	5,934

[a] Bighorn, Carbon, Converse, Crook, Fremont, Johnson, Sheridan, and Weston.
[b] Bighorn, Carbon, Crook, Johnson, and Weston.

Statistics of the production of coal, by counties, during the last five years, with the increases and decreases in 1906, as compared with 1905, are shown in the following table:

Coal production of Wyoming, 1902–1906, by counties, in short tons.

County.	1902.	1903.	1904.	1905.	1906.	Increase (+) or decrease (−), 1906.
Bighorn	902	....	6,235	4,605	4,743	+ 138
Carbon	382,207	243,323	336,292	354,358	450,636	+ 96,278
Converse	72,329	91,050	77,386	64,939	69,495	+ 4,556
Sheridan	309,066	455,309	554,785	742,314	1,014,318	+ 272,004
Sweetwater	1,595,340	1,628,944	1,992,993	2,113,979	2,121,546	+ 7,567
Uinta	1,595,333	1,782,668	1,800,069	1,897,668	2,078,772	+ 181,104
Weston	457,801	416,974	398,367	409,690	379,990	− 29,700
Crook, Fremont, Johnson, Natrona	16,513	14,934	9,254	11,798	[a] 12,929	+ 1,131
Small mines	....	2,091	3,175	2,670	1,565	− 1,105
Total	4,429,491	4,635,293	5,178,556	5,602,021	6,133,994	+ 531,973
Total value	$5,236,339	$5,731,281	$6,747,909	$7,336,951	$8,013,528	+$676,577

[a] Crook and Johnson only.

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 Rawlins 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.

During 1906 the geological work of the Survey on the coal fields of Wyoming was done in Uinta County, continuing the survey previously begun from Kemmerer north to Snake River. A survey was also made of the well-known Hanna field, in Carbon County, on the line of the Union Pacific Railroad.

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 table on a preceding page, giving the production of coal in the United States from the earliest times to the close of 1906.

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COKE.

By Edward W. Parker.

INTRODUCTION.

As in the chapters on coke published in preceding years, the statistics of the manufacture of coke presented in the following pages include only the figures for that product which is obtained from the distillation or partial combustion of bituminous coals in ovens of the beehive type, or in retort ovens, and which is suitable for furnace and foundry use. The coke obtained as a by-product in the manufacture of illuminating gas, popularly known as gas-house coke, is not considered as coming within the scope of this report. Owing, however, to certain changes that have taken place in the manufacture of coke during recent years and the use of specially prepared coke for domestic and other purposes where smokeless fuel is desired, it has been 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 manufactured was obtained from the beehive oven, the name being derived from the shape of the combustion chamber, which is similar to that of the conventional beehive.

After 1893, when the first plant of 12 by-product ovens was completed by the Semet-Solvay Company at Syracuse, N. Y., to the close of 1904, there was a steady and noteworthy increase in the construction of retort or by-product recovery ovens in the United States. During the last two years, however, there has been some decrease in the development of this branch of the industry, and at the end of 1906 there were fewer by-product ovens under construction than in any year since 1899. The reason given for this is that manufacturers are not pushing the construction of these ovens because of the lack of profitable markets for the large quantity of coal tar, which is one of the important by-products of retort-coke manufacture.

The coke product of the retort ovens is in some cases a high-grade metallurgical fuel and is primarily intended for such use, although the coke itself is not in all cases a primary product. In some instances the coke is a secondary product, but can not be considered a by-product like gas-house coke.

As stated in the opening paragraph, considerable quantities of coke made in both the by-product and the beehive ovens are sold for other than metallurgical purposes, and manufacturers are now making a specialty of the preparation of coke for domestic use, a branch of the industry which is constantly growing. For these reasons it is impossble to make any separation of the coke, either retort or beehive, which is used strictly for metallurgical purposes from the other uses to which it is put, and it is no longer possible to limit the discussion of coke making in this chapter to coke 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 quantity 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 unit of measurement used in this chapter is uniformly the short ton of 2,000 pounds.

PRODUCTION.

The total production of coke from the beehive and by-product ovens of the United States in 1906 amounted to 36,401,217 short tons against 32,231,129 short tons in 1905, an increase of 4,170,088 short tons, or 12.94 per cent. The production in 1906, as in 1905, surpassed all previous records in the history of coke making in the United States. Of the total production in 1906, 31,843,090 short tons were produced in beehive ovens against 28,768,781 short tons in 1905; the production from retort or by-product ovens in 1906 was 4,558,127 short tons against 3,462,348 tons in 1905, the increase in the production of beehive coke being 3,074,309 tons, and in the retort-oven product 1,095,779 short tons. From this it appears that while the total production from retort ovens in 1906 was only about 12 per cent of the total output, more than 25 per cent of the total increase was in by-product coke.

The value of the total coke product in 1906 increased in even greater proportion than the tonnage, from $72,476,196 in 1905 to $91,608,034 in 1906, a gain of $19,131,838, or 26 per cent, as compared with an increase of 12.94 per cent in quantity. The value of the product in 1906 was nearly double that of 1904, when the production amounted to 23,661,106 short tons, compared with which the production in 1906 shows an increase of 12,740,111 tons, or a little over 50 per cent.

The increased production in 1906, with the larger proportionate increase in value, was due primarily to the continued extraordinary demand created by the unchecked expansion in the production of iron and steel, and also, but to a minor degree, to the shortage in anthracite fuel occasioned by the suspension of operations in the spring of the year and to similar shortages in some of the bituminous coal-producing States, due to the same cause. The average price obtained for coke in 1906 was $2.52, as compared with $2.25 in 1905, and was the highest figure reached in a period of twenty-seven years, with the exception of 1903, when, because of the fuel famine caused by the strikes of 1902, the average price of coke was advanced to $2.63.

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 quantity of coal used in the manufacture of coke in 1906 was 55,746,374 short tons, valued at $62,232,524. The value of the coke produced from this coal was $91,608,034, a difference of $29,375,510, which represents the profits on the coking operations less the cost of manufacture and the expenses of administration and selling. In 1905 the value of the coal used was $50,614,674, and the value of the coke produced was $72,476,196, a difference to cover all expenses of manufacture, administration, and profits of $21,861,522.

The year 1906 was one practically without precedent in the history of the coke-making industry. There was throughout almost the entire year an active demand for coke, with prices unusually high. There was not even the usual summer dullness, as the demand for rails and bridge materials on the part of the railroads, and structural shapes, due largely to the requirements of building operations in San Francisco, kept the furnaces in continuous operation, and this in turn kept up the demand for coke. The year opened with coke in good demand and production was kept practically up to capacity in most of the high-grade coking regions during the first of the year. During February there was a slight reaction with a falling off in the demand, and it was anticipated that a number of the ovens, particularly in the Connellsville region, would go out of blast. The apprehension, however, of a shut down of the coal-mining operations pending a settlement of the wage scale on April 1 overcame the declining tendency and the demand became again firm, with prices showing an upward tendency. Connellsville furnace coke, which in January sold as low as $2.15 per ton, was quoted at from $2.30 to $2.75 per ton in April and May, the higher prices being usually for prompt delivery. With the settlement of the anthracite strike in May it was anticipated that there would be a falling off in the demand for coke, but such fears were not realized, and the production was actively continued during June and July. Instead of the dullness which generally prevails during the summer, there was a decided boom at that season, and prices continued to advance. The steady demand continued during the fall and winter months, with the result that by December the price of Connellsville furnace coke had advanced to from $3 to $3.60 per ton, while foundry coke was quoted at from $3.75 to $4.50 per ton.

There were at the close of 1906, 93,901 coke ovens in the United States, against 87,564 in 1905, an increase of 6,337. Of the total number of ovens in existence in 1906, 5,305 were idle during the entire year, leaving 88,596 active ovens which produced 36,401,217 tons of coke, an average of 410.9 tons per oven. In 1905 out of 87,564 ovens 5,932 were idle, showing that in addition to the new ovens added to the entire equipment in 1906 the number of ovens idle was 627 less than in 1905. The 81,632 active ovens in 1905 produced 32,231,129 tons of coke, an average of 394.8 tons per oven. The idle beehive ovens in 1906, with but few exceptions, were plants which had not been operated for several years and had been practically abandoned or were new plants which had not been put in blast before the end of the year. The idle ovens in 1906 included 241 retort ovens, of which 56 were a bank of Newton-Chambers ovens at Pocahontas, Va., which have not been operated to any extent since their installation several years ago. The total number of 93,901 ovens in 1906 included 3,603 by-product recovery ovens, of which, as stated, 241 were idle during the year. This left 3,362 ovens which were operated during the year. The production from these 3,362 ovens was 4,558,127 tons of coke, which, deducted from the total output of 36,401,217 short tons, leaves 31,843,090 tons as the output of 85,234 active beehive ovens. From this it appears that the average production from the by-product ovens was 1,356 tons, while the average output from each beehive oven was 373.6 tons. In 1905 the average production from each by-product oven was 1,158.8 tons, and that from each beehive oven 365.8 tons. In 1905 the average production from by-product ovens was a little more than three times that of the beehive ovens, while in 1906 it was nearly four times as great.

At the close of 1906, 4,519 new ovens were in course of construction, of which 112, or less than 2.5 per cent, were of the retort or by-product type, and all of these were of the Otto-Hoffmann or United-Otto type of structure. With the exception of one year, 1904, there were less ovens building at the close of 1906 than in any year since 1900, and there were fewer by-product ovens building at the end of 1906 than in any year since 1899.

The number of completed retort ovens in the United States has a little more than trebled in five years, there being 3,603 ovens in existence at the close of 1906, as compared with 1,165 in 1901. In the earlier year the production from this type of ovens was 1,179,900 tons, or 5.4 per cent of the total. In 1902 the production of by-product coke was 1,403,588 tons, or 5.5 per cent of the total; in 1903 it was 1,882,394 tons, or 7.4 per cent of the total; in 1904 it was 2,608,229 tons, or 11 per cent of the total; in 1905, 3,462,348 tons, or 10.7 per cent of the total, and in 1906, 4,558,127, or 12.5 per cent, of the total.

Considering each bank of ovens as a separate establishment, the returns for 1906 show a total of 532 establishments, as compared with

519 in 1905 and with 506 in 1904. There were 69 establishments that were idle throughout the year, as compared with 75 in 1905 and 82 in 1904. There were also 15 new establishments having a total of 1,887 ovens, which were not completed and put in blast before the close of 1906.

The totals of the production of coke in 1905 and 1906 are presented by States and Territories in the following tables:

Manufacture of coke in the United States, by States and Territories, in 1905 and 1906.

1905.

State or Territory.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke.	Price of coke per ton.
		Built.	Building.					
Alabama	42	9,586	150	4,409,854	58.4	2,576,986	$7,646,957	$2.97
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	2.69
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	2.01
Missouri	2	6	0	2,551	61.9	1,580	4,072	2.58
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	2.83
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	2.05
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	1.91
Washington	5	216	0	85,715	62	53,137	251,717	4.74
West Virginia	143	19,189	1,214	5,329,695	63.8	3,400,593	6,548,205	1.92
Maryland	1	200	0					
Massachusetts	1	400	0					
Michigan	2	135	15					
Minnesota	1	50	0	2,222,723	74.7	1,660,857	5,500,337	3.31
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	2.25

1906.

State or Territory.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke.	Price of coke per ton.
		Built.	Building.					
Alabama	42	9,731	160	5,184,597	58.5	3,034,501	$8,477,899	$2.79
Colorado [a]	15	3,419	80	2,566,196	56.7	1,455,905	4,504,748	3.09
Georgia	2	531	0	128,052	54.9	70,280	277,921	3.95
Illinois	4	309	0	362,163	74.2	268,693	1,205,462	4.48
Indiana	1	48	0	......	......	......	......	......
Indian Territory	5	490	0	95,296	52.2	49,782	204,205	4.10
Kansas	5	81	0	2,807	60.5	1,698	4,101	2.42
Kentucky	6	462	0	148,448	49.9	74,064	169,846	2.29
Missouri	2	6	0	0	......	0	0	......
Montana	4	555	100	69,045	55.3	38,182	266,024	6.97
New Mexico	4	571	450	261,609	56.5	147,747	442,712	3.00
Ohio	8	575	0	437,567	67.2	293,994	1,013,248	3.45
Pennsylvania	239	47,185	2,373	34,503,513	66.8	23,060,511	54,184,531	2.35
Tennessee	17	2,731	138	929,405	52	483,428	1,350,856	2.79
Utah	2	684	170	(b)	......	(b)	(b)	......
Virginia	18	4,641	695	2,296,227	68.7	1,577,659	3,611,659	2.29
Washington	5	216	0	76,896	59.4	45,642	226,977	4.97
West Virginia	141	19,714	353	5,822,619	63.8	3,713,514	8,192,956	2.21
Maryland								
Massachusetts								
Michigan								
Minnesota	12	1,952	0	2,861,934	72.9	2,085,617	7,474,889	3.58
New Jersey								
New York								
Wisconsin								
Wyoming								
Total	532	93,901	4,519	55,746,374	65.3	36,401,217	91,608,034	2.52

[a] Includes the production of Utah.

[b] Included with Colorado.

Of the 25 State and Territories in which coke was produced in 1906 there were 16 in which the production increased and 9 that showed a decreased output. All of those in which the production decreased were comparatively unimportant producers, their combined output amounting to less than 650,000 short tons. The 9 States in which the production decreased were Georgia, Indian Territory, Kansas, Kentucky, Michigan, Minnesota, Missouri, Washington, and Wyoming, and their total decreases amounted to 29,545 tons. The increases in the 16 other States amounted to 4,199,633 tons, making a net increase for the United States of 4,170,088 tons. The production from the by-product ovens increased from 3,462,348 short tons to 4,558,127 tons, a gain of 1,095,779 tons, or 31.6 per cent. The production of beehive ovens increased from 28,768,781 short tons in 1905 to 31,843,090 tons in 1906, a gain of 3,074,309 tons, or 10.7 per cent. The most notable increases were in Pennsylvania, whose production increased 2,486,775 tons, or 12.09 per cent; Alabama, whose increase was 457,515 tons, or 17.75 per cent; and West Virginia, whose increase amounted to 312,921 tons, or 9.2 per cent. The greatest percentage of increase was shown by Illinois, whose production in 1905 was 10,307 tons, and in 1906 268,693 tons, this being due to the fact that a bank of 160 Semet-Solvay ovens at South Chicago was put in blast during 1906. Illinois's percentage of increase in 1906 was 2,506.9.

The increases and decreases in the several States in 1906, as compared with 1905, are shown in the following table:

Increase and decrease in coke production, by States and Territories, in 1906, as compared with 1905 (in short tons).

State or Territory.	Total quantity.		Increase.		Decrease.	
	1906.	1905.	Quantity.	Percentage.	Quantity.	Percentage.
Alabama	3,034,501	2,576,986	457,515	17.75		
Colorado [a]	1,455,905	1,378,824	77,081	5.59		
Georgia	70,280	70,593			313	0.44
Illinois	268,693	10,307	258,386	2,506.9		
Indian Territory	49,782	54,781			4,999	9.13
Kansas	1,698	4,425			2,727	61.63
Kentucky	74,064	79,487			5,423	6.82
Missouri	0	1,580			1,580	100.00
Montana	38,182	31,482	6,700	21.28		
New Mexico	147,747	89,638	58,109	64.83		
Ohio	293,994	277,130	16,864	6.09		
Pennsylvania	23,060,511	20,573,736	2,486,775	12.09		
Tennessee	483,428	468,092	15,336	3.28		
Virginia	1,577,659	1,499,481	78,178	5.21		
Washington	45,642	53,137			7,495	14.11
West Virginia	3,713,514	3,400,593	312,921	9.2		
Maryland Massachusetts Michigan Minnesota New Jersey New York Wisconsin Wyoming	2,085,617	1,660,857	424,760	25.57		
Total	36,401,217	32,231,129	4,170,088	12.94		

[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 the last four years was 29,391,933 tons, an increase of 42.1 per cent over the average production for the five years from 1898 to 1902, inclusive.

In the following table are given the statistics of the manufacture of coke in the years 1880 and 1890 and from 1900 to 1906 inclusive.

Statistics of the manufacture of coke in the United States in 1880, 1890, and 1900–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Percentage yield of coal in coke.
		Built.	Building.					
1880	186	12,372	1,159	5,237,741	3,338,300	$6,631,267	$1.99	63.0
1890	253	37,158	1,547	18,005,209	11,508,021	23,215,302	2.02	64.0
1900	396	58,484	5,804	32,113,553	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	65.1
1906	532	93,901	4,519	55,746,374	36,401,217	91,608,034	2.52	65.3

The statistics of the production of coke in each State and Territory for the last five years, and the total annual production since 1880, are shown in the following tables. During the twenty-seven 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 in 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, 1902–1906, by States and Territories, in short tons.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	2,552,246	2,693,497	2,340,219	2,576,986	3,034,501
Colorado [a]	1,003,393	1,053,840	789,060	1,378,824	1,455,905
Georgia	82,064	85,546	75,812	70,593	70,280
Illinois			4,439	10,307	268,693
Indian Territory	49,441	49,818	44,808	54,781	49,782
Kansas	20,902	14,194	9,460	4,425	1,698
Kentucky	126,879	115,362	64,112	79,487	74,064
Missouri	5,780	1,839	2,446	1,580	
Montana	53,463	45,107	41,497	31,482	38,182
New Mexico	23,296	11,050	58,259	89,638	147,747
Ohio	146,099	143,913	109,284	277,130	293,994
Pennsylvania	16,497,910	15,650,932	14,861,064	20,573,736	23,060,511
Tennessee	560,006	546,875	379,240	468,092	483,428
Utah	(b)	(b)	(b)	(b)	(b)
Virginia	1,124,572	1,176,439	1,101,716	1,499,481	1,577,659
Washington	40,305	45,623	45,432	53,137	45,642
West Virginia	2,516,505	2,707,818	2,283,086	3,400,593	3,713,514
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	598,869	932,428	1,451,172	1,660,857	2,085,617
Total	25,401,730	25,274,281	23,661,106	32,231,129	36,401,217

a Colorado includes Utah. *b* Included with Colorado.

Quantity of coke produced in the United States, 1880–1906, in short tons.

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	1906	36,401,217

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 continued activity and expansion of the iron and steel industries through 1906, added to the scarcity of fuel brought about by the suspension of coal-mining operations on April 1, resulted in a still further advance in prices during 1906 and an increase of $19,131,-838 over the high record made in 1905.

Total value, at the ovens, of the coke made in the United States, 1902–1906, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	$8,300,838	$7,622,528	$5,716,413	$7,646,957	$8,477,899
Colorado	[a] 2,754,341	[a] 3,089,783	[a] 2,590,251	[a] 4,157,517	[a] 4,504,748
Georgia	298,963	368,351	212,697	224,260	277,921
Illinois	....	....	9,933	27,681	1,205,462
Indian Territory	202,921	227,542	209,165	199,424	204,205
Kansas	54,702	50,221	23,485	13,818	4,101
Kentucky	317,875	305,327	138,226	159,659	169,846
Missouri	14,450	5,797	6,115	4,072	....
Montana	360,927	310,882	280,745	211,351	266,024
New Mexico	74,051	31,539	171,976	253,229	442,712
Ohio	492,793	528,142	337,606	970,897	1,013,248
Pennsylvania	38,451,722	38,969,101	25,027,462	42,253,178	54,184,531
Tennessee	1,597,041	1,706,722	905,540	1,184,442	1,350,856
Utah	(b)	(b)	(b)	(b)	(b)
Virginia	2,322,228	2,724,047	1,772,717	2,869,452	3,611,659
Washington	199,195	214,776	207,357	251,717	226,977
West Virginia	5,833,226	7,115,842	3,757,850	6,548,205	8,192,956
Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	2,063,894	3,228,064	4,777,403	5,500,337	7,474,889
Total	63,339,167	66,498,664	46,144,941	72,476,196	91,608,034

[a] Includes value of Utah coke. [b] Included with Colorado.

Total value, at the ovens, of the coke made in the United States, 1880–1906.

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	1906	91,608,034

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 five 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-seven 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 strike and to the shortage of fuel caused thereby. A slump in the iron trade during the summer of 1904 checked production and reacted on the coking industry so that the output decreased and values were so demoralized that the average price for the year was the lowest since 1899. The setback of 1904 was, however, temporary, and 1905 developed into a year with exceptional activity and good prices, there being but a few weeks during the summer when demand was not up to supply and when prices were temporarily demoralized. The year 1906 was one of the most profitable and satisfactory in the history of the trade. This is shown by the fact that the average price for the year was $2.52, which was only 11 cents less than the extraordinarily high price developed in 1903, when the production, however, was only 25,274,281 short tons, while in 1906 it was 36,401,217 short tons.

The average prices of coke, by States, from 1901 to 1906, inclusive, and for the United States from 1880 to 1906 are shown in the following tables:

Average price per short ton, at the ovens, of the coke made in the United States, 1902–1906, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	$3.25	$2.83	$2.44	$2.97	$2.79
Colorado [a]	2.74	2.93	3.28	3.02	3.09
Georgia	3.64	4.31	2.81	3.18	3.95
Illinois	....	....	2.24	2.69	4.48
Indian Territory	4.10	4.57	4.67	3.64	4.10
Kansas	2.62	3.54	2.48	3.12	2.42
Kentucky	2.51	2.65	2.15	2.01	2.29
Missouri	2.50	3.15	2.50	2.58	....
Montana	6.75	6.89	6.77	6.71	6.97
New Mexico	3.18	2.85	2.95	2.83	3.00
Ohio	3.37	3.67	3.09	3.50	3.45
Pennsylvania	2.33	2.49	1.68	2.05	2.35
Tennessee	2.85	3.12	2.39	2.53	2.79
Utah	(b)	(b)	(b)	(b)	(b)
Virginia	2.07	2.32	1.61	1.91	2.29
Washington	4.94	4.71	4.56	4.74	4.97
West Virginia	2.32	2.63	1.65	1.92	2.21
Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	3.45	3.46	3.29	3.31	3.58
Average	2.49	2.63	1.95	2.25	2.52

[a] Includes Utah. [b] Included with Colorado.

Average price per short ton, at the ovens, of the coke made in the United States, 1880–1906.

1880	$1.99	1889	$1.62	1898	$1.59
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	2.04
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	1.84	1905	2.25
1888	1.46	1897	1.66	1906	2.52

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 at the end of each year from 1901 to 1906, inclusive, is shown in the following table. The numbers reported in 1850, 1860, and 1870 are for the census years; the others are for calendar years.

Number of coke establishments in the United States since 1850.

1850 (census year)	4	1890, December 31	253	1903, December 31	500
1860 (census year)	21	1900, December 31	396	1904, December 31	506
1870 (census year)	25	1901, December 31	423	1905, December 31	519
1880, December 31	186	1902, December 31	456	1906, December 31	532

The 532 establishments at the close of 1906 included 15 with a total of 1,887 ovens which were not completed or had not been put in blast during the year and consequently did not contribute to the production. In addition to these there were 69 plants having a total of 5,305 ovens idle during the entire year. The latter were for the most part comparatively small plants having an average of 77 ovens each. The majority of them have been idle for several years, and some of them have been practically abandoned. Deducting the idle plants and those not completed before the end of the year from the total of 532 plants, it is found that there were 448 active plants during 1906 with a total of 88,596 ovens, or an average of 198 ovens to each plant.

The total production from the 448 active establishments in 1906 was 36,401,217 short tons, or an average of 81,253 tons for each plant. In 1905 there were 434 active plants, the total production from which was 32,231,129 short tons, or an average of 74,265 tons each, indicating that the average output from each plant in 1906 was 9.4 per cent greater than it was in 1905. In 1880, the first year for which these statistics were collected, there were 186 establishments, the average production from which was 17,948 short tons, indicating that the average output from each plant in 1906 was 4.5 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 separate plants or banks of ovens whether operated or idle and whether reported from one central office or not. Different plants controlled or operated by one company are considered separate establishments.

The following tables show the number of coke ovens in existence in each State or Territory for the last five years and at the end of each five years since 1880:

Number of coke ovens in each State or Territory at the close of each year, 1902–1906.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	7,571	8,764	9,059	9,586	9,731
Colorado	3,010	3,455	3,419	3,421	3,419
Georgia	492	500	500	533	531
Illinois	149	155	155	275	309
Indiana	50	36	36	36	48
Indian Territory	280	286	286	388	490
Kansas	97	91	90	91	81
Kentucky	485	499	449	495	462
Maryland	....	200	200	200	200
Massachusetts	400	400	400	400	400
Michigan	75	75	135	135	150
Minnesota	....	....	50	50	50
Missouri	8	8	8	6	6
Montana	410	555	520	555	555
New Jersey	100	100	100	100	150
New Mexico	126	126	234	258	571
New York	30	40	352	399	540
Ohio	449	440	539	573	575
Pennsylvania	36,609	40,239	42,165	42,608	47,185
Tennessee	2,269	2,439	2,436	2,615	2,731
Utah	404	504	504	504	684
Virginia	2,974	4,251	4,345	4,549	4,641
Washington	231	256	256	216	216
West Virginia	12,656	15,613	16,929	19,189	19,714
Wisconsin	120	228	308	308	388
Wyoming	74	74	74	74	74
Total	69,069	79,334	83,599	87,564	93,901

Number of coke ovens in the United States on December 31 of each fifth year, from 1880 to 1906.

1880	12,372	1900	58,484
1885	20,116	1905	87,564
1890	37,158	1906	93,901
1895	45,565		

A statement of the number of ovens in course of construction at the end of each year since 1901 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 number of new ovens completed during any one year. It merely exhibits the condition of the industry as shown 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, 1901–1906.

1901	5,205	1904	4,430
1902	8,758	1905	4,751
1903	6,175	1906	4,519

RANK OF COKE-PRODUCING STATES.

In the following table is shown the relative importance of the different coke-producing States and Territories during the last five years. Pennsylvania, in the manufacture of coke as in the production of coal, has headed the list since these reports have been published. West Virginia and Alabama have for the last twenty-five years been rivals for second place, alternating frequently, and West

Virginia has held it twice consecutively in 1905 and 1906, the first time in six years that either State has done so. All of the seven most important States hold the same rank in 1906 as in 1905. The principal changes in 1906 were the advance of New York from fourteenth to eighth place and of Illinois from twenty-second to fourteenth, the advance being due to the operations of by-product coke plants in those States.

Rank of the States and Territories in production of coke, 1902–1906.

State or Territory.	1902.	1903.	1904.	1905.	1906.	State or Territory.	1902.	1903.	1904.	1905.	1906.
Pennsylvania	1	1	1	1	1	Illinois	22	23	23	22	14
West Virginia	3	2	3	2	2	New Jersey	......	13	13	13	15
Alabama	2	3	2	3	3	New Mexico	18	21	17	15	16
Virginia	4	4	4	4	4	Minnesota	......	......	21	16	17
Colorado	5	5	5	5	5	Kentucky	9	12	16	17	18
Tennessee	6	6	7	6	6	Georgia	11	14	15	18	19
Massachusetts	7	7	6	7	7	Indian Territory	15	17	19	19	20
New York	16	16	11	14	8	Washington	17	18	18	20	21
Maryland	......	8	8	8	9	Montana	13	19	20	21	22
Utah	10	9	9	11	10	Kansas	19	20	22	23	23
Michigan	14	11	10	9	11	Wyoming	20	22	24	24	24
Ohio	8	10	14	10	12	Missouri	21	24	25	25	......
Wisconsin	12	15	12	12	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 quantity 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 mines.

The quantity of coal used in the manufacture of coke, as obtained for this report, in the several States and Territories, from 1902 to 1906, and the total quantity used each five years since 1880, are shown in the tables which follow:

Quantity of coal used in the manufacture of coke in the United States, 1902–1906, by States and Territories, in short tons.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	4,237,491	4,483,942	3,996,578	4,409,854	5,184,597
Colorado [a]	1,695,188	1,776,974	1,376,354	2,368,365	2,566,196
Georgia	129,642	146,086	132,270	119,036	128,052
Illinois	....	....	8,131	16,821	362,163
Indian Territory	110,934	110,088	98,847	123,389	95,296
Kansas	35,827	30,503	14,525	6,504	2,807
Kentucky	265,121	247,950	140,139	154,783	148,448
Missouri	10,430	3,004	3,815	2,551	0
Montana	99,628	82,118	78,303	68,777	69,045
New Mexico	40,943	18,613	94,397	148,469	261,609
Ohio	219,401	211,473	165,487	396,961	437,567
Pennsylvania	25,017,326	23,724,207	22,432,064	31,030,345	34,503,513
Tennessee	1,025,864	1,001,356	718,181	862,320	929,405
Utah	(b)	(b)	(b)	(b)	(b)
Virginia	1,716,110	1,860,225	1,636,905	2,184,369	2,296,227
Washington	68,546	73,119	76,993	85,715	76,896
West Virginia	4,078,579	4,347,160	3,543,338	5,329,695	5,822,619
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	852,977	1,306,707	2,015,281	2,222,723	2,861,934
Total	39,604,007	39,423,525	36,531,608	49,530,677	55,746,374

[a] Includes coal coked in Utah. [b] Included with Colorado.

Quantity of coal used annually in the manufacture of coke in the United States each fifth year, 1880–1906.

	Short tons.		Short tons.
1880	5,237,741	1900	32,113,543
1885	8,071,126	1905	49,530,677
1890	18,005,209	1906	55,746,374
1895	20,848,323		

QUANTITY AND VALUE OF COAL USED IN COKE MAKING.

The total quantity and value of the coal consumed in the manufacture of coke in 1905 and 1906, 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 1906 was 55,746,374 short tons, against 49,530,677 tons in 1905. The value of the coal used in 1906 was $62,232,524, compared with $50,614,674 in 1905, there being a considerable difference in the value as compared with the quantity. In 1905 the average value per ton of the coal used was $1.02, and in 1906 it was $1.12, a difference of $0.10. There was also a marked difference in the value of the coke product, which was $72,476,196, or $2.25 per ton, in 1905, and $91,608,034, or $2.52 per ton, in 1906.

Quantity and value of coal used in the manufacture of coke in the United States in 1905 and 1906, and quantity and value of same per ton of coke, by States and Territories.

1905.

State or Territory.	Coal used (short tons).	Total value of coal.	Value of coal per ton.	Quantity of coal per ton of coke (short tons).	Value of coal to a ton of coke.
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

1906.

State or Territory.	Coal used (short tons).	Total value of coal.	Value of coal per ton.	Quantity of coal per ton of coke (short tons).	Value of coal to a ton of coke.
Alabama	5,184,597	$6,582,102	$1.27	1.708	$2.169
Colorado [a]	2,566,196	2,544,677	.992	1.762	1.748
Georgia	128,052	151,659	1.18	1.822	2.15
Illinois	362,163	968,351	2.67	1.347	3.596
Indian Territory	95,296	124,383	1.305	1.914	1.498
Kansas	2,807	3,306	1.177	1.653	1.946
Kentucky	148,448	65,648	.44	2.004	.882
Montana	69,045	210,615	3.05	1.808	5.514
New Mexico	261,609	246,460	.942	1.77	1.667
Ohio	437,567	823,749	1.88	1.488	2.797
Pennsylvania	34,503,513	35,395,374	1.025	1.496	1.533
Tennessee	929,405	955,739	1.028	1.922	1.976
Virginia	2,296,227	2,251,143	.98	1.455	1.426
Washington	76,896	154,964	2.015	1.684	3.393
West Virginia	5,822,619	5,230,561	.898	1.567	1.407
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, Wyoming	2,861,934	6,523,793	2.28	1.372	3.128
Total	55,746,374	62,232,524	1.116	1.531	1.709

[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. It will be observed that during the last three years there has been a steady decrease in the consumption of coal per unit of coke, due for the most part to the development of by-product coke manufacture, in which the yield of coke is considerably more than in beehive ovens.

Coal required to produce a ton of coke, in tons and pounds.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1880	1.57	3,140	1903	1.56	3,120
1890	1.56	3,120	1904	1.544	3,088
1900	1.57	3,140	1905	1.537	3,074
1901	1.57	3,140	1906	1.531	3,062
1902	1.56	3,120			

YIELD OF COAL IN COKE.

By the yield of coal in coke is meant the percentage by weight of the constituents of the coal that remain as coke after the process of coking is completed. The following table shows that the general average yield of coal in coke is about 64 per cent, but this is believed to be somewhat excessive. For the reasons stated in connection with the 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. What has been said in regard to the decreased consumption of coal per unit of coke in connection with the preceding tables, due to the larger production in by-product ovens, is also applicable here in connection with the increased percentage yield in the last three years.

The following tables show the percentage yield of coal in coke in each State and Territory during the last five years, and for the United States each ten years since 1880 and each year since 1901:

Percentage yield of coal in coke, 1902–1906, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	60.2	60	58.6	58.4	58.5
Colorado [a]	59.2	59.3	57.3	58.2	56.7
Georgia	63.3	58.5	57.3	59.3	54.9
Illinois	....	....	54.6	61.3	74.2
Indian Territory	44.6	45	45.3	44.4	52.2
Kansas	58.3	46.5	65	68	60.5
Kentucky	47.8	46.5	45.7	51.4	49.9
Missouri	55.4	61.2	64	61.9	....
Montana	53.7	54.9	53	45.8	55.3
New Mexico	56.9	59.4	61.7	60.4	56.5
Ohio	66.6	68	66	69.8	67.2
Pennsylvania	65.9	65.9	66.2	66.3	66.8
Tennessee	54.6	54.6	52.8	54.3	52
Virginia	65.5	63.2	67.3	68.6	68.7
Washington	58.8	62.4	59	62	59.4
West Virginia	61.7	62.3	64.4	63.8	63.8
Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	70.2	71.3	72	74.7	72.9
Total average	64.1	64.1	64.8	65.1	65.3

[a] Average, including Utah.

Percentage yield of coal in coke, 1880–1906.

1880	63	1901	63.7	1904	64.8
1890	64	1902	64.1	1905	65.1
1900	63.9	1903	64.1	1906	65.3

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 1906, 13,620,713 short tons, or 24.4 per cent, of the total quantity of coal used in coke making was slack, and of this slack coal 5,835,912 short tons, or 42.8 per cent, was washed before being coked. Of the run-of-mine coal used in coke making 17.5 per cent (7,377,403 tons out of a total of 42,125,661 tons in 1906) was washed before coking. There was a decided increase in the quantity of coal washed before coking in 1906 as compared with 1905, as shown by the fact that 13,213,315 tons were washed in 1906, against 9,551,137 in 1905.

Among the more important coke-producing States it is to be observed that in Pennsylvania only about 9 per cent of the coal used in 1906 was slack, and that 12.6 per cent of the run-of-mine coal used was washed. In 1905 only 5 per cent of the run-of-mine coal used in Pennsylvania was washed. In West Virginia nearly two-thirds of the coal charged into the ovens is slack, and of this about 10 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 10 per cent of the coal was washed in 1906, all of the washed coal being run of mine. In Colorado and Utah about 70 per cent of the coal coked in 1906 was slack, three-fourths of which is washed. All of the coal used in New Mexico is washed slack. In Tennessee about 60 per cent of the coal used is run of mine, nearly all of which is washed, and 40 per cent is slack, of which 60 per cent is washed.

Character of coal used in the manufacture of coke, by States and Territories, in 1905 and 1906, in short tons.

1905.

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	1,257,204	176,663	251,728	537,128	2,222,723
New Jersey					
New York					
Wisconsin					
Wyoming					
Total	31,783,314	3,187,994	8,196,226	6,363,143	49,530,677

1906.

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Alabama	1,493,549	1,810,089	121,122	1,759,837	5,184,597
Colorado [a]	4,866	703,440	1,065,353	792,537	2,566,196
Georgia	0	26,488	0	101,564	128,052
Illinois	251,870	0	0	110,293	362,163
Indian Territory	50,802	0	0	44,494	95,296
Kansas	0	0	2,807	0	2,807
Kentucky	1,000	0	65,126	82,322	148,448
Montana	12,935	56,110	0	0	69,045
New Mexico	0	0	0	261,609	261,609
Ohio	356,540	0	38,737	42.290	437,567
Pennsylvania	27,471,566	3,972,712	1,584,152	1,475,083	34.503.513
Tennessee	81,825	509,532	142,843	195,205	929,405
Virginia	1,014.299	228,347	1,053,581	0	2,296,227
Washington	0	70,685	0	6,211	76,896
West Virginia	2,093,483	0	3,388,877	340,259	5,822,619
Maryland					
Massachusetts					
Michigan					
Minnesota	1,915,523	0	322,203	624,208	2,861,934
New Jersey					
New York					
Wisconsin					
Wyoming					
Total	34,748,258	7,377,403	7,784,801	5,835,912	55,746,374

[a] Includes Utah.

In the following table are given the statistics regarding the character of the coal used in coke making for the years 1890, 1895, 1900, 1905, and 1906:

Character of coal used in the manufacture of coke in the United States, 1890–1906, in short tons.

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	14,060,907	338,563	2,674,492	931,247	18,005,20[illegible]
1895	15,609,875	237,468	3,052,246	1,948,734	20,848,32[illegible]
1900	21,062,090	1,369,698	5,677,006	4,004,749	32,113,54[illegible]
1905	31,783,314	3,187,994	8,196,226	6,363,143	49,530,67[illegible]
1906	34,748,258	7,377,403	7,784,801	5,835,912	55,746,37[illegible]

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 quantity 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; in 1905 it was 19 per cent, and in 1906 it was 23.7 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 oven completed in in 1906 was 3,603, against 3,159 in 1905 and 2,910 in 1904. The increase in 1906 over 1905 was 444, or 14 per cent. The production of by-product coke has increased from 2,608,229 short tons in 1904 to 3,462,348 tons in 1905, and to 4,558,127 tons in 1906, the gain in 1906 over 1905 being 1,095,779 short tons, or 31.6 per cent. The increase in 1905 over 1904 was 854,119 tons, or 32.7 per cent. Of the 3,603 by-product ovens in 1906, 241 were idle, leaving 3,362 ovens which made coke last year.

The average production of the 3,362 by-product ovens in operation in 1906 was 1,356 short tons of coke, as compared with an average production for each oven in 1905 of 1,158.8 tons and in 1904 of 896 tons. The average production from the beehive ovens in blast was 373.6 tons in 1906, 365.8 tons in 1905, and 283.5 tons in 1904.

The quantity of coal consumed in the manufacture of the 4,558,127 tons of by-product coke in 1906 was 6,192,086 short tons, indicating a yield of coal in coke of 73.6 per cent. In 1905 the percentage yield of coal in coke in by-product ovens was 74.8 and in 1904 it was 73. These are much larger yields than can possibly be obtained in beehive ovens, as a portion of the "fixed" carbon in the coal is unavoidably burned in beehive-oven practice, while in the retort oven the operation is one of distillation only without the admission of air and all of the fixed carbon remains as coke. As previously shown, the average yield of coal in coke (including the output of by-product recovery ovens) for the United States in the last few years has been about 65 per cent, and this is probably higher than the results actually obtained. The increase in the production of by-product coke is responsible for an increase in the general average yield of coal in coke in each of the last three years, from 64.1 in 1903 to 64.8 in 1904, 65.1 in 1905, and 65.3 in 1906.

What has been already commented on in previous reports about the slowness of manufacturers to change from the better known but wasteful beehive practice to the by-product recovery method of coke manufacture is particularly emphasized in the statistics presented in this chapter. For it would appear from the table following that the construction of by-product ovens had about come to a standstill, especially when the records for the preceding five years are taken into consideration. At the close of 1901, when there were only 1,165 by-product ovens completed in the United States, there were 1,533 in course of construction, 498 of which were completed during the following year. At the close of 1902, 1,346 retort ovens were building, 293 of which were added to the completed plants in 1903. At the close of 1903, 1,335 new ovens were building and 954 of these were put in blast before January 1, 1905, at which time 832 new ovens were in course of construction. At the close of 1905 there were only 417 new ovens building, and at the close of 1906 new work was limited to 112 Otto-Hoffmann ovens, which were being added to the 260 ovens already built at Johnstown, Pa., by the Cambria Steel Company. These new ovens were completed and put in blast in February, 1907.

This condition is somewhat difficult to understand when the economies effected by the use of retort ovens have been so clearly demonstrated. These economies consist not only in the higher yield of coal in coke, but in the recovery of the valuable by-products of gas, tar, and ammonia. One of the reasons that has been assigned for the comparatively retrogressive condition exhibited by the statistics for 1905 and 1906 (comparison being made with beehive oven construction, 5,893 new beehive ovens having been completed in 1906, with 4,407 building at the close of the year) is the lack of a profitable market for coal tar, and yet the United States is importing coal-tar products to the value of several million dollars annually, while the development of the fuel-briquetting industry has been held back because of the lack of assurance of a steady supply of coal-tar pitch for a binder, and users of creosoting oils for the preservation of timber complain of an insufficient domestic supply of this product of coal-tar distillation.

There does not appear to be any trouble in disposing of the ammonia, for which a good demand exists, and the practicability of long distance transmission of the gas has been successfully demonstrated, thus insuring markets for the surplus of this retort-oven product. The Otto-Hoffmann oven plant at Camden, N. J., is distributing gas to Plainfield, New Brunswick, and other cities and towns, the maximum distance being 83 miles.

The original cost of installation and the length of time required to build a by-product oven plant as compared with a beehive, together with the well-known unwillingness of iron masters to adopt a new fuel, are probably the most potent factors in holding back the development of the by-product coking industry. The prejudice of blast-furnace managers against retort-oven coke, the appearance of which, compared with Connellsville or other high-grade beehive coke, is indeed somewhat against it, has been decidedly pronounced; but this is gradually yielding, and must in the end yield entirely, to the effects of successful experience with by-product coke. The fact that the Cambria Steel Company, of Johnstown, Pa., has added a fourth installment of 112 ovens to its by-product plant, making the total 372 ovens, is sufficient evidence on this point. Of the 25 by-product plants in the United States, 15 produce coke for blast-furnace use. Aside from the 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 coal in communities forbidding the use of smoke-producing fuels is growing. In the course of time the wasteful beehive oven must give place to the more advanced and more economical recovery oven, and with this change will come a transfer, in large part, of the coking industry from the coal mining regions to points nearer the places of consumption, particularly of the coke and gas, and with this will also be made a long stride in the abatement of the smoke nuisance, from which so many of the interior and western cities are endeavoring to escape.

The most important development in by-product oven construction promised for the future is in the announcement made by the United States Steel Corporation that a plant of 1,000 retort ovens will be built at Gary, Ind., and operated in connection with the new steel works under construction at that place. The type and the general method of construction have not been made public, but the ovens are reported as being different in design from the ones now in use, the aim being to produce a coke capable of supporting the heavy load of the modern blast furnace and a gas of high calorific value and in sufficient quantity for fuel in the manufacture of open-hearth steel. This is an encouraging sign, and bears out the prediction made in the preceding paragraph.

The first plant of by-product ovens built in the United States was one of 12 Semet-Solvay ovens at Syracuse, N. Y. It was completed in 1893, 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 oven 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 1906 there were 1,295 Semet-Solvay ovens in operation, with none building; of the Otto-Hoffmann type there were 1,890 completed and 112 building. In addition to these there were 362 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.

In the following table is shown the record of by-product coke making since 1893, when the first plant was established at Syracuse, N. Y.:

Record of by-product coke making, 1893–1906.

Year.	Ovens.		Production. (short tons).	Year.	Ovens.		Production (short tons).
	Built.	Building.			Built.	Building.	
1893	12	0	12,850	1900	1,085	1,096	1,075,727
1894	12	60	16,500	1901	1,165	1,533	1,179,900
1895	72	60	18,521	1902	1,663	1,346	1,403,588
1896	160	120	83,038	1903	1,956	1,335	1,882,394
1897	280	240	261,912	1904	2,910	832	2,608,229
1898	520	500	294,445	1905	3,159	417	3,462,348
1899	1,020	65	906,534	1906	[a] 3,603	[b] 112	4,558,127

[a] Includes 1,295 Semet-Solvay, 1,890 Otto-Hoffmann, 362 Rothberg, and 56 Newton-Chambers.
[b] Otto-Hoffmann.

In the following table is shown the record of by-product coke ovens, by States, at the close of 1902–1906:

Record of by-product ovens, by States, 1902–1906.

State.	Dec. 31, 1902.		Dec. 31, 1903.		Dec. 31, 1904.		Dec. 31, 1905.		Dec. 31, 1906.	
	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Building.
Alabama	240	40	240	40	240	40	280	0	280	0
Illinois	0	0	0	120	0	120	120	0	160	0
Maryland	0	200	200	0	200	0	200	0	200	0
Massachusetts	400	0	400	0	400	0	400	0	400	0
Michigan	75	60	75	60	135	0	135	15	150	0
Minnesota	0	0	0	50	50	0	50	0	50	0
New Jersey	100	0	100	0	100	0	100	50	150	0
New York	30	574	40	500	352	658	399	0	540	0
Ohio	50	60	50	66	116	14	130	0	130	0
Pennsylvania	592	412	675	419	1,061	0	1,089	272	1,207	112
Virginia	56	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	80	80	0	80	80	160	0
Total	1,663	1,346	1,956	1,335	2,910	832	3,159	417	3,603	112

The distribution by States and by kind of by-product ovens built and building in the United States at the close of 1906 is shown in the following table:

Kind of by-product coke ovens built and building in the United States, by States, at the close of 1906.

State.	Semet-Solvay.		Otto-Hoffmann and Schniewind.		Rothberg.		Total.	
	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.
Alabama	280	....	....	....	....	....	280	0
Illinois	160	....	....	....	....	....	160	0
Maryland	....	....	200	....	....	....	200	0
Massachusetts	....	....	400	....	....	....	400	0
Michigan	120	....	30	....	....	....	150	0
Minnesota	....	....	50	....	....	....	50	0
New Jersey	....	....	150	....	....	....	150	0
New York	70	....	188	....	282	....	540	0
Ohio	....	....	50	....	80	....	130	0
Pennsylvania	385	....	822	112	....	....	1,207	112
Virginia	....	....	....	....	....	....	[a] 56	0
West Virginia	120	....	....	....	....	....	120	0
Wisconsin	160	....	....	....	....	....	160	0
Total	1,295	....	1,890	112	362	....	3,603	112

[a] Newton-Chambers.

The writer is indebted to Mr. Albert Ladd Colby for the following compilation showing, in addition to the number of ovens at each by-product plant in the United States and Canada, the uses to which the coke and gas are put, the dates the plants were put in operation, and other interesting information regarding their construction and operation. This statement includes also the garbage-carbonizing plant of Semet-Solvay ovens at Boston, Mass. The ovens classed as "Otto" include Otto-Hoffmann, United-Otto, and Schniewind types.

Complete list of by-product coke-oven plants of the United States and Canada, January 1, 1907.

State.	Town.	System.	Name of company.	Number of installments.	Date put in operation.	Number of ovens.	Uses of coke.	Uses of surplus gas.	Remarks.
Mass.	Boston	Semet-Solvay	City plant for carbonizing garbage.		1898	*a* 400	Domestic (?)	Illuminating gas for Boston and vicinity.	Make sulphate.
	Everett	Otto	New England Gas and Coke Co.		June, 1899	400	Domestic and locomotive in about equal proportion.	Illuminating gas and fuel gas; 6,000,000 to 7,000,000 cubic feet daily of illuminating gas.	Have inclined coke-quenching car. First illuminating gas system installed. Use Bell washers.
N. Y.	Syracuse	Semet-Solvay	Solvay Process Co	First	Jan., 1893	12	Burning limestone; also iron foundry.		First by-product plant in United States. Main purpose to obtain ammonia for alkali works.
				Second	1896	*b* 25			
				Third	Bet. 1896–1905.	*b* 40			
	Geneva		The Empire Coke Co.	First	Aug., 1904	30			
	Buffalo	Otto	Lackawanna Steel Co.		May, 1904	*c* 564	Blast furnace	Fuel gas	282 are Rothberg ovens. Make sulphate. Used stamped coal, but have now gone back to top-charging (1907).
N. J.	Camden	do	South Jersey Gas, Electric and Traction Co.	First	About Jan., 1903.	100	Foundry and domestic (domestic coke crushed and sized for sale).	Illuminating gas and fuel gas 2,500,000 to 3,000,000 cubic feet. Illuminating gas pumped daily under 10 pounds pressure to Trenton, 38 miles distant. In 1906 extended delivery of illuminating gas to New Brunswick and Plainfield, 83 miles from Camden. Towns now included: Camden, Bordentown, Woodbury, Trenton, New Brunswick, Plainfield, and smaller towns.	(Have end burners.) Sell ammonia liquor. First to install enrichment by benzol transfer.
				Second	July, 1906	50			
Pa.	Dunbar	Semet-Solvay	The Dunbar Furnace Co.	First	Aug., 1896	50	Blast furnace		
				Second	July, 1903	60			
	Chester	do	The Suburban Gas Co.	First	Apr., 1904	40			
	Sharon	do	The National Steel Co.	do	Oct., 1896	25			
	South Sharon	Otto	Sharon Coke Co.		July, 1903	210	Blast furnace	Fuel gas	Make sulphate.

a Small. *b* Increased to. *c* Contracted for; 188 in operation in January, 1907.

Complete list of by-product coke-oven plants of the United States and Canada, January 1, 1907—Continued.

State.	Town.	System.	Name of company.	Number of installments.	Date put in operation.	Number of ovens.	Uses of coke.	Uses of surplus gas.	Remarks.
Pa.	Glassport	Otto	Pittsburg Gas and Coke Co.		Feb., 1897	120	Blast furnace and domestic. Installed a crushing outfit in 1905.	Illuminating gas and fuel gas to McKeesport.	
	Johnstown	do	Cambria Steel Co	First	Nov., 1895	60	Blast furnace	Fuel gas and power gas	60 ovens old type Otto-Hoffmann.
				Second	Mar., 1899	100			100 ovens old-type Schniewind.
				Third	Sept., 1904	100			100 ovens new-type Schniewind.
				Fourth	Feb., 1907	*a* 112			Have the Moore coke quencher.
	Lebanon	Semet-Solvay	Pennsylvania Steel Co.	First	July, 1904	90	Blast furnace	Semet-Solvay Co. delivers surplus gas to Pennsylvania Steel Co., which sells it to American Iron and Steel Mfg. Co. for use in heating furnaces.	Erected by Semet-Solvay Co. at expense of Pennsylvania Steel Co. "Five high" type of oven.
	Lebanon	Otto	Lackawanna Steel Co.		Mar., 1903	232	do	Fuel gas	Have gone back to top-charging since resumption.
	Steelton	Semet-Solvay	Pennsylvania Steel Co.	First	Jan., 1907	120	do		"Five high" type of oven.
W. Va.	Benwood	do	National Tube Co.	First	Oct., 1898	60			
				Second	Mar., 1901	60			
Md.	Sparrows Point.	Otto	Maryland Steel Co.	First	Mar., 1903	200	Blast furnace	Illuminating gas for city of Baltimore, 11 miles distant; 4,000,000 cubic feet daily.	Make sulphate.
Ala.	Ensley (near Birmingham).	Semet-Solvay	Tennessee Coal, Iron and R. R. Co.	First	Oct., 1898	120	do		
				Second	Mar., 1902	120	do		
	Tuscaloosa	do	Central Iron and Coal Co.	First	Since 1905	40	do		"Five high" type of oven.
Ohio.	Hamilton	Otto	Hamilton Otto Coke Co.		Apr., 1901	50	Mostly domestic; some foundry. Installed crushing outfit 1905.	Illuminating gas for Hamilton; also power gas.	Have end burners. Sell ammonia liquor. Have inclined coke wharf.
	Cleveland	Rothberg	Cleveland Furnace Co. Wellman-Seaver-Morgan Co.		About Apr., 1905.	80	Blast furnace		Use stamped coal.

Ill	South Chicago on Calumet River.	Semet-Solvay		First	1905	120	Blast furnace and foundry.		
				Second	1906	40			
Wis	Milwaukee	do	Milwaukee Coke and Gas Co.	First	Mar., 1904	80			
				Second	1906	80			
Mich	Detroit	do	The Solvay Process Co.	First	Sept., 1901	30			
				Second	Nov., 1902	30			
				Third	July, 1903	60			
	Wyandotte	Otto	Michigan Alkali Co	First	Oct., 1902	15	Burning limestone.	Fuel gas	Use the by-products in their works. Use the Moore coke-quencher.
				Second	Aug., 1906	15			
Minn	Duluth	do	Zenith Furnace Co	First	July, 1904	50	Blast furnace	Illuminating gas for Duluth.	Have end burners. Have inclined coke-quenching car.
Nova Scotia.	Halifax	Semet-Solvay			Apr., 1898	10		Illuminating gas for Halifax.	Originally built by another system.
	Sydney	Otto	Dominion Iron and Steel Co.		Dec., 1900	400	Blast furnace	Fuel gas	

[a] Completed in February, 1907.

IMPORTS AND EXPORTS.

The following table gives the quantity and value of coke imported and entered for consumption in the United States from 1901 to 1906, inclusive. In the reports of the Bureau of Statistics of the Department of Commerce and Labor, from which these figures are obtained, the quantities are expressed in long tons of 2,240 pounds. These have been reduced to short tons in order to make them conform to the standard unit of this report.

Coke imported and entered for consumption in the United States, 1901–1906, in short tons.

1901	81,456	$266,075	1904	180,855	$648,521
1902	140,489	423,775	1905	203,142	796,545
1903	142,776	437,625	1906	147,819	570,150

The quantity of coke exported from the United States has increased each year since 1900. The exports for the last six years are shown in the following table, the quantities in this case also being reduced to short tons:

Coke exported from the United States since 1901, in short tons.

1901	430,450	$1,561,898	1904	585,861	$2,311,401
1902	439,590	1,785,188	1905	670,939	2,243,010
1903	466,351	2,091,875	1906	857,013	2,753,551

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, 1896–1906.

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
1906	2,772	991	661,155	Free.	806,901	Free.	5,717,932	1,715,380

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
1906	864,067	172,814	483,416	Free.	8,536,243	1,889,185

[a] Fiscal years.

PRODUCTION OF COKE, BY STATES.

ALABAMA.

Since 1880, the first year for which the statistics of coke production have been published by the United States Geological Survey, Alabama has contested with West Virginia for second place in the rank of coke-producing States. In the five years from 1901 to 1905 each State held the place alternately. In 1905 the honor fell to West Virginia, that State having in that year an increase of nealy 50 per cent over 1904, and while Alabama's gain in 1906 over 1905 was larger than the increase in West Virginia, it was not sufficient to overcome the lead taken by the latter State the preceding year. A large amount of development work has been carried on in new coking coal fields of West Virginia during the last few years, and that State will probably retain its present position.

The production of coke in Alabama in 1906 amounted to 3,034,501 short tons, valued at $8,477,899, against 2,576,986 short tons, valued at $7,646,957, in 1905, an increase for 1906 of 457,515 short tons, or 17.75 per cent, in quantity and of $830,942, or 10.9 per cent, in value. The average price per ton declined from $2.97 in 1905 to $2.79 in 1906.

There were 42 coke-making establishments in Alabama in 1906, the same number as in 1904 and 1905. The total number of ovens has been increased, however, from 9,059 in 1904 to 9,586 in 1905 and to 9,731 in 1906. The 42 establishments included 6, with a total of 1,211 ovens, that were idle during 1906, as compared with 8 idle establishments with a total of 1,450 ovens in 1905. There were 160 new ovens (all beehive) building at the close of 1906, against 150 in 1905 and 440 in 1904.

The production of coke in Alabama in 1880, 1890, 1900, and for the last five years is shown in the following table:

Statistics of the manufacture of coke in Alabama, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.67	58.9
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	2.44	58.6
1905	42	9,586	150	4,409,854	2,576,986	7,646,957	2.97	58.4
1906	42	[a] 9,731	160	5,184,597	3,034,501	8,477,899	2.79	58.5

[a] Includes 280 Semet-Solvay ovens.

About 70 per cent of the coal used in the manufacture of coke in Alabama is washed before being charged into the ovens. In 1906, 3,569,926 tons out of a total of 5,184,597 tons of coal used for coke making were washed. The washed coal was nearly equally divided between mine-run and slack. The unwashed coal used consisted of 1,493,549 tons of mine-run and 121,122 tons of slack.

The character of the coal used in the manufacture of coke in Alabama in 1890, 1895, and 1900, and for the last five years, is shown in the following table:

Character of coal used in the manufacture of coke in Alabama, 1890–1906, in short tons.

Year.	Run-of-mine.		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
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
1906	1,493,549	1,810,089	121,122	1,759,837	5,184,597

COLORADO AND UTAH.

The statistics of the manufacture of coke in Colorado and Utah are 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 production of the two States in 1906 amounted to 1,455,905 short tons, valued at $4,504,748, against 1,378,824 tons, worth $4,157,517, in 1905. The increase in 1906 was 77,081 tons, or 5.6 per cent, in quantity, and $347,231, or 8.35 per cent, in value. The average price per ton advanced from $3.02 in 1905 to $3.09 in 1906.

The number of coking establishments in 1906 was the same as in 1905 and 1904, but the number of ovens was increased from 3,925 in 1905 to 4,103 in 1906. One establishment of 23 ovens was idle in 1906.

The statistics of the manufacture of coke in Colorado and Utah in 1880, 1890, 1900, and for the last five years are shown in the following table:

Statistics of the manufacture of coke in Colorado and Utah, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	14	1,692	0	997,861	618,755	1,746,732	2.82	62
1902	17	3,414	363	1,695,188	1,003,393	2,754,341	2.74	59.2
1903	18	3,959	0	1,776,974	1,053,840	3,089,783	2.93	59.3
1904	17	3,923	0	1,376,354	789,060	2,590,251	3.28	57.3
1905	17	3,925	150	2,368,365	1,378,824	4,157,517	3.02	58.2
1906	17	4,103	250	2,566,196	1,455,905	4,504,748	3.09	56.7

All of the coal used in the manufacture of coke in Colorado and Utah in 1905 was slack, and about 70 per cent of this was washed. In 1906 there were 708,306 tons of run-of-mine coal used, of which 703,440 tons were washed. The quantity of slack coal used in 1906 was 1,857,890 tons, of which 792,537 tons were washed.

The character of the coal used in the manufacture of coke in Colorado and Utah in 1890, 1895, 1900, and from 1902 to 1906 is shown in the following table:

Character of coal used in the manufacture of coke in Colorado and Utah, 1890–1906.

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
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
1906	4,866	703,440	1,065,353	792,537	2,566,196

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.

The returns for 1906 show that while the quantity of coal used was 128,052 short tons against 119,036 tons of coal used in 1905, the production of coke decreased from 70,593 tons in 1905 to 70,280 tons in 1906. The value showed a substantial increase, however, from $224,260 in 1905 to $277,921 in 1906, and the average price per ton advanced from $3.18 to $3.95. There are only 2 establishments in the State, both of which have been in operation since 1900.

The statistics of coke production in Georgia in 1880, 1890, 1900, and from 1902 to 1906 are shown in the following table:

Statistics of the manufacture of coke in Georgia, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.85	52.4
1902	2	492	38	129,642	82,064	298,963	3.64	63.3
1903	2	500	0	146,086	85,546	368,351	4.31	58.5
1904	2	500	0	132,270	75,812	212,697	2.81	57.3
1905	2	533	0	119,036	70,593	224,260	3.18	59.3
1906	2	531	0	128,052	70,280	277,921	3.95	54.9

ILLINOIS.

During 1905 a bank of 120 Semet-Solvay ovens was completed at South Chicago and put in blast in October of that year, 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 and 1906. The Gallatin plant used washed slack, and the Semet-Solvay ovens at South Chicago used mine run. As a result of the operations of the South Chicago plant the coke production of Illinois increased from 10,307 short tons, valued at $27,681, in 1905, to 268,693 short tons, valued at $1,205,462, in 1906, and the State advanced from twenty-second to fourteenth place in the rank of coke-producing States.

INDIAN TERRITORY.

There are 5 coke-making establishments in Indian Territory, 4 of which made coke in 1905 and 1906. The 100 ovens at Howe have not been in operation for several years. The number of ovens was increased from 388 to 490, but the production of coke decreased from 54,781 tons in 1905 to 49,782 tons in 1906. The value, however, with an advance from $3.64 to $4.10 in the average price per ton, increased from $199,424 in 1905 to $204,205 in 1906.

The statistics of the manufacture of coke in Indian Territory in 1880, 1890, 1900, and during the last five years are shown in the following table:

Statistics of the manufacture of coke in the Indian Territory, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
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
1906	5	490	0	95,296	49,782	204,205	4.10	52.2

All of the ovens in the 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 demand. In 1905, however, about 20 per cent and in 1906 more than half of the coal used was mine run. None of this was washed. All of the slack coal used in 1906 was washed.

The character of the coal used in the manufacture of coke in 1890, 1900, and since 1902 has been as follows:

Character of coal used in the manufacture of coke in the Indian Territory, 1890–1906, in 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
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
1906	50,802	0	0	44,494	95,296

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 three years. One establishment of 10 ovens was abandoned in 1906, reducing the number of plants from 6 to 5 and the number of ovens from 91 to 81. Of these 81 ovens 55 were idle in 1906. The production has decreased steadily from 20,902 tons in 1902 to 14,194 tons in 1903, 9,460 tons in 1904, 4,425 tons in 1905, and to 1,698 tons in 1906. The coal used is Pittsburg (Kansas) slack.

The production in 1890, 1900, and since 1902 has been as follows:

Statistics of the manufacture of coke in Kansas, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
1902	10	97	12	35,827	20,902	54,702	2.62	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
1906	5	81	0	2,807	1,698	4,101	2.42	60.5

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 eastern interior or Illinois-Indiana field is worked extensively in the western part of Kentucky. Coke is made from coal mined in both the eastern and the 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 although little or no coke is made from the coals of the eastern interior 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, 4 of which made coke in 1906. The 2 idle establishments consisted of 54 ovens. Thirty-three ovens were abandoned in 1906, reducing the total number from 495 to 462. These produced in 1906, 74,064 tons of coke, valued at $169,846, against an output of 79,487 tons in 1905, valued at $159,659, a decrease in quantity of 5,423 tons and an increase in value of $10,187. The average price per ton advanced from $2.01 to $2.29. Most of the coal used for coke making in Kentucky is washed slack. 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 production of coke in Kentucky for a series of years has been as follows:

Statistics of the manufacture of coke in Kentucky, 1880–1906.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (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	2.47	50.2
1902	7	485	12	265,121	126,879	317,875	2.51	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	2.01	51.4
1906	6	462	0	148,448	74,064	169,846	2.29	49.9

MISSOURI.

Coke making in Missouri has never been much of an industry, and, as in Kansas, has been limited to the coking of a small quantity of Pittsburg (Kansas) slack, the product being used at the zinc works in connection with which the ovens are operated. There are two small coking plants, both of which were idle in 1906, as shown in the following table:

Statistics of the manufacture of coke in Missouri, 1887–1906.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (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
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	2.58	61.9
1906	2	6	0	0	0	0	0	0

MONTANA.

There are 4 coking establishments in Montana, 2 of which were operated and 2 were idle in 1906 as in 1905. The 2 idle plants have 100 ovens each. The production of coke in 1906 amounted to 38,182 short tons, valued at $266,024, as compared with 31,482 short tons, worth $211,351, in 1905. The average price per ton in 1906 was $6.97 against $6.71 in 1905. The percentage yield of coke in 1906 was 55.3 as compared with 45.8 in 1905. This was probably due to the fact that in 1905 the weight of the coal used was given for the coal before washing, while in 1906 the weight of the washed coal was reported. As shown in the following table, the quantity of coal reported as used in 1906 was less than 300 tons more than that used in 1905, whereas there was an increase of nearly 7,000 tons in the quantity of coke produced. All of the coal used for coke making in Montana is mine run and practically all of it is washed before coking.

The statistics of the manufacture of coke in Montana in 1884, when production was first reported, and for the years 1890, 1900, and since 1902 have been as follows:

Statistics of the manufacture of coke in Montana, 1884-1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	6.16	50.3
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
1906	4	555	100	69,045	38,182	266,024	6.97	55.3

NEW MEXICO.

Coke making in New Mexico took a decided step forward in 1906, one new establishment and 313 new ovens being added to the equipment. The returns also show that there were 450 new ovens in course of construction at the end of the year. The production of coke has increased rapidly during the last three years, from 11,050 tons in 1903 to 58,259 tons in 1904, to 89,638 tons in 1905, and to 147,747 tons in 1906. The increase in 1906 over 1905 was 58,109 short tons, or 65 per cent. The value of the product increased from $253,229 to $442,712, a gain of $189,483, or 75 per cent. The average price per ton in 1906 was $3 against $2.83 in 1905.

The coal used for coke making in New Mexico in 1906 consisted of 261,609 tons of washed slack.

The statistics of production in 1882, 1890, 1900, and from 1902 to 1906 are shown in the following table:

Statistics of the manufacture of coke in New Mexico, 1882-1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.91	60.3
1902	2	126	0	40,943	23,296	74,051	3.18	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	2.83	60.4
1906	4	571	450	261,609	147,747	442,712	3.00	56.5

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 1906, and the Otto-Hoffmann plant at Cincinnati, together with an increased production of bee-hive coke at Leetonia, has, however, brought the total production for the State during the last two years up to considerable importance The coke product of Ohio in 1905 was more than two and one-half times that of 1904, amounting 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. A further increase to 293,994 short tons, having a value of $1,013,248, is shown in the production for 1906. Of the 8 establishments in the State, 2 with a total of 170 ovens, were idle both in 1905 and 1906. The 405 active ovens produced an average of 726 tons of coke each.

The statistics of the production of coke in Ohio in 1880, 1890, 1900, and for the last five years are shown in the following table:

Statistics of the manufacture of coke in Ohio, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton	Yield of coal in coke (per cent).
		Built.	Building.					
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
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
1906	8	[c] 575	0	437,567	293,994	1,013,248	3.45	67.2

[a] Rothberg ovens.
[b] Includes 50 Otto-Hoffmann and 66 Rothberg ovens.
[c] Includes 50 Otto-Hoffmann and 80 Rothberg ovens.

Over 80 per cent of the coal used for coke making in Ohio is unwashed run of mine. Of the slack coal used in 1906, 81,027 tons, something over one-half, was washed. The character of the coal used in the manufacture of coke in Ohio in 1890, 1895, 1900, and annually since 1902 is shown in the following table:

Character of coal used in the manufacture of coke in Ohio since 1890, in 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
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
1906	356,540	0	38,737	42,290	437,567

PENNSYLVANIA.

Pennsylvania in the manufacture of coke, as in the mining of coal, stands preeminently at the head, having for more than a quarter of a century contributed over 50 per cent of the total coke product of the country. 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 yield 80 per cent of the entire production of the State and over 50 per cent of the total output of the United States.

The quantity of coke produced in Pennsylvania in 1906 was 23,060,511 short tons out of a total for the United States of 36,401,217 short tons. In 1905 Pennsylvania produced 20,573,736 short tons out of a total of 32,231,129 tons, and in 1904 this State contributed 14,861,064 tons out of a total of 23,661,106 tons. Out of these totals for the State the Connellsville district produced in 1906, 12,057,840 tons; in 1905, 11,365,077 tons, and in 1904, 8,883,220 tons. Including the Lower and the Upper Connellsville districts the production of the entire region was for these years, respectively, 18,257,204 tons, 15,992,333 tons, and 12,161,216 tons.

Compared with 1905 the coke production of Pennsylvania in 1906 shows an increase of 2,486,775 short tons, or a little over 12 per cent. The record for 1906 was in fact the most satisfactory in the history of the Pennsylvania coke trade. In addition to the largest production ever made, prices were higher than at any time in recent years with the exception of 1903, when, because of the coal shortage due to the strike in the anthracite fields, coke prices were abnormally advanced. There was a short time in the early part of 1906 when supply got somewhat ahead of demand and some coke was stocked; but prices were held firm and the threatened slump was averted by the suspension of mining operations on April 1 preceding the adjustment of the wage scale. For some time prior to that date, in anticipation of a shortage of fuel, consumers began to order coke, the accumulated stocks were absorbed, and production was pushed to capacity. Moreover, the idleness at the mines away from the coking regions released a large number of cars, so that transportation facilities for the coke were unusually good. The mines in the principal coking regions were not affected by the order of suspension.

There was not even the usual "summer idleness" in 1906, the demand for structural shapes, due in large part to the needs of San Francisco, having kept the furnaces unusually active, and coke was accordingly in demand.

The total value of the coke product of Pennsylvania in 1906 was $54,184,531, against $42,253,178 in 1905, a gain of $11,931,353, or 28 per cent, as compared with an increase of 12 per cent in tonnage. The average price per ton for all the coke made in Pennsylvania in 1906 was $2.35, as compared with $2.05 in 1905, and was the highest average, with one exception, in recent years. The percentage yield of coal in coke in 1906 was also above the average.

The quantity of coal consumed in the manufacture of coke in Pennsylvania in 1906 was 34,503,513 short tons, valued at $35,395,374, and represented 26.7 per cent of the total production of bituminous coal in the State during the year. In 1905 the consumption of coal for coke making was 31,030,345 short tons (26.2 per cent of the State's total bituminous coal product), valued at $29,736,804. The difference between the value of the coke and the coal from which it was made in 1906 was $18,789,157, or 53 per cent, while in 1905 the difference was $12,516,374, or 42 per cent. Coke prices were low in 1904, particularly as compared with the price of coal, and the difference in that year was only $3,568,206, or 16.6 per cent. In 1903, on the other hand, when coke prices were abnormally inflated by the scarcity of anthracite fuel, the difference between the coal and the coke values was nearly 60 per cent.

The number of coke-making establishments increased from 226 to 239, a gain of 13, and the number of completed ovens increased from 42,608 to 47,185, a gain of 4,577. There were 2,373 ovens building at the close of 1906, as compared with 2,384 at the end of 1905. The completed ovens included 410 Semet-Solvay and 934 Otto-Hoffmann by-product recovery ovens, a total of 1,344, against a total of 1,089 by-product ovens in 1905.

The statistics of the production of coke in Pennsylvania for the years 1880, 1890, 1900, and for the last five years are shown in the following table:

Statistics of the manufacture of coke in Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
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	1.68	66.2
1905	226	42,608	2,384	31,030,345	20,573,736	42,253,178	2.05	66.3
1906	239	47,185	2,373	34,503,513	23,060,511	54,184,531	2.35	66.8

The character of the coal used in the manufacture of coke in Pennsylvania in 1890, 1895, 1900, and from 1902 to 1906 has been as follows:

Character of coal used in the manufacture of coke in Pennsylvania since 1890, in short tons.

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	11,788,625	303,591	630,195	323,732	13,046,143
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
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
1906	27,471,566	3,972,172	1,584,152	1,475,083	34,503,513

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 formerly included 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. All but one of the Allegheny Valley plants have been abandoned, and the production of the one establishment has for the last few years been included in that of the Pittsburg 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 also 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 that of the Broadtop district.

The statistics of the manufacture of coke in Pennsylvania by districts, in 1905 and 1906, are presented in the following tables:

Coke production in Pennsylvania in 1905 and 1906, by districts.

1905.

District.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	3.20	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	1.96	66.9
Greensburg	7	1,328	100	908,003	551,233	1,155,958	2.10	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	1.95	68.3
Pittsburg [g]	6	[h] 2,173	380	2,317,159	1,463,774	3,599,436	2.46	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	2.05	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.

Coke production in Pennsylvania in 1905 and 1906, by districts—Continued.

1906.

District.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke per ton.	Yield of coal in coke (per cent).
Allegheny Mountain	16	[a] 2,137	[b] 137	1,271,710	893,271	$2,552,967	$2.85	70.2
Allegheny Valley [c]	2	50	0					
Broadtop [d]	5	584	0	978,893	710,143	2,824,343	3.98	72.5
Clearfield-Center	7	738	0	91,822	56,634	162,722	2.87	61.6
Connellsville	101	[e] 23,616	142	17,956,160	12,057,840	26,858,660	2.23	67.1
Greensburg	8	1,428	260	1,118,227	678,817	1,641,473	2.42	60.7
Irwin	5	581	0	348,007	230,552	510,572	2.21	66.2
Lebanon and Schuylkill [d]	4	[f] 507	0	(d)	(d)	(d)	(d)	(d)
Lower Connellsville	53	9,708	1,502	7,465,205	5,188,135	12,046,889	2.32	69.4
Pittsburg [g]	8	[h] 2,818	0	2,376,403	1,463,795	3,620,030	2.47	61.5
Reynoldsville-Walston	8	2,502	0	1,399,801	770,095	1,794,127	2.33	55.8
Upper Connellsville	22	2,516	332	1,497,285	1,011,229	2,172,748	2.15	67.5
Total	239	47,185	2,373	34,503,513	23,060,511	54,184,531	2.35	66.8

[a] Includes 260 Otto-Hoffmann ovens.
[b] Includes 112 Otto-Hoffmann ovens.
[c] Production included in Pittsburg district.
[d] Production in Lebanon and Schuylkill valleys included in Broadtop district.
[e] Includes 110 Semet-Solvay ovens.
[f] Includes 275 Semet-Solvay and 232 Otto-Hoffmann ovens.
[g] Includes production of ovens in Allegheny Valley district.
[h] Includes 330 Otto-Hoffmann and 25 Semet-Solvay ovens.

Allegheny Mountain district.—This district includes all of the coke ovens in the vicinity of Johnstown, Cambria County, and those lying along the line of the Pennsylvania Railroad in Indiana County; it also includes a few plants in Somerset County. The plants in Cambria County include 260 Otto-Hoffmann by-product ovens at Johnstown operated in connection with the iron and steel works of the Cambria Steel Company of that city. An addition of 112 ovens of the same type was under construction at the end of the year. There was in 1906 a reaction from the unusually large production of the preceding year, and the output declined from 967,042 tons in 1905 to 893,271 tons in 1906. The value of the product, however, increased from $2,421,799 to $2,552,967.

The statistics of the manufacture of coke in the Allegheny Mountain district in 1880, 1890, 1900, and from 1902 to 1906 have been as follows:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (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
1902	16	1,563	380	965,412	644,053	1,782,660	2.77	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
1906	16	[c] 2,137	[d] 137	1,271,710	893,271	2,552,967	2.85	70.2

[a] Includes 160 Otto-Hoffmann ovens.
[b] Otto-Hoffmann ovens.
[c] Includes 260 Otto-Hoffmann ovens.
[d] Includes 112 Otto-Hoffmann ovens.

Broadtop district.—The Broadtop district includes the ovens in Bedford and Huntingdon counties, the coal for which is drawn from the Broadtop coal field. There are only 5 establishments in the district and 1 of these, having a total of 122 ovens, was not operated in 1906. One establishment dismantled 36 of its ovens in 1906, and another added 6 ovens to its equipment, the total number in the district being thus reduced by 30. The Semet-Solvay ovens at Lebanon and Chester and the Otto-Hoffmann ovens at Lebanon have been added to this district. This addition is responsible for the apparently large increase from 237,639 tons, valued at $645,045, in 1904, to 483,198 tons, valued at $1,544,966, in 1905, and to 710,143 tons, valued at $2,824,343, in 1906.

The statistics of the manufacture of coke in the Broadtop district, including the output of the by-product ovens at Lebanon and Chester, are shown in the following table:

Statistics of the manufacture of coke in the Broadtop district, Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
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	3.20	70.2
1906 [b]	5	584	0	978,893	710,143	2,824,343	3.98	72.5

[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 the three counties mentioned. The district is not of much importance and is declining, as shown by the fact that 180 ovens were abandoned in 1905, and although 90 more were added in 1906 there were 200 idle during the year, and the production decreased more than 50 per cent—from 119,651 tons in 1905 to 56,634 tons in 1906.

The statistics of production for the years 1880, 1890, 1900, and from 1902 to 1906 have been as follows:

Statistics of the manufacture of coke in the Clearfield-Center-Elk district, Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens.		Coal used. (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
1902	8	623	0	308,289	198,725	489,637	2.46	64.5
1903	9	850	0	278,329	178,276	583,906	3.28	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
1906	7	738	0	91,822	56,634	162,722	2.87	61.6

Connellsville district.—The Connellsville district of Pennsylvania is the largest coke-producing district in the world. The coal basin occupies a comparatively narrow synclinal trough extending in a northeast-southwest direction nearly across the two counties of Fayette and Westmoreland, within the boundaries of which it is entirely contained. It lies a short distance east of the city of Pittsburg, and supplies the larger part of the fuel consumed in the iron and steel furnaces of Pittsburg and vicinity, the greatest iron-manufacturing center of the world. This district, until 1903, produced from 40 to 50 per cent of the total coke output of the United States, the smaller percentage during the last four years being due to the largely increased production from the lower Connellsville or Klondike region which lies entirely within Fayette County, and is separated from the Connellsville basin proper by the Greensburg anticline. If to the Connellsville production is added that of the lower Connellsville, the supremacy of the district has been more than maintained.

Connellsville coal is an ideal fuel for coking in beehive ovens, and all but 110 of the 23,616 ovens in this district at the close of 1906 were of the beehive type. The coke is considered by some ironmasters as without a rival for blast-furnace use, and it is undoubtedly the standard by which all other blast-furnace cokes are judged.

The production of coke in the Connellsville district proper in 1906 was 12,057,840 short tons, valued at $26,858,660, against 11,365,077 short tons, valued at $22,315,361, in 1905, an increase in 1906 of 692,763 short tons, or 6.1 per cent, in quantity, and of $4,543,299, or 20.3 per cent in value. The combined production of the Connellsville and the lower Connellsville districts in 1906 amounted to over 17,200,000 short tons, an increase of about 4,000,000 tons over the preceding year. The average price of Connellsville coke advanced from $1.96 in 1905 to $2.23 in 1906.

The number of establishments in the Connellsville district in 1906 was 101, a gain of 1 over 1905. The number of ovens increased from 22,033 to 23,616, a gain of 1,583. Of the total number of ovens 101 were idle during the year.

In the following table are presented the statistics of the manufacture of coke in the Connellsville district in 1880, 1890, 1900, and from 1902 to 1906:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1906.

Year	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
1902	97	[a]21,659	374	15,538,701	10,418,366	23,785,433	2.28	67.1
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	1.58	67.4
1905	100	[d]22,033	200	16,980,341	11,365,077	22,315,361	1.96	66.9
1906	101	[d]23,616	142	17,956,160	12,057,840	26,858,660	2.23	67.1

[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 1905 and 1906, 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 United States Geological Survey.

Shipments of coke from the Connellsville region, including Upper and Lower Connellsville districts, in 1905 and 1906, by months.

Month.	1905.			1906.		
	Cars.	Daily average.	Short tons.	Cars.	Daily average.	Short tons.
January	49,352	1,592	1,283,152	62,049	2,386	1,665,747
February	51,928	1,856	1,350,128	53,398	2,225	1,435,452
March	57,606	1,858	1,497,756	62,694	2,334	1,683,212
April	70,904	2,367	1,843,502	59,922	2,397	1,604,906
May	55,829	1,801	1,451,554	64,923	2,404	1,739,743
June	52,095	1,736	1,354,470	61,673	2,372	1,654,209
July	62,423	2,014	1,622,998	61,995	2,384	1,662,545
August	51,077	1,648	1,328,002	62,948	2,331	1,685,036
September	66,413	2,214	1,726,734	60,157	2,406	1,610,509
October	55,009	1,774	1,430,238	68,940	2,516	1,850,450
November	57,267	1,909	1,488,942	65,194	2,507	1,752,234
December	58,425	1,885	1,519,050	61,381	2,361	1,655,283
Total	688,328	1,886	17,896,526	745,274	2,385	19,999,326

The monthly shipments of coke from this region in the years 1902 to 1906, as reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville region, 1902–1906, in short tons.

Month.	1902.	1903.	1904.	1905.	1906.
January	1,173,860	1,134,272	718,382	1,283,152	1,665,747
February	971,048	958,981	845,428	1,350,128	1,435,452
March	1,133,978	1,274,863	1,062,192	1,497,756	1,683,212
April	1,219,928	1,346,053	1,118,043	1,843,502	1,604,906
May	1,300,648	1,288,550	1,146,907	1,451,554	1,739,743
June	1,234,596	1,379,257	945,520	1,354,470	1,654,209
July	1,271,045	1,327,239	887,402	1,622,998	1,662,545
August	1,238,260	1,211,826	975,724	1,328,002	1,685,036
September	1,246,095	1,239,265	1,153,471	1,726,734	1,610,509
October	1,230,860	1,041,966	1,148,089	1,430,238	1,850,450
November	1,079,037	629,768	1,207,131	1,488,942	1,752,234
December	1,039,385	513,187	1,219,174	1,519,050	1,655,283
Total	14,138,740	13,345,230	12,427,463	17,896,526	19,999,326

The total shipments, in cars, for the last nineteen years were as follows:

Total and daily average shipments, in cars, 1888–1906.

Year.	Daily average.	Total cars.	Year.	Daily average.	Total cars.	Year.	Daily average.	Total cars.
1888	905	282,441	1895	1,410	441,243	1902	1,986	624,198
1889	1,046	326,220	1896	920	289,137	1903	1,782	558,738
1890	1,147	355,070	1897	1,181	367,383	1904	1,623	510,759
1891	884	274,000	1898	1,415	441,249	1905	1,886	688,328
1892	1,106	347,012	1899	1,676	523,203	1906	2,385	745,274
1893	874	270,930	1900	1,619	504,410			
1894	900	281,677	1901	1,857	581,051			

The following table shows the prices for Connellsville furnace and foundry cokes, by months, during the years 1902 to 1906. The abnormally high prices reported for both grades of coke in 1902 and 1903 were due to the scarcity of fuel caused by the strike in the anthracite region and were for prompt delivery. The prices quoted in this table are for strictly Connellsville coke as reported by the Iron Age. "Main Line" and "outside" cokes are usually quoted from 15 to 25 cents below strict Connellsville.

Prices of Connellsville furnace and foundry coke, 1902–1906, by months.

Month.	Furnace.						
	1902.		1903.		1904.	1905.	1906.
	Contract price.	For prompt delivery.	Six months' contracts.	Prompt delivery.			
Jan	$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	$2.15 to $2.75
Feb	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	2.10 to 2.50
Mar	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	2.20 to 2.50
Apr	$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	2.30 to 2.75
May	2.25 to 2.50	....	3.00 to 3.50	3.50 to 4.00	1.60 to 1.65	1.80 tc 2.00	2.30 to 2.75
June	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	2.30 to 2.50
July	2.25	3.00 to 4.00	2.50	2.50	1.40 to 1.50	1.75 to 2.10	2.40 to 2.75
Aug	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	2.75 to 2.85
Sept	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	2.85 to 2.90
Oct	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	2.75 to 3.25
Nov	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	3.00 to 3.60
Dec	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	3.00 to 3.60

Month.	Foundry.					
	1902.[a]	1903.[a]	1903.[b]	1904.	1905.	1906.
Jan	$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	$2.75 to $3.50
Feb	2.75 to 3.00	(c)	6.00 to 7.00	2.10 to 2.25	2.50 to 3.00	2.50 to 3.00
Mar	2.75 to 3.00	(c)	6.00 to 7.00	2.10 to 2.50	2.75 to 3.25	2.75 to 3.25
Apr	2.75 to 3.00	5.00	5.50 to 6.00	2.15 to 2.50	2.65 to 3.00	2.90 to 3.10
May	2.75 to 3.00	4.00	4.00 to 5.50	2.00 to 2.15	2.50 to 2.75	2.65 to 3.10
June	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	2.65 to 2.75
July	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	2.75 to 3.00
Aug	2.75 to 3.00	3.00	3.00	1.75 to 1.85	2.25 to 2.50	3.00 to 3.25
Sept	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	3.25 to 3.50
Oct	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	3.25 to 4.00
Nov	4.50 to 5.00	....	2.50 to 2.65	2.00 to 2.50	3.50 to 4.00	3.75 to 4.50
Dec	4.50 to 5.00	....	2.15 to 2.50	2.25 to 2.50	3.40 to 4.00	3.75 to 4.50

[a] Contract prices. [b] Prompt delivery. [c] No contract prices quoted.

Greensburg district.—The ovens in the Greensburg district, all located in the vicinity of Greensburg, were increased by 100 new ovens in 1906, bringing the total number up to 1,428. The production of coke increased from 551,233 tons in 1905 to 678,817 tons in 1906, with an increase in value from $1,155,958 to $1,641,473.

The statistics of the manufacture of coke in the Greensburg district, Pennsylvania, from 1889 to 1906 are given in the following table:

Statistics of the manufacture of coke in the Greensburg district, Pennsylvania, 1889-1906.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (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
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	2.10	60.7
1906	8	1,428	260	1,118,227	678,817	1,641,473	2.42	60.7

Irwin district.—This district, which is of minor importance, includes about 600 ovens located near the town of Irwin in Westmoreland County. Of the ovens in the district, 180 were idle during 1906, as compared with more than half of the total number idle in 1905. The production increased from 164,601 tons in 1905 to 230,552 tons in 1906.

The Irwin district began making coke in 1889. The statistics of production in that year, in 1890, 1900, and from 1902 to 1906, have been as follows:

Statistics of the manufacture of coke in the Irwin district, Pennsylvania, 1889–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
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
1906	5	581	0	348,007	230,552	510,572	2.21	66.2

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 7 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 and in 1906 more than three times 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 in 1904 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 showed an increase of nearly 1,000,000 tons over that of 1904, and 1906 showed a gain of 1,316,825 tons over 1905. The number of coke-making establishments increased from 45 in 1905 to 53 in 1906, while the number of ovens (all of beehive construction) increased from 7,484 to 9,708. All but 4 of the 53 establishments in 1906 made coke, and all of the nonproducers were new plants.

The record of the district for the seven years of its existence has been as follows:

Statistics of the manufacture of coke in the Lower Connellsville district, Pennsylvania, 1900–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	1.78	66.9
1902	21	4,253	705	2,826,242	1,899,111	4,701,068	2.48	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	1.95	68.3
1906	53	9,708	1,502	7,465,205	5,188,135	12,046,889	2.32	69.4

Lebanon Valley and Schuylkill districts.—The Semet-Solvay ovens at Chester (40) and at Steelton (145) were not in operation during 1905 and 1906. Both plants at Lebanon, however, (90 Semet-Solvay and 232 Otto-Hoffmann ovens) were in operation in both years. The total production of these two plants in 1906 was 559,601 short tons, as compared with 297,716 short tons in 1905.

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 run-of-mine coal is also brought from the fourth pool of the Monongahela River at Pittsburg. The production of 120 Otto-Hoffmann ovens at Glassport and of 25 Semet-Solvay ovens located at Sharon in Mercer County is included in this district. The production of coke in the last two years was almost exactly the same, being 1,463,774 tons in 1905 and 1,463,795 tons in 1906. The number of establishments increased from 8 to 10, and the number of ovens from 2,226 to 2,868.

The statistics of the manufacture of coke in the Pittsburg district for 1880, 1890, 1900, and from 1902 to 1906 are given in the following table:

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
1902 [a]	10	1,611	232	1,488,973	953,863	1,924,942	2.02	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]	8	2,226	380	2,317,159	1,463,774	3,599,436	2.46	63.2
1906 [a]	[b] 10	[c] 2,868	0	2,376,403	1,463,795	3,620,030	2.47	61.5

[a] Includes ovens and production in Allegheny Valley district.
[b] Includes 2 establishments in Mercer County, 1 in Beaver County, and 2 in Allegheny Valley district.
[c] Includes 330 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 1906 amounted to 770,095 short tons, compared with 831,904 tons in 1905. All of the 8 establishments in the district made coke in 1906.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880, 1890, 1900, and from 1902 to 1906:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
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	2.24	54
1905	8	2,303	200	1,463,680	831,904	1,638,934	1.97	56.8
1906	8	2,502	0	1,399,801	770,095	1,794,127	2.33	55.8

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 1906 amounted to 1,011,229 short tons, against 755,946 tons in 1905.

In the following table are given the statistics of the manufacture of coke in the Upper Connellsville district, Pennsylvania, in 1880, 1890, 1900, and from 1902 to 1906:

Statistics of the manufacture of coke in the Upper Connellsville District, Pennsylvania, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.00	66.2
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
1906	22	2,516	332	1,497,285	1,011,229	2,172,748	2.15	67.5

TENNESSEE.

The production of coke in Tennessee in 1906 amounted to 483,428 short tons, valued at $1,350,856, against 468,092 short tons, valued at $1,184,442, in 1905, an increase of 15,336 short tons in quantity and of $166,414 in value. The average price per ton advanced from $2.53 in 1905 to $2.79 in 1906.

The number of coke-making establishments in the State increased from 16 in 1905 to 17 in 1906, a gain of 1, while the number of ovens increased from 2,615 in 1905 to 2,731 in 1906, a gain of 116. Of the 17 establishments 3, with a total of 536 ovens, were idle during 1906. There were 138 new ovens under construction at the close of the year.

The statistics of the manufacture of coke in Tennessee in the years 1880, 1890, 1900, and from 1902 to 1906 are shown in the following table:

Statistics of the manufacture of coke in Tennessee, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
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	2.39	52.8
1905	16	2,615	60	862,320	468,092	1,184,442	2.53	54.3
1906	17	2,731	138	929,405	483,428	1,350,856	2.79	52

The character of the coal used in the manufacture of coke in Tennessee has for several years been nearly equally divided between run of mine and slack, although the balance was considerably in favor of run-of-mine coal in 1906. Most of the coal is washed before being charged into the ovens. In 1906 there were 591,357 short tons of run-of-mine coal used, of which 509,532 tons were washed. The slack coal used amounted to 338,048 tons, of which 195,205 tons were washed before coking. The total quantity of coal washed was 704,737 tons, the unwashed coal amounting to 224,668 tons.

The following table exhibits the character of the coal used in the manufacture of coke in Tennessee in 1890, 1895, 1900, and from 1902 to 1906:

Character of coal used in the manufacture of coke in Tennessee, 1890–1906, in 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
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
1906	81,825	509,532	142,843	195,205	929,405

UTAH.

As there is but one company in Utah engaged in the manufacture of coke the statistics of production have been included with those of the State of Colorado, which adjoins Utah on the east. The coals of Utah which are used in the manufacture of coke are practically identical in character with those of western Colorado.

VIRGINIA.

The development of the coking industry in the southwestern counties of Virginia, which has been referred to in previous reports, continued in 1906, the production showing an increase from 1,499,481 short tons in 1905, to 1,577,659 short tons in 1906, an increase of

78,178 tons, or 5.2 per cent. The value increased from $2,869,452 in 1905, to $3,611,659 in 1906, a gain of $742,207, or 25.8 per cent. The average price per ton advanced from $1.91 in 1905, to $2.29 in 1906. Two new plants were added in 1906 to those already established, increasing the total number from 16 to 18. The number of ovens increased from 4,549 in 1905 to 4,641 in 1906. There were 695 new ovens under construction at the close of the year. The Newton-Chambers ovens at Pocahontas, 56 in number, continued idle during 1906. This is the only establishment which was idle throughout the whole of last year. Until 1906 practically all of the new work within 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 in the State. There are two plants in Virginia, one at Lowmoor and one at Covington, the coal for both of 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.

During 1906 considerable activity was shown in the development of coal-mining properties in the Black Mountain region of Lee County. This is a territory which promises to show important developments in the near future, both in the production of coal and in the manufacture of coke.

The following statistics cover the manufacture of coke in Virginia in 1883, when the industry was first established, and in 1890, 1900, and from 1902 to 1906:

Statistics of the manufacture of coke in Virginia, 1883–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.14	63.2
1902	14	a 2,974	1,208	1,716,110	1,124,572	2,322,228	2.07	65.5
1903	16	a 4,251	142	1,860,225	1,176,439	2,724,047	2.32	63.2
1904	16	a 4,345	68	1,636,905	1,101,716	1,772,717	1.61	67.3
1905	16	a 4,549	0	2,184,369	1,499,481	2,869,452	1.91	68.6
1906	18	a 4,641	695	2,296,227	1,577,659	3,611,659	2.29	68.7

a Includes 56 Newton-Chambers by-product ovens.

Of the 2,296,227 short tons of coal used in the manufacture of coke in Virginia in 1906 1,242,646 tons were run of mine and 1,053,581 tons were slack. Four of the 17 establishments in the State using run-of-mine coal in 1906 washed the coal before charging it into the ovens. All of the slack coal used was unwashed.

The following table shows the character of the coal used in coke making in Virginia in 1890, 1900, and from 1902 to 1906:

Character of coal used in the manufacture of coke in Virginia, 1890–1906, in 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
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
1906	1,014,299	228,347	1,053,581	0	2,296,227

WASHINGTON.

Washington is the only one of the Pacific coast States which produces coal of a quality suitable for the manufacture of coke. The coke-making operations of Washington are not of special importance when 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 Pacific coast coals. There are 5 establishments in the State, 3 of which made coke in 1906. Two plants, having a total of 31 ovens, were idle during both of the last two years. The production in 1906 amounted to 45,642 short tons, valued at $226,977, against 53,137 short tons, valued at $251,717 in 1905. All of the coal used in coke making in Washington in 1906 was washed. Two of the plants used washed run of mine, and one plant used washed slack. The washed run-of-mine coal amounted to 70,685 tons and the washed slack to 6,211 tons.

The coke-making industry of Washington began in 1884, when 400 tons of coke were produced. The production since that time has been as follows:

Statistics of the manufacture of coke in Washington, 1884–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	4.80	61.5
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
1906	5	216	0	76,896	45,642	226,977	4.99	59.4

WEST VIRGINIA.

During the last twenty-five years West Virginia and Alabama have been close rivals for the second place among the coal-producing States and have frequently alternated with each other for that position. From 1900 to 1905 each State held second place alternately. An exceptionally large production in West Virginia in 1905 gave that State the advantage of over 800,000 tons in output over Alabama, and this lead was maintained in 1906. The indications are that West Virginia will continue to rank next to Pennsylvania as a producer of coke. During the last few years there has been a rapid extension of railroad lines in West Virginia, the older transportation companies having been active in the building of branch feeders into new coal fields. The Coal and Coke Railway from Charleston to Elkins has been completed and has opened up important coal fields in the central part of the State. This road crosses a large portion of the State in a northeast-southwest direction. The eastern connection of the Wabash Railroad interests, now building to tidewater at Baltimore, will give an additional outlet for the coals and cokes in the northern part of the State. It is expected that the Virginian (formerly the Deepwater-Tidewater) Railroad, building from Sewells Point, near Norfolk, Va., to the coal fields of the Pocahontas, New River, and Kanawha series, will be completed early in 1908, and an increased production, both of coal and of coke, from the southern part of the State will naturally follow. Important developments have also been made in the northwestern part of the State on the line of the Morgantown and Kingwood Railroad. In this locality the Freeport coal of Pennsylvania is well developed and possesses excellent coking qualities.

The coke production of West Virginia in 1906 amounted to 3,713,514 short tons, valued at $8,192,956, against 3,400,593 short tons, valued at $6,548,205, in 1905, an increase of 312,921 tons, or 9.2 per cent, in quantity, and of $1,644,751, or 25.1 per cent, in value.

A number of establishments in the Kanawha and the Upper Monongahela districts of West Virginia have been idle for several years, and 2 plants in each of these districts were abandoned in 1906. Two new establishments were, however, added to the Upper Potomac-Tygarts Valley district, making a net decrease of 2, from 143 to 141, in the total number of establishments in the State. The total number of ovens increased from 19,189 in 1905, to 19,714 in 1906, an increase of 525. There were 353 new ovens under construction at the end of 1906. Of the 141 establishments, 27, having a total of 1,364 ovens, were idle during the year. Four of the idle establishments, having a total of 483 ovens, were new plants whose ovens had not been put in blast before the close of the year. Of the idle establishments, 17, with a total of 851 ovens, were in the Upper Monongahela district, and 5, with a total of 346 ovens, were in the New River district.

The following table exhibits the statistics of coke production in West Virginia in 1880, 1890, 1900, and from 1902 to 1906:

Statistics of the manufacture of coke in West Virginia, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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
1902	120	a12,656	2,341	4,078,579	2,516,505	5,833,226	2.32	61.7
1903	136	a15,613	2,687	4,347,160	2,707,818	7,115,842	2.63	62.3
1904	137	a16,929	1,319	3,543,338	2,283,086	3,757,850	1.65	64.4
1905	143	a19,189	1,214	5,329,695	3,400,593	6,548,205	1.92	63.8
1906	141	a19,714	353	5,822,619	3,713,514	8,192,956	2.21	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 for coke making in West Virginia is slack, and about 90 per cent of this slack coal is unwashed. All run-of-mine coal used is unwashed.

Character of coal used in the manufacture of coke in West Virginia since 1890, in 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
1906	2,093,483	0	3,388,877	340,259	5,822,619

PRODUCTION BY DISTRICTS.

It has been customary in the preceding reports of this series to consider the coke production by the 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 of 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 continuous with 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. In 1906 the production from the Flat Top and New River districts showed decreases, while substantial increases were exhibited in the other districts.

Production of coke in West Virginia in 1905 and 1906, by districts.

1905.

District.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
Flat Top[a]	56	11,287	1,074	3,162,820	2,042,123	$3,604,923	$1.77	64.6
Kanawha	14	1,617	0	415,808	249,251	504,734	2.03	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

1906.

District.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
Flat Top[a]	56	11,872	200	2,985,931	1,912,595	$4,000,986	$2.09	64.1
Kanawha	12	1,605	50	582,260	358,903	860,514	2.40	61.6
New River	25	2,039	0	394,365	240,474	658,729	2.74	60.9
Upper Monongahela	37	[b]2,873	50	1,028,258	659,427	1,412,215	2.14	64.1
Upper Potomac and Tygarts Valley	11	1,325	53	831,805	542,115	1,260,512	2.33	65.1
Total	141	19,714	353	5,822,619	3,713,514	8,192,956	2.21	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 or Klondike district of Pennsylvania in 1902 placed that district above the Flat Top as a coke producer. Like the coal of the Connellsville region, that of the Flat Top district of West Virginia produces a coke which makes an ideal blast-furnace fuel. Chemically the Flat Top coke is superior to that of Connellsville, as it is lower in mineral content or ash, and it is regarded by some ironmasters as equal in physical properties to the Connellsville coke.

In the production of the Flat Top district is included that of the Tug River district, immediately to the west, in which the United States Coal and Coke Company has completed something over 2,000 ovens up to the close of 1906. The combined production of the Flat Top and the Tug River districts in 1906 amounted to 1,912,595 short tons, valued at $4,000,986, a decrease of 129,528 short tons in production compared with 1905, but an increase of $396,063 in value. The number of establishments was the same in 1906 as in 1905, but the number of ovens increased from 11,287 to 11,872.

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 in 1900, and from 1902 to 1906, inclusive, have been as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia, 1886–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	1.90	61.9
1902	44	6,940	1,741	1,781,136	1,109,203	2,189,607	1.97	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	1.77	64.6
1906	56	11,872	200	2,985,931	1,912,595	4,000,986	2.09	64.1

[a] Includes establishments in the Tug River district since 1900.

The 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 on the west. 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 is a good blast-furnace fuel. It is also a high-grade steaming coal, nearly smokeless in character, and the demand for it as a steam coal is probably responsible for the somewhat backward tendency shown by the coke production during the last few years. Of the 25 establishments and 2,039 ovens in the district, 6 establishments, having 346 ovens, were idle in 1906. The production decreased from 301,626 short tons in 1905 to 240,474 short tons in 1906, while the value, owing to the advanced prices in 1906, increased from $622,815 to $658,729.

The statistics of the manufacture of coke in the New River district in 1880, 1890, 1900, and from 1902 to 1906, have been as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.20	60
1902	27	2,156	175	521,973	317,086	981,753	3.10	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
1906	25	2,039	0	394,365	240,474	658,729	2.74	60.9

Kanawha district.—The Kanawha district includes all of 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 recent developments on the Virginian (Deepwater-Tidewater) Railroad along lower Loup Creek, and the inclusion of this latter factor is responsible for the marked increases in production in 1905 and 1906. The output of the district had decreased from 179,988 tons in 1903 to 92,014 tons in 1904. As the result of the bringing in of the Loup Creek production the output in 1905 increased to 249,251 short tons, and a further increase to 358,903 tons is shown in production in 1906. The value increased from $142,858 in 1904 to $504,734 in 1905 and to $860,514 in 1906. Two of the establishments in the older part of the Kanawha district were abandoned in 1906, reducing the total number of establishments in the district from 14 to 12. The total number of ovens in the district decreased from 1,617 to 1,605, and of the 12 establishments, 2, with a total of 100 ovens, were not operated in 1906.

The statistics of the manufacture of coke in the Kanawha district in 1880, 1890, 1900, and from 1902 to 1906, have been as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.50	56.7
1902	11	872	60	232,145	130,642	354,759	2.72	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	2.03	60
1906	12	1,605	50	582,260	358,903	860,514	2.40	61.6

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 of the upper Monongahela district in 1906 showed a notable increase over that of any recent year, amounting to 659,427 short tons, valued at $1,412,215, against 389,213 tons, valued at $965,402, a gain in quantity of 270,214 tons, or 69.4 per cent, and in value of $446,813, or 46.3 per cent.

Unlike the records shown in most of the coke-producing districts, the average price per ton of the coke made in the upper Monongahela district decreased from $2.48 in 1905 to $2.14 in 1906.

The statistics of coke production in the upper Monongahela district in 1880, 1890, 1900, and from 1902 to 1906, are shown in the following table:

Statistics of the manufacture of coke in the Upper Monongahela district, West Virginia, 1880–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	2.30	60.9
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
1906	37	a 2,873	50	1,028,258	659,427	1,412,215	2.14	64.1

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 below the Ohio-Potomac divide, but practically continuous with the Upper Potomac district. The number of establishments in this district increased from 9 in 1905 to 11 in 1906; the number of ovens increased from 1,295 in 1905 to 1,325 in 1906, and the production increased from 418,380 short tons in 1905 to 542,115 short tons in 1906. The value shows a gain of $410,181, from $850,331 in 1905 to $1,260,512 in 1906.

The statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district in 1887, 1890, 1900, and from 1902 to 1906, are shown in the following table:

Statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district, West Virginia, 1887–1906.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	1.66	60.8
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
1906	11	1,325	53	831,805	542,115	1,260,512	2.33	65.1

OTHER STATES.

In the following table are presented the statistics of production of coke in the years 1900 to 1906 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—Maryland, Michigan, Minnesota, New Jersey, New York, and Wisconsin—produced coke made from coal mined in other States, while one—Massachusetts—obtained its chief supply of coal from Nova Scotia and smaller quantities from West Virginia. All of the ovens in Maryland, Massachusetts, Minnesota, New Jersey, New York, and Michigan are by-product retort ovens, and one of the two establishments in Wisconsin is also a by-product recovery plant. The statistics of production for Wisconsin and Wyoming for the years previous to 1900 may be found by reference to preceding volumes of the report, Mineral Resources of the United States.

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 1906 in States having only one or two establishments.

Year.	Establishments.	Ovens.		Coal used (short tons).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke (per cent).
		Built.	Building.					
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	1,666	145	2,222,723	1,660,857	5,500,337	3.31	74.7
1906	12	[a] 1,952	0	2,861,934	2,085,617	7,474,889	3.58	72.9

[a] Includes 350 Semet-Solvay, 1,018 Otto-Hoffmann, and 282 Rothberg ovens.

Of the total production of 2,085,617 short tons in 1906, shown in the preceding table, 2,038,872 short tons, or 98 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 1906.

NATURAL GAS.

By B. Hill.

INTRODUCTION.

By David T. Day.

The value of the natural gas product of 1906 increased to $46,873,932. In 1905 the corresponding figure was $41,562,855. The increase of $5,311,077, or 12.8 per cent, was partly an incident of the increased activity in oil exploitation in the Mid-Continent field, and was still more largely due to continued exploitation in West Virginia (increase over $3,500,000) and in Ohio (increase about $1,400,000). Pennsylvania lost ground to the extent of $639,091, or 3.3 per cent, while Indiana suffered a decrease of nearly half its product, or 43.4 per cent. Pennsylvania, however, more than made up for its loss in production by borrowing from West Virginia, as in previous years, so that the gas consumed in Pennsylvania showed an increase from $19,237,218 in 1905 to $21,085,077 in 1906. Ohio also borrowed heavily, so that increased consumption exceeded increased production by $5,506,711. This increased pumping of natural gas has tended greatly to the steadying of the industry and to the development of enterprises dependent upon it. The transportation of natural gas being so much cheaper than that of coal enabled the natural gas to compete with coal at comparatively greater distances.

Quantity of natural gas produced.—For the first time in the history of these statistics a successful effort has been made to collect the quantity of gas produced. Many small producers kept no record of the quantity produced, and were only able to report the total value of gas sold. This rendered very difficult the task of collecting a record of the total quantity produced.

In 1906 the product amounted to 388,842,562,000 cubic feet measured at the atmospheric pressure, or 9,396,963.8 short tons. The average price of $5 per short ton for natural gas is interesting, considering that the corresponding average price of bituminous coal in 1906 was only $1.11 per short ton. The difference is fully made up by the superior fuel efficiency of natural gas, weight for weight, by the great economy of labor in its use and the cost of removing ashes.

The principal new producing field of interest is at Caddo, in northern Louisiana, which is referred to in detail, as are other natural-gas fields, in the current report on petroleum. Reference should also be made to the descriptions of natural-gas fields contained in the natural-gas report for 1905.[a]

The decrease in the number of natural-gas companies in the United States was noted in the report for 1905. This decrease continued. In 1905 there were 2,139 producing companies; in 1906 they declined to 1,871. The increase in the distances to which gas is transported tends to the consolidation of smaller companies faster than they are formed.

PRODUCTION.

For the first time this report presents not only statistics of the value of the natural-gas product, but a statement of the quantity produced in each State, and also the quantity consumed in each State. The latter statement is necessary on account of the increasing practice of piping and frequently pumping natural gas from the State where it is produced to some other State where the demand for consumption is not met by its own product.

It is not possible for 1906 to compare the quantity of gas produced with that of the preceding twelve months, but it is evident in general that increased price was not alone responsible for the increased value, the increases from West Virginia, from Kansas, and from Ohio being most apparent.

The following table gives, by States, the total value of the natural gas produced in the entire country from 1882 to 1906, inclusive:

Approximate value of natural gas produced in the United States, 1882–1906, 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

[a] Mineral Resources U. S., for 1905, U. S. Geol. Survey, 1906, pp. 799–812.

Approximate value of natural gas produced in the United States, 1882–1906, by States—Continued.

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

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	249,000	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	1,334,023	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.	1906.
Pennsylvania	$10,215,412	$12,688,161	$14,352,183	$16,182,834	$18,139,914	$19,197,336	$18,558,245
New York	335,367	293,232	346,471	493,686	522,575	623,251	672,795
Ohio	2,178,234	2,147,215	2,355,458	4,479,040	5,315,564	5,721,462	7,145,809
West Virginia	2,959,032	3,954,472	5,390,181	6,882,359	8,114,249	10,075,804	13,735,343
Illinois	1,700	1,825	1,844	3,310	4,745	7,223	87,211
Indiana	7,254,539	6,954,566	7,081,344	6,098,364	4,342,409	3,094,134	1,750,715
Kansas	356,900	659,173	824,431	1,123,849	1,517,643	2,261,836	4,010,986
Missouri	547	1,328	2,154	7,070	6,285	7,390	7,210
California	79,083	67,602	120,648	104,521	114,195	133,696	134,560
Alabama	....	....	....	....			
Texas	20,000	18,577	14,953	13,851	} 14,082	14,409	} 150,695
Louisiana	....	....	....	....	....	1,500	
Kentucky	286,243	270,871	365,356	390,301	322,104	237,290	287,501
Tennessee	....	....	300	300	300	300	300
Arkansas and Wyoming	....	....	....	2,460	6,515	21,135	34,500
Colorado	1,800	1,800	1,900	14,140	14,300	20,752	22,800
South Dakota	9,817	7,255	10,280	10,775	12,215	15,200	15,400
Oklahoma	....	....	360	1,000	49,665	130,137	259,862
Total	23,698,674	27,066,077	30,867,863	35,807,860	38,496,760	41,562,855	46,873,932

CONSUMPTION.

The preceding table shows the value of the gas produced in each State. In the tables to follow the quantity and the value of the gas consumed in each State are shown. For years Pennsylvania, West Virginia, Ohio, and, more recently, Kansas, Oklahoma, and Indian Territory have produced more gas than they have consumed. In 1906 Pennsylvania reversed the conditions and consumed slightly more than her entire product. New York and Ohio also drew heavily on other States for their supply.

Quantity and value of natural gas produced and consumed in the United States in 1906, by States.

State.	Produced.			Consumed.		
	Quantity, M cubic feet.	Cents per M cu. ft.	Value.	Quantity, M cubic feet.	Cents per M cu ft.	Value.
Pennsylvania	138,161,385	13.4	$18,558,245	162,095,173	13.0	$21,085,077
Ohio	45,436,020	15.7	7,145,809	74,812,562	16.9	12,652,520
West Virginia	119,400,392	11.5	13,735,343	58,455,009	6.3	3,720,440
Kansas	69,322,633	5.8	4,010,986	69,468,461	5.8	4,030,776
Missouri	33,560	21.5	7,210			
New York	2,547,769	26.4	672,795	10,182,422	26.0	2,654,115
Indiana	7,861,140	22.2	1,750,715	7,861,540	22.2	1,750,755
Kentucky	789,154	36.4	287,501	789,154	36.4	287,501
Oklahoma	3,520,396	7.3	259,862	3,408,128	7.2	247,282
California	153,021	87.9	134,560	153,021	87.9	134,560
Alabama	1,038,569	14.5	150,695	1,038,569	14.5	150,695
Louisiana						
Texas						
Illinois	409,556	21.3	87,211	409,556	21.3	87,211
Colorado	23,567	96.7	22,800	23,567	96.7	22,800
Arkansas	120,500	28.6	34,500	120,500	28.6	34,500
Wyoming						
South Dakota	22,900	67.2	15,400	22,900	67.2	15,400
Tennessee	2,000	15.0	300	2,000	15.0	300
Total	388,842,562	12.1	46,873,932	388,842,562	12.1	46,873,932

Distribution of natural gas consumed in the United States in 1906, by States.

State.	Number of producers.	Consumers.		Gas consumed.		
				Domestic.		
		Domestic.	Industrial.	Quantity, M cubic feet.	Cents per M cu. ft.	Value.
Pennsylvania	309	273,184	3,307	41,135,808	22.2	$9,128,837
Ohio	409	310,175	3,316	33,049,479	24.7	8,165,567
Kansas	130	79,512	995	9,576,572	17.5	1,673,979
Missouri	19					
West Virginia	67	51,281	913	9,619,147	15.5	1,489,473
New York	143	74,538	95	8,999,871	27.7	2,495,040
Indiana	578	47,368	156	5,049,759	27.8	1,403,987
Kentucky	45	17,216	18	679,941	40.5	275,860
Oklahoma	50	8,391	202	1,446,879	11.8	170,774
Alabama	2	1	1	273,919	30.4	83,320
Louisiana	4	2,700	28			
Texas	5	702	1			
California	18	5,537	10	122,577	97.3	119,338
Illinois	66	1,429	2	359,556	22.8	82,211
Arkansas	4	1,700	4	58,500	49.1	28,711
Wyoming	3	3	4			
Colorado	3	800	11	20,500	100.0	20,500
South Dakota	13	406	10	12,900	88.4	11,400
Tennessee	3	1	1	400	25.0	100
Total	1,871	874,944	9,074	110,405,808	22.7	25,149,097

Distribution of natural gas consumed in the United States in 1896, by States—Continued.

State.	Gas consumed.					
	Industrial.			Total.		
	Quantity, M cubic feet.	Cents per M cu. ft.	Value.	Quantity, M cubic feet.	Cents per M cu. ft.	Value.
Pennsylvania	120,959,365	9.9	$11,956,240	162,095,173	13.0	$21,085,077
Ohio	41,763,083	10.7	4,486,953	74,812,562	16.9	12,652,520
Kansas / Missouri	59,891,889	3.9	2,356,797	69,468,461	5.8	4,030,776
West Virginia	48,835,862	4.6	2,230,967	58,455,009	6.3	3,720,440
New York	1,182,551	13.4	159,075	10,182,422	26.0	2,654,115
Indiana	2,811,781	12.3	346,768	7,861,540	22.2	1,750,755
Kentucky	109,213	10.6	11,641	789,154	36.4	287,501
Oklahoma	1,961,249	3.9	76,508	3,408,128	7.2	247,282
Alabama / Louisiana / Texas	764,650	8.8	67,375	1,038,569	14.5	150,695
California	30,444	50.0	15,222	153,021	87.9	134,560
Illinois	50,000	10.0	5,000	409,556	21.3	87,211
Arkansas / Wyoming	62,000	9.3	5,789	120,500	28.6	34,500
Colorado	3,067	75.0	2,300	23,567	96.7	22,800
South Dakota	10,000	40.0	4,000	22,900	67.2	15,400
Tennessee	1,600	12.5	200	2,000	15.0	300
Total	278,436,754	7.8	21,724,835	388,842,562	12.1	46,873,932

Value of natural gas consumed in the United States, 1902–1906, by States.

State.	1902.	1903.	1904.	1905.	1906.
Pennsylvania	$13,942,783	$16,060,196	$17,205,804	$19,237,218	$21,085,077
Ohio	4,785,766	7,200,867	9,393,843	10,396,633	12,652,520
Kansas	824,431	1,123,849	1,517,643	2,265,945	4,030,776 (Kansas and Missouri)
Missouri	2,154	7,070	6,285	7,390	
West Virginia	2,473,174	3,125,061	3,383,515	3,586,608	3,720,440
New York	1,723,709	1,944,667	2,222,980	2,434,894	2,654,115
Indiana	[a] 6,710,080	[a] 5,915,367	[a] 4,282,409	[a] 3,056,634	[a] 1,750,755
Kentucky	255,481	280,426	268,264	237,290	287,501
Oklahoma	360	1,000	49,665	126,028	247,282
Alabama	....	....	14,082 (Alabama and Texas)		150,695 (Alabama, Texas and Louisiana)
Texas	14,953	13,851 (Alabama and Texas)		14,409 (Alabama and Texas)	
Louisiana	....	....	....	1,500	
California	120,648	104,521	114,195	133,696	134,560
Illinois	1,844	3,310	4,745	7,223	87,211
Arkansas	....	2,460 (Arkansas and Wyoming)	6,515	21,135	34,500
Wyoming	....				
Colorado	1,900	14,140	14,300	20,752	22,800
South Dakota	10,280	10,775	12,215	15,200	15,400
Tennessee	300	300	300	300	300
Total	30,867,863	35,807,860	38,496,760	41,562,855	46,873,932

[a] A portion of this was consumed in Chicago, Ill.

COMBINED VALUE OF NATURAL GAS AND PETROLEUM.

The following tables give the value of natural gas and of petroleum and their combined value in 1905 and 1906, by States, arranged in the order of the value of the combined production.

Value of the natural gas and petroleum produced in 1905 and 1906, and their combined value, by States.

1905.

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	41,562,855	84,157,399	125,720,254

1906.

Pennsylvania	$18,558,245	$16,596,943	$35,155,188
West Virginia	13,735,343	16,170,293	29,905,636
Ohio	7,145,809	16,997,000	24,142,809
Oklahoma	259,862	9,615,198	13,886,046
Kansas	4,010,986		
Alabama		0	
Louisiana	150,695	3,557,838	10,274,111
Texas		6,565,578	
California	134,560	9,553,430	9,687,990
Indiana	1,750,715	6,770,066	8,520,781
Illinois	87,211	3,274,818	3,362,029
New York	672,795	1,995,377	2,668,172
Kentucky	287,801	1,031,629	1,319,430
Tennessee			
Colorado	22,800	262,675	285,475
Arkansas	34,500	49,000	83,500
Wyoming			
South Dakota	15,400	0	15,400
Michigan	0	4,890	12,100
Missouri	7,210		
Total	46,873,932	92,444,735	139,318,667

The combined value of petroleum and natural gas increased more than $13,500,000 in 1906, and was the greatest value ever recorded. Every producing State joined in the gain except Indiana and Colorado. Pennsylvania was still in the lead, followed by West Virginia, while California, first in the quantity of oil produced, was sixth in total value.

WELL RECORD.

The following table summarizes the activity in gas-well drilling for 1906, showing the number of producing wells at the beginning and at the end of the year. The total number of wells actually producing at the end of the year showed a very healthy increase of nearly an even thousand. Indiana was the only State having a decrease in the number of producing wells, 624 having been abandoned during the year and only 159 new producing wells added. More new wells were added in Pennsylvania than in any other State, and Kansas added 331, almost as many as Ohio. Drilling was more successful in 1906 in the Mid-Continent field, only 24.3 per cent of the wells being dry holes, than in 1905, when 31.5 per cent were dry in Kansas and 36 per cent were dry in Oklahoma and Indian Territory. In West Virginia 8 per cent were dry in 1906, and 7 per cent in 1905.

Record of natural gas wells in 1906, by States.

State.	Wells.					
	Productive Dec. 31, 1905.	Drilled in 1906.			Abandoned in 1906.	Productive Dec. 31, 1906.
		Productive.	Dry.	Total.		
Alabama	8	2	3	5		10
Arkansas	9	34	5	39		43
California	43	1		1		44
Colorado	2					2
Illinois	68	19	7	26		87
Indiana	3,650	159	46	205	624	3,185
Kansas	1,142	331	99	430	28	1,445
Kentucky	149	16	1	17	2	163
Louisiana	10	11	1	12	1	20
Missouri	42	2	2	4	2	42
New York	839	64	14	78	6	897
Ohio	1,705	337	51	388	65	1,977
Oklahoma	79	81	33	114	1	159
Pennsylvania	6,566	603	153	756	169	7,000
South Dakota	16					16
Tennessee	3					3
Texas	16	4	13	17	3	17
West Virginia	1,579	263	23	286	47	1,795
Wyoming	8	1		1		9
Total	15,934	1,928	451	2,379	948	16,914

ACREAGE CONTROLLED BY NATURAL GAS COMPANIES.

The following table shows the number of acres of land held by natural gas companies in 1906 and whether the acreage was owned or leased, and also whether it was held by operation or by rental:

Acreage controlled by natural gas companies in 1906, by States.

State.	Acreage.				
	Owned.	Leased.	Total.	Held by operation.	Held by rental.
Alabama	70	70,000	70,070	3,000	67,000
Arkansas		50,320	50,320	1,920	48,400
California	648		648		
Colorado					
Illinois		34,785	34,785	2,715	32,070
Indiana	16,539	117,785	134,324	71,570	46,215
Kansas	15,607	[a] 567,469	583,076	103,906	207,371
Kentucky	138	47,493	47,631	7,422	40,071
Louisiana					
Missouri	2,068	10,015	12,083	40	9,975
New York	2,331	118,305	120,636	35,578	82,727
Ohio	5,182	712,451	717,633	114,219	598,232
Oklahoma	6,527	711,999	718,526	692,209	19,790
Pennsylvania	322,029	1,325,664	1,647,693	397,286	928,378
South Dakota					
Tennessee		2,500	2,500		2,500
Texas	598	28,709	29,307	7,720	20,989
West Virginia	34,078	1,039,173	1,073,251	250,856	788,317
Wyoming	250	2,210	2,460	1,490	720
Total	406,065	[a] 4,838,878	5,244,943	1,689,931	2,892,755

[a] Includes 256,192 acres concerning which no statements were made as to whether they were held by operation or by rental.

NATURAL GAS INDUSTRY, BY STATES.

The following tables show the number of producers and the value of gas produced in the States mentioned. In addition, the number of consumers and the value of gas they consumed, the number of wells drilled, and the results of the drilling are given as indicating the activity of the search for natural gas. Furthermore, the results are given of an investigation as to the acreage in the gas fields and the pressure limits of the gas in the gas-producing counties of the respective States.

PENNSYLVANIA.

Record of natural gas industry in Pennsylvania, 1897–1906.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers. Domestic.	Number of consumers. Industrial.	Value.	Drilled. Gas.	Drilled. Dry.	Productive Dec. 31.
1897	176	$6,242,543	a 201,059	1,124	$5,392,661	314	96	2,467
1898	232	6,806,742	a 213,410	1,021	6,064,477	373	74	2,840
1899	281	8,337,210	a 232,060	1,236	7,926,970	467	104	3,303
1900	266	10,215,412	a 229,730	1,296	9,812,615	513	142	3,776
1901	296	12,688,161	a 326,912	1,743	11,785,996	660	143	4,436
1902	379	14,352,183	185,678	2,448	13,942,783	775	232	5,211
1903	414	16,182,834	214,432	2,834	16,060,196	699	126	5,910
1904	414	18,139,914	238,481	2,929	17,205,804	701	174	6,352
1905	351	19,197,336	257,416	2,845	19,237,218	765	168	6,566
1906	309	18,558,245	273,184	3,307	21,085,077	603	153	7,000

a Number of fires supplied.

Depth and gas pressure of wells in Pennsylvania in 1906, by counties.

County.	Depth, in feet.	Pressure, in pounds.
Allegheny	1,530–2,800	1–380
Armstrong	a 1,250–2,600	7–900
Beaver	1,000	Unknown
Butler	900–2,600	22–700
Clarion	600–2,600	6–450
Elk	1,600–2,500	50–990
Crawford Erie	750–800	25–100
Fayette and Somerset	1,700–2,660	28–300
Forest	975–2,225	6–90
Greene	1,500–3,100	80–350
Jefferson	1,800–2,715	70–800
McKean	1,000–2,600	18–880
Mercer	1,100–1,500	30–150
Potter	965–2,200	125–400
Venango	1,000–2,000	90–200
Warren	1,050–1,600	20–100
Washington	2,200–3,304	30–1,300
Westmoreland	1,800–2,000	80–100

a One well 3,384 feet deep.

NEW YORK.

Record of natural-gas industry in New York, 1897–1906.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1897	41	$200,076	a 55,086	80	$874,617	33	7	359
1898	62	229,078	a 68,662	103	1,006,567	63	9	422
1899	84	294,593	a 76,544	121	1,236,007	36	7	447
1900	89	335,367	a 89,837	138	1,456,286	57	11	504
1901	114	293,232	a 95,161	98	1,694,925	53	14	557
1902	116	346,471	50,536	215	1,723,709	69	8	626
1903	144	493,686	57,935	208	1,944,667	75	11	700
1904	153	522,575	67,203	451	2,222,980	78	12	744
1905	148	623,251	67,848	447	2,434,894	89	17	839
1906	143	672,795	74,538	95	2,654,115	64	14	897

a Number of fires supplied.

Depth and gas pressure of wells in New York, by counties.

County.	Depth, in feet.	Pressure, in pounds.
Allegany	850–1,500	30–250
Cattaraugus	500–1,500	20–90
Chautauqua	800–2,000	5–650
Erie, Niagara	550–2,000	56–400
Genesee	1,150	....
Livingston	120–530	5–10
Onondaga	1,000–3,000	100–350
Ontario, Seneca	700–2,000	10–600
Oswego	800–1,200	4–400
Schuyler, Yates	1,200–1,600	100–435
Steuben	600–850	70–300
Wyoming	1,700–1,800	120–200

WEST VIRGINIA.

West Virginia shows the largest gain in production of natural gas in 1906. The estimated output amounted to 119,400,392,000 cubic feet. Of this total product less than one-half, or 58,455,009,000 cubic feet, was consumed in the State, and 60,945,383,000 cubic feet were piped to other States for consumption. The total value of natural gas produced in this State was $13,735,343, of which only $3,720,440 worth was consumed in the State, so that the value of 60,945,383,000 cubic feet of gas piped out of the State was $10,014,903. The total value of natural gas consumed in the State is greatly reduced on account of the numerous manufacturing establishments located there, which use gas in large quantities and to which the gas is furnished at a low price. Large quantities of gas are consumed in the manufacture of carbon black; some of the factories in West Virginia have been removed from the exhausted gas fields of Indiana, and a few are from Pennsylvania, where also carbon works are in operation. The carbon black is manufactured chiefly by companies which own their wells, and the price placed upon the gas is low, ranging in 1906 from 2 to 4 cents per thousand cubic feet. It is estimated that in

1906 the carbon black manufacturers alone consumed in West Virginia 14,405,043,000 cubic feet of gas, valued at $395,002. Natural gas is also furnished at low prices to glass manufacturers, some of whom formerly operated works in the Indiana gas fields. Gas is purchased in West Virginia by the large gas companies, which pipe it from the State at as low as 2 cents per thousand cubic feet at the casing head.

Record of natural-gas industry in West Virginia, 1897-1906.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1897	12	$912,528	[a] 30,015	393	$791,192	47	1	196
1898	19	1,334,023	[a] 28,652	125	914,969	32	4	227
1899	30	2,335,864	[a] 38,137	305	1,310,675	78	6	300
1900	34	2,959,032	[a] 45,943	184	1,530,378	129	6	428
1901	44	3,954,472	[a] 55,808	266	2,244,758	177	8	604
1902	79	5,390,181	29,357	877	2,473,174	142	37	745
1903	88	6,882,359	36,179	1,122	3,125,061	242	43	987
1904	90	8,114,249	44,563	1,005	3,383,515	292	33	1,274
1905	76	10,075,804	45,588	1,417	3,586,608	385	28	1,579
1906	67	13,735,343	51,281	913	3,720,440	263	23	1,795

[a] Number of fires supplied.

Depth and gas pressure of wells in West Virginia, by counties.

County.	Depth, in feet.	Pressure, in pounds.
Cabell	1,000-2,150	350-650
Calhoun	1,650-2,860	300
Doddridge	1,700-2,800	100-900
Gilmer	1,280-1,425	465
Hancock	1,135-1,200	80-90
Harrison	2,300-3,049	325-1,000
Kanawha, Roane	1,700	....
Lewis	2,000-2,700	200-900
Marion	2,700-3,000	400-750
Monongalia	1,400-3,106	150-500
Pleasants, Ritchie	1,500-2,000	170-500
Tyler	1,800-2,700	80
Wetzel	2,700-2,800	42-50
Wirt	700-1,360	60-530

KENTUCKY.

During 1906 gas produced from some wells in Menifee and Powell counties, Ky., was piped and supplied to domestic and industrial consumers in the town of Lexington. A pipe line was also laid from the Knox County field to Barboursville, but this gas was not furnished to consumers until January, 1907. Other operations in this State remain practically the same as in 1905.

OHIO.

Record of natural-gas industry in Ohio, 1897–1906.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1897	157	$1,171,777	a 85,368	183	$1,506,454	88	51	729
1898	237	1,488,308	a 68,211	349	2,250,706	120	12	806
1899	359	1,866,271	a 77,787	691	3,207,286	134	17	929
1900	281	2,178,234	a 135,743	1,092	3,823,209	97	19	990
1901	305	2,147,215	a 149,709	949	4,119,059	113	35	1,099
1902	451	2,355,458	120,127	786	4,785,766	266	40	1,343
1903	515	4,479,040	197,710	1,786	7,200,867	290	62	1,523
1904	453	5,315,564	232,557	1,136	9,393,843	334	49	1,661
1905	425	5,721,462	274,585	2,955	10,396,633	342	58	1,705
1906	409	7,145,809	310,175	3,316	12,652,520	337	51	1,977

a Number of fires supplied.

Depth and gas pressure of wells in Ohio in 1906, by counties.

County.	Depth, in feet.	Pressure, in pounds.
Allen	1,200–1,260	25–100
Athens, Vinton, Jackson	700– 900	50–350
Auglaize	1,220	....
Columbiana	700–850	90–225
Darke	1,100–1,170	....
Fairfield	1,900–2,300	15–300
Guernsey	1,150–1,200	250
Hancock	1,200–1,400	2–250
Hardin, Logan	1,300–1,460	25–250
Harrison	703–1,600	100–300
Hocking	2,300	500–600
Holmes	700–1,000	210
Jefferson	700–2,026	200–300
Knox	2,200–2,680	50–940
Licking	2,100–2,400	300–500
Lucas	1,165–1,330	0–90
Mercer	1,185–1,300	20–43
Belmont, Monroe	1,500–2,000	136–150
Morgan	1,000–1,450	30–500
Ottawa	1,250–1,600	50–420
Richland	2,550	1,000–1,260
Sandusky	1,325–1,400	30–150
Van Wert	1,200–1,270	75–200
Washington	1,050–2,600	80–640
Wood	1,200–1,400	10–60

INDIANA.

It will be seen from the following tables that the wells in Indiana are rapidly being exhausted. Many wells have been abandoned; others have a showing of oil. In this State many of the gas wells are located on what are called "sites," there being only enough space to operate the well.

Record of natural-gas industry in Indiana, 1897-1906.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1897	452	$5,009,208	[a] 214,750	935	$3,945,307	419	66	2,881
1898	533	5,060,969	[a] 173,454	1,867	4,682,401	706	111	3,325
1899	571	6,680,370	[a] 181,440	1,741	5,833,370	838	109	3,909
1900	670	7,254,539	[a] 181,751	2,751	6,412,307	861	156	4,546
1901	656	6,954,566	[a] 153,869	2,570	6,276,119	985	208	4,572
1902	929	7,081,344	101,481	3,282	6,710,080	1,331	205	5,820
1903	924	6,098,364	90,118	1,020	5,915,367	895	242	5,514
1904	846	4,342,409	84,862	390	4,282,409	706	153	4,684
1905	740	3,094,134	63,194	231	3,056,634	252	74	3,650
1906	578	1,750,715	47,368	156	1,750,755	159	46	3,185

[a] Number of fires supplied.

Depth and gas pressure of wells in Indiana, in 1906, by counties.

County.	Depth, in feet.	Pressure, in pounds.
Bartholomew	864–990	25–150
Blackford	975–1,080	1
Daviess, Martin	520–600	4–15
Decatur, Franklin	728–1,000	30–340
Delaware	880–1,200	1–35
Gibson	950	(a)
Grant	900–1,100	[b] 0–15
Hamilton	800–1,200	10–200
Hancock	900–1,026	5–200
Harrison	350	30
Henry	800–1,050	10–200
Howard	900–1,050	20–200
Jay	900–1,200	0–190
Madison	850–1,000	½–50
Miami	927–975	70–100
Randolph	1,050–1,100	25–275
Rush	780–1,000	40–350
Shelby	800–1,000	60–330
Clinton, Tipton	900–1,200	45–215
Wayne	880–1,150	70–75

[a] Gas from oil wells. [b] Run on vacuum.

ILLINOIS.

The developments in both oil and natural gas have been rapid in this State since 1905. During 1906 a total of 19 good gas wells were drilled in Clark and Crawford counties, and gas was furnished to domestic consumers in the following-named towns: Casey, Robinson, Hutsonville, Annapolis, Martinsville, Marshall, and Flat Rock, and Palestine and Oblong since the beginning of 1907. The gas is found at a depth of from 350 feet in Clark County to 1,000 feet in Crawford County, the pressure varying from 150 pounds to 435 pounds.

Several wells in Bureau County furnish sufficient gas for domestic consumption by the owners of the wells.

KANSAS.

It will be noted that the table gives the combined consumption of natural gas in Kansas and Missouri in 1906. Since the Kansas Natural Gas Company was the only producer which piped gas from Kansas to Missouri, it was not advisable to make separate statements of quantity and value of gas consumed in the two States. Gas sold by this company in the various cities supplied by it throughout Kansas and Missouri was by meter, while gas sold by most of the other gas companies was at flat rate, making it possible to give only approximate figures of the total consumption. A small quantity of gas was piped from Oklahoma to Kansas and used by domestic consumers.

The average price received per thousand cubic feet for gas produced in the States of Kansas and Missouri and sold for domestic purposes in these States was 17.5 cents, the price ranging from 6 cents in Kansas to 29 cents in Missouri. The average price received for gas sold for domestic purposes in Missouri in 1906 was a little over 25 cents, while the average price received in Kansas was a little over 16 cents. Large quantities of gas are sold by producers in Kansas to distributors of gas for delivery to domestic consumers, for which as little as 2 cents was paid per thousand cubic feet.

Natural gas is used in large quantities in Kansas for manufacturing purposes by zinc smelters, cement and brick works, and glass and other factories. It is estimated that during 1906 a total of 39,100,850,000 cubic feet of gas, valued at $810,440, was consumed in zinc, cement, and brick works alone. Of this quantity the zinc smelters consumed 26,108,350,000 cubic feet, valued at $470,209, an average value of 1.8 cents per thousand cubic feet, the price ranging from 1 to 3 cents; cement works consumed 8,755,000,000 cubic feet, valued at $202,500, an average of 2⅓ cents per thousand cubic feet and a range of from 2 to 3 cents; brick works consumed 4,237,500,000 cubic feet, valued at $137,731, an average of 3¼ cents per thousand, and a range of from 3 to 5 cents. The price of gas sold for industrial or manufacturing purposes in these States in 1906 ranged from 1 to 12½ cents per thousand cubic feet.

Record of natural-gas industry in Kansas, 1897–1906.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1897	10	$105,700	[a] 3,956	20	$105,700	16	8	90
1898	29	174,640	[a] 6,186	44	174,640	34	18	121
1899	31	332,592	[a] 10,071	71	332,592	44	22	160
1900	32	356,900	[a] 9,703	65	356,900	54	15	209
1901	48	659,173	[a] 10,227	72	659,173	71	35	276
1902	80	824,431	13,488	91	824,431	144	63	404
1903	120	1,123,849	15,918	143	1,123,849	295	66	666
1904	190	1,517,643	27,204	298	1,517,643	378	135	1,029
1905	171	2,261,836	46,852	601	2,265,945	340	157	1,142
1906	130	4,010,986	58,268	416	[b] 4,023,566	331	99	1,445

[a] Number of fires supplied. [b] Includes gas taken from Kansas and consumed in Missouri.

Depth and gas pressure of wells in Kansas in 1906, by counties.

County.	Depth, in feet.	Pressure, in pounds.
Allen	825–1,000	40–400
Anderson	240–650	65–240
Bourbon Crawford	150–350	5–60
Chautauqua Cowley	400–1,300	75–320
Douglas Johnson	550–600	150–180
Elk Greenwood	365–1,278	80–290
Labette	700–750	250–285
Linn	270–500	25–185
Miami Franklin	300–600	70–75
Montgomery	525–1,500	100–650
Neosho	515–1,000	90–300
Wilson Woodson	720–1,080	135–400

MISSOURI.

It is estimated that 33,560,000 cubic feet of gas, valued at $7,210, were produced in Missouri during 1906. This gas was produced from a few wells located in Bates, Cass, Clay, and Jackson counties, being used for domestic purposes in the towns of Hume, Belton, West Line, and Holt. A small quantity of gas produced from wells in Kansas City is used for industrial purposes by the owners of the wells. As already stated, most of the gas consumed in Missouri is piped from the Kansas gas fields. Some of the cities in Missouri supplied with gas from Kansas were: Joplin, Webb City, Carthage, Kansas City, St. Joseph, Weston, and Carterville.

OKLAHOMA AND INDIAN TERRITORY.

Oklahoma, including Indian Territory, developed some very large gas wells in 1906, most of which are closed in, there being no market for the product. Several lines are now under construction, and gas will be piped to points of consumption during the current year. Very few meters are used in the State, most of the gas used for domestic purposes being sold at flat rates, and it is possible to give only approximate figures of production and consumption in 1906. On account of the abundant supply of gas and the lack of markets, the price received for the gas was extremely low. The average price of that sold for domestic purposes was 11.8 cents per thousand cubic feet, and of that sold for industrial purposes, 3.9 cents, the average price for the State being 7.2 cents. Some of the cities wholly or partly supplied with gas in 1906 were as follows: Bartlesville, Cleveland, Tulsa, Ramona, Pawhuska, Ponca City, Sapulpa, Muskogee, Claremore, Inola, Collinsville, Ocheleta, Bigheart, Nowata, Lenapah, Skiatook, Oologah, Gotebo, Okmulgee, Blackwell, and Wagoner.

Depth and gas pressure of wells in Oklahoma and Indian Territory, by districts.

District.	Depth, in feet.	Pressure, in pounds.
Cherokee Nation	500-1,400	50-590
Chickasaw Nation Comanche	400-1,190	220-250
Creek Nation	1,205-1,700	500-780
Kay	500-1,200	100-425
Kiowa	375- 390	100-130
Osage Nation	870-2,100	250-620
Pawnee	1,600-1,700	300-480

ALABAMA.

Eight very good gas wells, with pressures varying from 75 to 135 pounds, and depths from 375 to 500 feet, have been completed in Madison County by the New York-Alabama Oil Company. The gas from these wells was used in 1906 for development purposes only, the line from the gas field to Huntsville being in course of construction. This company began supplying gas to consumers about the middle of 1907, and the output of the wells seemed to be increasing each day.

Two wells which produce a small quantity of gas have been drilled about 1½ miles southwest of the corporate limits of Mobile in Mobile County. So far the gas from these wells has not been utilized.

ARKANSAS.

The report shows a slight gain in production of natural gas in Arkansas in 1906 over that of 1905. The gas consumed in this State comes from wells located in the Fort Smith district, Sebastian County. During 1906 some very good wells were brought in in this district, the product of which was not sold until 1907, when gas was supplied to consumers in the towns of Fort Smith and Van Buren. It is reported that these wells have an estimated daily capacity of from 20,000,000 to 40,000,000 cubic feet. The towns wholly or partly supplied with gas in Arkansas in 1906 were Fort Smith, Mansfield, and Huntington, where the gas is used for domestic purposes. A small quantity of gas was used in this State for development purposes in 1906.

LOUISIANA.

On account of there being but one natural-gas producer of importance in Louisiana in 1906 it was thought best to combine the figures of this State with those of Alabama and Texas. During 1906 there were 11 gas wells drilled in the Caddo field, 10 of which have been closed awaiting the completion of pipe lines which are either contemplated or under construction to points distant from the field, there being no market for the gas in the vicinity of the wells. A good gas well in the Caddo field has produced 35,000,000 cubic feet of gas daily. A 6-inch line, extending from this gas field to Shreveport has been in operation, supplying the towns of Mooringsport, Blanchard, Caddo City, and Shreveport in 1906. An 8-inch line is now being laid from this field. Three wells in Lafourche Parish produced a small quantity of gas, which was utilized for farm purposes.

TEXAS.

With the exception of one small well in Bexar County, all the natural gas consumed in Texas is from wells in the Navarro County field. The gas is furnished to domestic consumers in the town of Corsicana.

SOUTH DAKOTA.

The principal gas-producing section of this State is in Hughes County, where some artesian wells furnished, in 1906, sufficient gas to supply consumers in Pierre, the gas being used chiefly for domestic purposes.

In Stanley and Sully counties a few wells which produce a small gas output have been drilled, but very little of the gas has been utilized. It is probable that the gas produced in Stanley County, near Fort Pierre, will be utilized in the near future to supply the town. A gas tank is now in course of construction. The water and gas from this well have both gone to waste since the drilling of the well almost three years ago. Gas from the wells in Sully County has been used chiefly on the ranches on which they are located.

COLORADO.

Nothing new can be added to information furnished in previous reports concerning the gas production of this State. Most of the gas consumed comes from a well located at Boulder. A small quantity is also utilized in the Florence field.

WYOMING.

The gas produced from wells in the Douglas field, Converse County, in 1906 was used principally for heat, light, forge, and boiler purposes.

CALIFORNIA.

The California natural-gas situation remains practically the same as in 1905, no new gas fields having been developed.

CANADA.

Quebec.—According to Mr. J. Obalski, Canadian superintendent of mines, natural-gas wells have been bored in the St. Lawrence Valley to depths of from 180 to 250 feet and have obtained gas which has been piped to neighboring villages. It is proposed to reach Three Rivers with an 8-inch gas main.

Ontario.—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, 1902–1906.

Year.	Producing wells.	Miles of gas pipe.	Workmen employed.	Value of gas product.	Wages for labor.
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	[a] 316,476	88,865
1906	332	550	108	533,446	64,968

[a] In addition gas valued at $33,000 was produced from 12 wells at Medicine Hat, Alberta, Canada.

PETROLEUM.[a]

By W. T. Griswold.

IMPORTANT FEATURES OF THE YEAR.

The most important features in connection with the production of petroleum in the United States during the year 1906 are as follows:

(1) The extension in area and the increased daily production of oil in the Mid-Continent field.

(2) The expansion of the area in Illinois from which oil is being produced. This field has expanded from its point of original discovery near Casey to the southeast, into Lawrence county.

(3) The growth of the consumption of fuel oil in California. The consumption of fuel oil in 1906 in this State exceeded the total production of the California field during the year.

(4) The falling off in the production from the pools of the Coastal Plain district of the Gulf States.

(5) The continued decrease in the average daily production from the Appalachian field.

(6) The laying of the second pipe line from the Mid-Continent field to Whiting, Ind., and the building of a pipe line across the Isthmus of Panama for the delivery of the oil from the California field to the Atlantic Ocean.

PRODUCTION.

The production of petroleum in the United States during the year 1906 was 126,493,936 barrels. This quantity was produced from the five great fields as follows: Appalachian field, 27,741,472 barrels; Lima-Indiana-Illinois field, 21,951,711 barrels; Mid-Continent field, 21,718,648 barrels; Gulf field, 21,645,425 barrels; California field, 33,098,598 barrels; and besides these quantities, 338,082 barrels were produced from scattering States, principally Colorado and Wyoming.

This production is made up of what for lack of better terms may be called the two great classes of petroleum—illuminating crude and fuel crude. These distinctive names are not absolutely correct, as all petroleum furnishes some illuminating oil and any petroleum may be used for fuel. The greater part of the oil from the Gulf and the California fields, however, is consumed as fuel, while but a small proportion of that produced in the other fields is so consumed.

Just what proportion of the different commercial products may be obtained from the crude petroleums of the different fields of the

[a] The statistical tables in this report, as in preceding reports, were compiled chiefly by Miss Belle Hill, of this office.

United States can not be definitely stated. Such proportionate production depends, to some extent, on the requirements of the market and on the purpose of the refiner. Any of the different oils can be made to produce more or less of a particular commercial product within certain limits. The following table shows approximately the percentages of the different commercial products obtained from the oils of the different fields in the United States:

Percentage of approximate average yield of leading products from different kinds of crude oil, by fields.[a]

Product.	Appalachian.	Lima-Indiana.	Illinois.	Mid-Continent.	Gulf.	California.	Corsicana.	Colorado.
Naphthas—gasoline, benzine, etc.	12.0	11.5	3.5	11.0	3.0	6.0	7.0	3.5
Illuminating oil	67.0	43.0	39.0	41.0	15.0	18.0	50.0	35.0
Lubricating oils (including grease	12.5	15.0	....	....	6.0	1.5	....	3.0
Gas oil				25.0	45.0		....	....
Fuel oil (including acid oil and asphaltum oil and asphalt)	4.0	25.0	56.0	20.0	28.0	72.0	40.0	55.0
Paraffin wax	2.0	2.0	....	....	....	....	....	....
Total	97.5	96.5	98.5	97.0	97.0	97.5	97.0	96.5

[a] Report Commissioner of Corporations on the Petroleum Industry, pt. 1, May 20, 1907, p. 108—except as to crude oil from Illinois the test given in the table being for oil from only one part of the State.

Production of crude oil for illuminating purposes.—In the year 1900 the Appalachian field produced 36,295,433 barrels of petroleum, the greatest quantity ever taken in one year from that field. Since that date there has been a steady falling off in the yearly production of the Appalachian field as follows, expressed in percentage of the year 1900: 7.4 per cent in 1901, 11.8 per cent in 1902, 13 per cent in 1903, 13.5 per cent in 1904, 19.1 per cent in 1905, and 23.6 per cent in 1906. It is probable that the production from the Appalachian field will continue to decrease each year, as there are very few untested areas within the limits of the field that could contain a large pool of oil.

The quantity of oil produced from the Lima-Indiana-Illinois field was 523,544 barrels less than the production of the year 1905. That the falling off in output from this field is so slight is due to the large new producing area in Illinois that has been added to the field. This portion of the field increased in production from 181,084 barrels in 1905 to 4,397,050 barrels in 1906. The older portion of the field included in western Ohio and Indiana shows a falling off in the quantity produced since the year 1904, when 24,689,184 barrels of oil were taken from the ground. In the year 1905 this quantity decreased by 9.7 per cent, and in 1906 by 21.3 per cent.

The Mid-Continent oil field produced more oil in 1906 than in any previous year. The production of this field has rapidly increased since 1902. During this period the oil development has been carried south until at the end of 1906 it extended from Humboldt, Kans., to 15 miles south of Tulsa, Ind. T.

The oil production of Colorado and most of that of Wyoming should be added to the illuminating crude-oil supply. The total quantity of crude oil for illuminating purposes produced in the year 1906 was 71,749,913 barrels.

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 1905 and 1906; 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 1905 and 1906, by States.

State.	1905.			1906.		
	Quantity (barrels).	Value.	Average price per barrel.	Quantity (barrels.)	Value.	Average price per barrel.
California	33,427,473	$8,201,846	$0.245	33,098,598	$9,553,430	$0.289
Colorado	376,238	337,606	.897	327,582	262,675	.802
Illinois	*a* 181,084	116,561	.644	4,397,050	3,274,818	.745
Indiana	10,964,247	9,404,909	.858	7,673,477	6,770,066	.882
Indian Territory, Oklahoma, Kansas	12,013,495	6,546,398	.545	21,718,648	9,615,198	.443
Kentucky, Tennessee	1,217,337	943,211	.775	1,213,548	1,031,629	.850
Louisiana	8,910,416	1,601,325	.180	9,077,528	3,557,838	.392
Michigan, Missouri	3,100	3,320	1.071	3,500	4,890	1.397
New York	1,117,582	1,557,630	1.394	1,243,517	1,995,377	1.605
Ohio	16,346,660	17,054,877	1.043	14,787,763	16,997,000	1.149
Pennsylvania	10,437,195	14,653,278	1.404	10,256,893	16,596,943	1.618
Texas	28,136,189	7,552,262	.268	12,567,897	6,565,578	.522
West Virginia	11,578,110	16,132,631	1.393	10,120,935	16,170,293	1.598
Wyoming	8,454	51,545	6.10	*a*7,000	*a*49,000	7.000
Total	134,717,580	84,157,399	.625	126,493,936	92,444,735	.731

a Estimated.

The increase or decrease in the production by States, as well as the percentage of increase or decrease in 1906 compared with 1905, are shown in the following table:

Total production of crude petroleum and percentage of increase or decrease, by States, in 1906, as compared with 1905, in barrels.

State.	Production.		Increase.	Decrease.	Percentage.	
	1905.	1906.			Increase.	Decrease.
California	33,427,473	33,098,598	....	328,875	....	0.98
Colorado	376,238	327,582	....	48,656	....	12.93
Illinois	181,084	4,397,050	4,215,966	....	2,328.18	....
Indiana	10,964,247	7,673,477	....	3,290,770	....	30.01
Indian Territory, Oklahoma, Kansas	12,013,495	21,718,648	9,705,153	....	80.79	....
Kentucky, Tennessee	1,217,337	1,213,548	....	3,789	....	.31
Louisiana	8,910,416	9,077,528	167,112	....	1.88	....
Michigan, Missouri	3,100	3,500	400	....	12.90	....
New York	1,117,582	1,243,517	125,935	....	11.27	....
Ohio	16,346,660	14,787,763	....	1,558,897	....	9.54
Pennsylvania	10,437,195	10,256,893	....	180,302	....	1.73
Texas	28,136,189	12,567,897	....	15,568,292	....	55.33
West Virginia	11,578,110	10,120,935	....	1,457,175	....	12.59
Wyoming	8,454	*a* 7,000	....	1,454	....	17.20
Total	134,717,580	126,493,936	....	8,223,644	....	6.10

a Estimated.

RANK OF STATES.

In the two following tables is shown the rank of the several States of the United States with reference to the petroleum industry. In the first table the States are ranked as to the quantity of oil produced and in the second table as to the value of the oil production.

California maintains its first place as to quantity, having produced nearly one-fourth of the total production of the United States. Kansas, Indian Territory, and Oklahoma occupy jointly the second place. If the production of these States were separated, it is probable that Indian Territory would fall into seventh place, while the other two States would be much farther down the list.

In the rank of States as to the value of the oil produced, Ohio stands first with Pennsylvania and West Virginia second and third.

Rank of petroleum-producing States and Territories, with quantity produced and percentage of each in 1905 and 1906, in barrels.

1905.				1906.			
State.	Rank.	Quantity.	Percentage.	State.	Rank.	Quantity.	Percentage.
California	1	33,427,473	24.81	California	1	33,098,598	26.17
Texas	2	28,136,189	20.89	Kansas Indian Territory Oklahoma	2	21,718,648	17.17
Ohio	3	16,346,660	12.13	Ohio	3	14,787,763	11.69
Kansas Indian Territory Oklahoma	4	12,013,495	8.92	Texas	4	12,567,897	9.93
West Virginia	5	11,578,110	8.59	Pennsylvania	5	10,256,893	8.11
Indiana	6	10,964,247	8.14	West Virginia	6	10,120,935	8.00
Pennsylvania	7	10,437,195	7.75	Louisiana	7	9,077,528	7.18
Louisiana	8	8,910,416	6.61	Indiana	8	7,673,477	6.07
Kentucky Tennessee	9	1,217,337	.90	Illinois	9	4,397,050	3.47
New York	10	1,117,582	.83	New York	10	1,243,517	.98
Colorado	11	376,238	.28	Kentucky Tennessee	11	1,213,548	.96
Illinois	12	181,084	.14	Colorado	12	327,582	.26
Wyoming	13	8,454	.01	Wyoming	13	7,000	.01
Michigan Missouri	14	3,100		Michigan Missouri	14	3,500	
Total	......	134,717,580	100.00	Total	......	126,493,936	100.00

Rank of petroleum-producing States and Territories, with value of production and percentage of each, in 1905 and 1906.

1905.				1906.			
State.	Rank.	Value.	Percentage.	State.	Rank.	Value.	Percentage.
Ohio	1	$17,054,877	20.27	Ohio	1	$16,997,000	18.39
West Virginia	2	16,132,631	19.17	Pennsylvania	2	16,596,943	17.95
Pennsylvania	3	14,653,278	17.41	West Virginia	3	16,170,293	17.49
Indiana	4	9,404,909	11.18	Kansas Indian Territory Oklahoma	4	9,615,198	10.40
California	5	8,201,846	9.74	California	5	9,553,430	10.34
Texas	6	7,552,262	8.97	Indiana	6	6,770,066	7.32
Kansas Indian Territory Oklahoma	7	6,546,398	7.78	Texas	7	6,565,578	7.10
Louisiana	8	1,601,325	1.90	Louisiana	8	3,557,838	3.85
New York	9	1,557,630	1.85	Illinois	9	3,274,818	3.54
Kentucky Tennessee	10	943,211	1.12	New York	10	1,995,377	2.16
Colorado	11	337,606	.40	Kentucky Tennessee	11	1,031,629	1.12
Illinois	12	116,561	.14	Colorado	12	262,675	.28
Wyoming Michigan Missouri	13	54,865	.07	Wyoming Michigan Missouri	13	53,890	.06
Total	......	84,157,399	100.00	Total	......	92,444,735	100.00

RODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES FROM 1859 TO 1906, INCLUSIVE.

In the following table will be found a statement of the production f crude petroleum from each State of the United States from the ear 1859 to and including the production of the year 1906:

'roduction of crude petroleum in the United States, 1859–1906, by years and by States, in barrels of 42 gallons.

Year.	Pennsylvania and New York.	Ohio.	West Virginia.	California.	Kentucky and Tennessee.	Colorado.	Indiana.	Illinois.
359	2,000	...	...	...	...	...	...	...
360	500,000	...	...	...	...	...	...	...
361	2,113,609	...	...	...	...	...	...	...
362	3,056,690	...	...	...	...	...	...	...
363	2,611,309	...	...	...	...	...	...	...
364	2,116,109	...	...	...	...	...	...	...
365	2,497,700	...	...	...	...	...	...	...
366	3,597,700	...	...	...	...	...	...	...
367	3,347,300	...	...	...	...	...	...	...
368	3,646,117	...	...	...	...	...	...	...
369	4,215,000	...	...	...	...	...	...	...
870	5,260,745	...	...	...	...	...	...	...
871	5,205,234	...	...	...	...	...	...	...
872	6,293,194	...	...	...	...	...	...	...
873	9,893,786	...	...	...	...	...	...	...
874	10,926,945	...	...	...	...	...	...	...
875	8,787,514	...	...	...	...	...	...	...
876	8,968,906	31,763	120,000	12,000	...	...	...	...
877	13,135,475	29,888	172,000	13,000	...	...	...	...
878	15,163,462	38,179	180,000	15,227	...	...	...	...
879	19,685,176	29,112	180,000	19,858	...	...	...	...
880	26,027,631	38,940	179,000	40,552	...	...	...	...
881	27,376,509	33,867	151,000	99,862	...	...	...	...
882	30,053,500	39,761	128,000	128,636	...	...	...	...
883	23,128,389	47,632	126,000	142,857	4,755	...	...	...
884	23,772,209	90,081	90,000	262,000	4,148	...	...	...
885	20,776,041	661,580	91,000	325,000	5,164	...	...	...
886	25,798,000	1,782,970	102,000	377,145	4,726	...	...	...
887	22,356,193	5,022,632	145,000	678,572	4,791	76,295	...	...
888	16,488,668	10,010,868	119,448	690,333	5,096	297,612	...	...
889	21,487,435	12,471,466	544,113	303,220	5,400	316,476	33,375	1,460
890	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
1906	11,500,410	14,787,763	10,120,935	33,098,598	1,213,548	327,582	7,673,477	4,397,050
Total.	676,213,803	354,042,657	175,944,422	162,217,450	4,455,734	8,542,434	84,999,474	4,584,710

Production of crude petroleum in the United States, 1859–1906, by years and by States, in barrels of 42 gallons—Continued.

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
1906	[d] 21,718,648	12,567,897	[a] 3,500	([e])	[f] 7,000	9,077,528	126,493,936	92,444,735
Total.	39,947,629	105,497,295	17,471	1,560,313	76,446	22,413,290	1,640,513,128	1,534,770,936

[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.
[f] Estimated.

OIL FIELDS OF THE UNITED STATES.

The area of the United States from which petroleum and natural gas have been produced in commercial quantity may be divided into five great fields and a few scattering States. The division into fields is governed by the quality of oil produced and the geographic location. Four of the great fields include more than one State, and one State enters into two fields. This is Ohio, which in its eastern and southern part belongs to the Appalachian field and in its northwestern part to the Lima-Indiana-Illinois field. The division of the oil territory into fields allows the production of one year to be compared with those of previous years for oils that find different uses in the commercial world, and by considering each of the great fields as a unit the rate of increase or decrease in the production of oil of particular quality can be followed from year to year.

Appalachian field.—This field produces oil of paraffin base of the very best quality. The field extends along the western side of the Appalachian Mountains from New York, through Pennsylvania, southeast Ohio, West Virginia, and Kentucky into Tennessee.

Lima-Indiana-Illinois field.—This field furnishes oil having a paraffin base, but containing a percentage of sulphur. The field includes the northwestern part of Ohio, a strip through the middle of Indiana, and the southeastern portion of Illinois. There is some doubt as to whether the oil-producing area of Illinois should rightly be added to the Lima-Indiana field, as the oil is not produced from the same geologic horizon.

Mid-Continent field.—This field produces oil with a mixed asphalt and paraffin base. The quality of oil produced from different sections differs materially. The area included within the field is the western portion of Missouri, the State of Kansas, and Oklahoma and Indian Territories.

Gulf field.—The greater portion of the oil from the Gulf field has an asphalt base, with qualities favorable for use in the manufacture of lubricants and as a fuel. This oil comes from the coastal plains of Texas and Louisiana. In the central portion of Texas a lighter oil is produced from the Corsicana district, which is also included in the Gulf field.

California field.—California produces large quantities of oil of asphalt base. The present area of production is in southern California and at the south end of the San Joaquin Valley.

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.

PRODUCTION BY FIELDS.

In the following tables are given the production of petroleum in the United States by fields.

The first table gives the production of each field from 1901 to 1906, inclusive. The second table gives the percentage that the production of each field bears to the total production of the United States from 1901 to 1906, inclusive. The third table gives the quantity, total value, and price per barrel of the petroleum produced in each field of the United States during the year 1906.

Production of petroleum in the United States, 1901–1906, by fields, in barrels.

Field.	1901.	1902.	1903.	1904.	1905.	1906.
Appalachian	33,618,171	32,018,787	31,558,248	31,408,567	29,366,960	27,741,472
Lima-Indiana-Illinois	21,933,629	23,358,826	24,080,264	24,689,184	22,475,255	21,951,711
Mid-Continent	189,151	368,849	1,071,125	5,617,527	12,013,495	21,718,648
Gulf	4,393,658	18,632,275	18,873,343	25,200,371	37,046,605	21,645,425
California	8,786,330	13,984,268	24,382,472	29,649,434	33,427,473	33,098,598
Other	468,255	403,911	495,885	515,877	387,792	338,082
Total	69,389,194	88,766,916	100,461,337	117,080,960	134,717,580	126,493,936

Percentages of total crude petroleum produced in the several fields, 1901–1906.

Field.	1901.	1902.	1903.	1904.	1905.	1906.
Appalachian	48.45	36.07	31.41	26.83	21.80	21.93
Lima-Indiana-Illinois	31.61	26.31	23.97	21.08	16.68	17.35
Mid-Continent	.27	.42	1.07	4.80	8.92	17.17
Gulf	6.33	20.99	18.79	21.52	27.50	17.11
California	12.66	15.75	24.27	25.33	24.81	26.17
Other	.68	.46	.49	.44	.29	.27
Total	100.00	100.00	100.00	100.00	100.00	100.00

Quantity, total value, and price per barrel received at wells for crude petroleum produced in the United States in 1906, by fields.

Field.	Quantity in barrels.	Value.	Price per barrel.
Appalachian	27,741,472	$43,633,601	$1.573
Lima-Indiana-Illinois	21,951,711	19,202,525	.875
Mid-Continent	21,718,648	9,615,198	.443
Gulf	21,645,425	10,123,416	.468
California	33,098,598	9,553,430	.289
Other	338,082	316,565	.936
Total	126,493,936	92,444,735	.731

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 Pennsylvanian (Carboniferous period) to the base of the Devonian period.

In general the field occupies the bottom and western side of a large spoon-shaped trough. In detail the slope of the beds is not regular, but is affected by two sets of foldings. The main fold has a northeast and southwest strike, generally parallel to the ridges of the Appalachian Mountains. This is crossed by a secondary fold of less pronounced character at nearly right angles to the first. This combination forms a system of structures, which consist 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 and Volcano 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.

PRODUCTION OF THE APPALACHIAN FIELD.

In the following table is given the production of the Appalachian field by States and months for the year 1906.

The figures contained within this table are made up by compilation of the quantities published by the various common carrier pipe-line companies, combined with figures furnished by all the companies that operate private pipe lines within the Appalachian field. During a portion of the year the Buckeye Pipe Line Company did not separate in its published statements the runs of Macksburg oil from those of Lima oil. The division of these runs could not be procured, upon request, from the Standard Oil Company, the controlling owners of the Buckeye Pipe Line Company. It was found upon examination that almost exactly 33⅓ per cent of the total runs of the Buckeye Pipe Line were from the Macksburg division for a number of months prior to and after the months in which the separate runs were not published. Therefore, to fill in the months in which information was lacking, 33⅓ per cent of the total runs of the Buckeye Pipe Line for these months were assumed to be from the Macksburg division.

Production of the Appalachian oil field by States and months in 1906, in barrels.

Month.	Pennsylvania.	New York.	Ohio.	West Virginia.	Kentucky and Tennessee.	Total.
January	863,084	103,492	431,825	832,628	115,317	2,346,346
February	745,599	94,432	377,214	752,399	101,084	2,070,728
March	860,932	103,077	426,964	897,277	109,351	2,397,601
April	871,464	101,492	416,490	833,514	103,690	2,326,650
May	910,711	110,492	427,322	923,039	102,224	2,473,788
June	884,651	105,964	414,252	872,138	106,005	2,383,010
July	871,792	105,837	403,975	917,879	106,708	2,406,191
August	887,274	109,169	427,127	906,522	106,936	2,437,028
September	822,898	101,130	400,628	777,682	96,561	2,198,899
October	881,790	106,621	412,544	833,781	94,385	2,329,121
November	836,245	103,749	389,100	762,915	88,483	2,180,492
December	820,453	98,062	379,138	811,161	82,804	2,191,618
Total	10,256,893	1,243,517	4,906,579	10,120,935	1,213,548	27,741,472

In the following table is given the total production of the Appalachian field from the year 1859 to 1906, 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 of Pennsylvania crude in the fourth.

Production of petroleum in the Appalachian field, 1859–1906, in 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	1906.....	27,741,472	21.93	−1,625,488	1.59¾

In the last few years the production of the Appalachian field has dropped from over a half of the total production of the United States to less than one-fourth. This has come to pass not so much by the falling off in the production of the field as by the great increase in the quantity of oil produced in other portions of the United States. The Appalachian field produced 8,553,961 barrels of oil less in 1906 than in 1900, the year of greatest production.

In the following table is given the production of the Appalachian field, by States, from 1900 to 1906, inclusive:

Production of petroleum in the Appalachian field, 1900–1906, by States, in barrels.

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
1906........................	11,500,410	10,120,935	4,906,579	1,213,548	27,741,472

In the following table is shown the production of the Appalachian field, by States, in the years 1905 and 1906, with the increase and decrease for each State and the percentage of increase or decrease as compared with the previous year.

Production of petroleum in the Appalachian field in 1905 and 1906, by States, showing increase or decrease, in barrels.

State.	Production.		Increase.	Decrease.	Percentage.	
	1905.	1906.			Increase.	Decrease.
New York	1,117,582	1,243,517	125,935		11.27	
Pennsylvania	10,437,195	10,256,893		180,302		1.73
West Virginia	11,578,110	10,120,935		1,457,175		12.59
Southeastern Ohio	5,016,736	4,906,579		110,157		2.20
Kentucky and Tennessee	1,217,337	1,213,548		3,789		.31
Total	29,366,960	27,741,472		1,625,488		5.54

In the following table is given the quantity, value, and price per barrel of the oil produced in the Appalachian field during the year 1906, by States:

Quantity and value at wells of crude petroleum produced in the Appalachian field in 1906, by States.

State.	Quantity, in barrels.	Value.	Value per barrel.
New York	1,243,517	$1,995,337	$1.605
Pennsylvania	10,256,893	16,596,943	1.618
Southeastern Ohio	4,906,579	7,839,359	1.598
West Virginia	10,120,935	16,170,293	1.598
Kentucky and Tennessee	1,213,548	1,031,629	.850
Total	27,741,472	43,633,601	1.573

In the two following tables are given the production of crude petroleum in the Appalachian oil field from 1901 to 1906, 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, 1901–1906, by months and years, in barrels.

Month.	1901.	1902.	1903.	1904.	1905.	1906.
January	3,003,285	2,614,845	2,726,634	2,377,630	2,368,186	2,346,346
February	2,567,288	2,253,491	2,353,281	2,294,922	2,207,659	2,070,728
March	2,916,677	2,629,104	2,759,807	2,719,887	2,685,538	2,397,601
April	2,862,813	2,664,668	2,691,431	2,599,224	2,445,161	2,326,650
May	2,963,001	2,759,717	2,681,586	2,743,881	2,685,829	2,473,788
June	2,751,409	2,598,349	2,731,722	2,700,030	2,570,383	2,383,010
July	2,921,520	2,825,398	2,758,308	2,697,037	2,434,710	2,406,191
August	2,941,578	2,728,825	2,628,708	2,822,017	2,523,737	2,437,028
September	2,644,103	2,769,060	2,633,513	2,668,124	2,358,897	2,198,899
October	2,814,972	2,860,506	2,664,422	2,606,321	2,376,013	2,329,121
November	2,590,781	2,609,453	2,374,373	2,558,764	2,268,847	2,180,492
December	2,640,744	2,705,371	2,554,463	2,620,730	2,442,000	2,191,618
Total	33,618,171	32,018,787	31,558,248	31,408,567	29,366,960	27,741,472

In the following table is given the average daily production in the Appalachian oil field from 1901 to 1906, by months and years:

Average daily production of crude petroleum in the Appalachian oil field each month, 1901–1906, by months and years, in barrels.

Month.	1901.	1902.	1903.	1904.	1905.	1906.
January	96,880	84,350	87,956	76,698	76,393	75,689
February	91,689	80,482	84,046	79,135	78,845	73,955
March	94,086	84,810	89,026	87,738	86,630	77,342
April	95,427	88,822	89,714	86,641	81,505	77,555
May	95,581	89,023	86,503	88,512	86,640	79,798
June	91,714	86,612	91,057	90,001	85,679	79,434
July	94,243	91,142	88,978	87,001	78,539	77,619
August	94,890	88,027	84,797	91,033	81,411	78,614
September	88,137	92,302	87,784	88,937	78,630	73,297
October	90,806	92,274	85,949	84,075	76,646	75,133
November	86,359	86,982	79,146	85,292	75,628	72,683
December	85,185	87,270	82,402	84,540	78,774	70,697
Average	92,105	87,723	86,461	85,816	80,457	76,004

PIPE LINES OF THE APPALACHIAN AND LIMA-INDIANA-ILLINOIS FIELDS.

The petroleum of the Appalachian field is transported almost entirely by pipe-line companies. In this method of transportation the separate tanks at each well in the oil fields are connected to a large tank at a general receiving station for the district by small pipe lines. The station is located, when possible, on land lower than the location of the producing wells, so that the oil in the tanks at the wells will flow by gravity to the main receiving station. When this is not possible, the oil is forced to the receiving station by small pumps run by gas or other engines in the field. For this service the lease owner is given credit.

At the main receiving station are large and powerful pumps of the highest mechanical efficiency run by triple expansion engines, the steam being furnished from boilers of from 300 to 350 horsepower. These pumps draw the oil from the receiving tanks and force it into the main pipe lines under pressure of from 600 to 800 pounds to the square inch. The main pipe lines are usually 6 or 8 inches in diameter, laid in straight lines over hills and valleys from one pump station to another. The pump stations are located from 30 to 50 miles apart. The main trunk lines are capable of transporting from 20,000 to 30,000 barrels of oil in twenty-four hours.

In the transportation of oil by pipe lines there is a loss due mainly to three causes—leakage from pipes and tanks, evaporation, and the forming of B. S. in the tanks (the brown sediment from the partially solidified paraffin). To equalize for this loss, 2 per cent is deducted from the actual measured quantity of oil taken from each tank.

The runs of a pipe line represent the number of barrels of oil received from the tanks at wells after the deduction of 2 per cent has been made. The shipments of a pipe line represent the number of barrels of oil delivered to the refineries or other consumers of oil.

The net stock of a pipe line is the actual quantity of merchantable oil that a pipe line has in its tanks or pipes. This stock does not always check with the difference between the quantity received and the quantity delivered, owing to the receipt of 2 per cent in excess of the quantity credited to the runs and to the loss from different causes.

Besides runs and shipments, pipe lines have irregular receipts and make irregular deliveries. These are receipts from and deliveries to other pipe lines.

In the following tables are given the monthly reports of the principal pipe lines handling oil in the Appalachian and the Lima-Indiana-Illinois fields. Owing to a combination of the figures of some of the principal pipe-line companies doing business in both the Appalachian and the Lima-Indiana-Illinois fields it is no longer possible to publish actual figures of the stocks held by the pipe lines divided between Appalachian oil and Lima-Indiana-Illinois oil. At the beginning of the year 1906 the pipe lines held 3,542,014 barrels of Appalachian oil and 12,637,117 barrels of Lima-Indiana-Illinois oil. Upon an inspection of the stock table it will be noted that during the first months of the year the stocks of the National Transit Pipe Line Company were gradually increased to 1,062,331 by the end of July. This was at the expense of the stocks of the New York Transit Company and the Crescent Pipe Line Company, the stocks of which were reduced to almost nothing. In the month of August the stock of the Buckeye Pipe Line Company, the Lima-Indiana division, was reduced 3,522,171 barrels. During the same month the stocks of the New York Transit Company, the Northern Pipe Line Company, and the Crescent Pipe Line Company were increased to 3,589,506 barrels. From these figures it seems a fair conclusion that the National Transit Pipe Line Company is handling Appalachian oil and that the New York Transit Company, the Northern Pipe Line Company, and the Crescent Pipe Line Company are handling oils of the Lima-Indiana-Illinois field. If this assumption be true, the stocks of Appalachian oil at the end of the year are those held by the following pipe-line companies: National Transit, Eureka, Southwest, Tidewater, Producers and Refiners, Emery, Cumberland, Southern, United States, Franklin, and Macksburg division of the Buckeye. The quantity held by the last-named company is not known. Without it the combined stocks of the other lines amounts to 3,114,216 barrels.

Pipe-line runs in the Appalachian oil field in 1906, by lines and months, in barrels.

Month.	National Transit.	Eureka.	Southwest.	Tidewater.	Producers and Refiners.	Emery.
January	430,651	795,228	181,994	146,760	214,625	26,342
February	360,827	720,546	164,539	128,982	192,661	21,321
March	408,398	862,770	195,065	144,060	224,625	26,370
April	422,803	800,339	196,469	143,385	220 247	24,727
May	441,510	888,314	209,128	151,042	220 628	26,681
June	421,472	823,599	204,779	148,239	235,030	25,712
July	422,264	844,701	197,504	142,490	256,131	25,532
August	406,211	843,205	198,876	146,097	255,406	25,836
September	373,159	728,304	178,344	135,518	240,798	24,328
October	409,200	789,421	189,699	146,522	235,072	26,120
November	389,656	712,968	178,450	137,842	238,582	24,882
December	377,152	759,427	172,827	138,214	237,580	26,521
Total	4,863,303	9,568,822	2,267,674	1,709,142	2,771,385	304,372

Pipe-line runs in the Appalachian oil field in 1906, by lines and months, in barrels—Continued.

Month.	Franklin.	Cumberland.	New York Transit.	Buckeye Macksburg.	Other pipe lines.	Total.
January	3,202	105,920	....	317,964	123,660	2,346,346
February	2,157	91,687	....	273,683	114,325	2,070,728
March	2,947	99,954	....	303,874	129,538	2,397,601
April	4,244	94,293	....	295,852	124,291	2,326,650
May	2,543	92,827	....	304,740	136,375	2,473,788
June	3,904	96,608	....	285,203	138,473	2,383,010
July	3,188	97,311	....	279,138	137,932	2,406,191
August	3,170	97,539	27,662	(*a*)	433,026	2,437,028
September	2,774	87,164	24,453	(*a*)	404,057	2,198,899
October	3,608	84,988	26,297	(*a*)	418,194	2,329,121
November	2,834	79,086	26,077	(*a*)	390,115	2,180,492
December	2,818	73,402	23,604	(*a*)	380,073	2,191,618
Total	37,389	1,100,779	128,093	2,060,454	2,930,059	27,741,472

a Included under ' Other pipe lines."

Pipe-line shipments in the Appalachian and the Lima-Indiana-Illinois oil fields in 1906, by lines and months, in barrels.

Month.	National Transit.	Eureka.	Southwest.	Tidewater.	Producers and Refiners.	Emery.	New York Transit.	Cumberland.
January	1,043,543	46,759	67,086	253,778	224,502	29,521	80,110	27,735
February	916,658	19,993	61,675	240,251	177,245	21,661	62,302	20,727
March	871,249	23,306	66,150	275,471	193,911	24,787	9,407	24,284
April	1,003,880	20,845	66,120	230,778	203,740	24,582	....	22,471
May	935,598	23,460	63,761	228,143	218,887	25,822	234	34,170
June	946,952	21,103	64,952	209,974	222,207	27,505	127	33,138
July	939,027	19,868	70,547	258,574	242,155	27,709	117	29,807
August	1,133,860	22,654	65,856	212,918	233,782	28,489	1,769,225	45,280
September	1,180,351	20,424	64,011	203,469	248,554	21,462	1,425,702	36,936
October	1,184,216	35,811	74,964	196,677	257,059	25,688	1,395,748	32,150
November	1,103,860	54,355	67,533	211,273	259,352	24,841	1,266,862	35,536
December	1,025,289	81,302	63,070	274,852	221,796	25,245	1,199,641	36,706
Total	12,284,483	389,880	795,725	2,796,158	2,703,190	307,312	7,209,475	378,940

Month.	Southern.	Crescent.	Buckeye Macksburg.	Franklin.	Lima-Ind.	Lima-Ohio.	Illinois.*a*	Total.
January	457,260	134,635	9,318	10,511	1,985,370		52,512	4,422,640
February	390,355	167,475	6,852	3,275	1,889,436		65,108	4,043,013
March	524,968	167,371	8,990	638	2,191,362		20,777	4,402,671
April	552,475	5,059	8,429	638	2,246,538		36,652	4,422,207
May	633,098	57	8,415	319	2,176,189		194,776	4,542,929
June	599,448	1,007	10,401	....	1,892,828		437,078	4,466,720
July	648,532	....	9,870	....	2,051,470		619,206	4,916,882
August	708,955	141,177	(*b*)	....	84,549	322,904	642,387	5,412,036
September	657,772	109,327	(*b*)	2,308	256,676	260,092	353,257	4,840,341
October	603,006	148,262	(*b*)	10,333	723,275	296,153	74,114	5,057,456
November	637,295	143,358	(*b*)	10,031	795,213	364,379	52,699	5,026,587
December	522,756	156,553	(*b*)	3,428	673,039	296,306	26,232	4,606,215
Total	6,935,920	1,174,281	62,275	41,481	18,505,779		2,574,798	56,159,697

a Figures published by Oil City Derrick.
b Included under Lima, Ohio.

Net stocks held by the principal pipe lines at the close of each month in 1906 in barrels.

Month.	National Transit.	Eureka.	Southwest.	Tidewater.	Producers and Refiners.	Emery.	New York Transit.	Northern.
January	691,464	859,926	175,830	332,139	227,150	14,241	18,511	....
February	705,992	714,095	187,290	297,662	242,566	13,901	13,082	....
March	761,195	730,213	211,318	285,553	273,281	15,484	3,675	....
April	828,345	780,178	258,553	282,774	289,787	15,630	3,675	....
May	861,002	892,808	215,640	306,666	291,528	16,489	3,675	....
June	832,903	941,386	237,581	346,088	304,351	14,695	3,675	....
July	1,062,331	698,385	293,058	317,903	318,328	12,518	3,675	....
August	712,442	782,736	211,154	328,086	339,952	9,864	2,376,652	1,133,943
September	732,040	688,596	202,880	....	332,195	12,731	2,456,262	963,165
October	614,440	681,515	200,428	....	310,209	13,162	2,475,597	873,021
November	584,135	552,357	329,845	....	289,438	13,203	2,312,505	938,939
December	679,813	732,941	318,741	448,161	305,221	14,480	2,260,592	923,591

Month.	Cumberland.	Southern.	Crescent.	United States.	Buckeye-Macksburg.	Franklin.	Lima, Indiana.	Lima, Ohio.	Total.
January	181,388	400,076	103,721	104,669	262,670	30,429	12,412,850		15,815,064
February	163,896	436,156	89,909	91,882	274,187	29,310	11,880,080		15,140,008
March	169,969	513,046	12,137	90,359	271,254	31,619	11,337,199		14,706,302
April	133,566	466,284	7,078	97,444	242,725	35,225	10,528,682		13,969,946
May	140,237	456,309	7,021	95,191	280,068	37,449	10,228,204		13,832,287
June	152,175	479,386	6,013	102,139	246,241	41,353	10,170,099		13,878,085
July	179,950	530,146	6,013	89,523	297,230	44,541	10,306,388		14,159,989
August	189,300	547,607	78,911	67,166	(a)	47,711	665,924	6,118,293	13,609,741
September	147,135	504,034	111,658	66,477	(a)	48,177	780,586	5,409,443	12,455,379
October	147,120	541,786	115,271	69,995	(a)	41,453	626,732	4,779,755	11,490,484
November	119,222	486,264	111,797	84,253	(a)	34,256	691,340	4,469,470	11,017,024
December	91,520	448,822	102,265	74,517	(a)	33,646	530,469	4,293,966	11,258,745

[a] Included with Lima, Ohio.

PRICES OF APPALACHIAN OIL.

The prices of Appalachian oils are made by the Seep Purchasing Agency. This agency publishes daily the price it is willing to pay for oils of different grades. Fully 90 per cent of the oil of the Appalachian field is sold under the head of Pennsylvania grade. A few localities furnish an oil that brings a premium above the Pennsylvania grade, and a number of localities produce small quantities of oil that have a less commercial value than the Pennsylvania grade. In the two following tables are given the quotations for the oils of different grades made by the Seep Purchasing Agency during the years 1905 and 1906.

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 1905 and 1906, per barrel of 42 gallons.

	Tiona, Pa.	Pennsylvania.	Second sand, Pa.	Corning, Ohio.	Newcastle, Ohio.	Butler and Richland.	Cabell, W. Va.
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

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 1905 and 1906, per barrel of 42 gallons—Continued.

	Tiona, Pa.	Pennsylvania.	Second sand, Pa.	Corning, Ohio.	Newcastle, Ohio.	Butler and Richland.	Cabell, W. Va.
1905.							
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
1906.							
January 1	1.68	1.58	1.58	1.10	1.35	$1.78	1.18
April 13	1.71	1.61	1.61	1.13	1.38	1.81	1.21
April 25	1.74	1.64	1.64	1.16	1.41	1.84	1.24
July 28	1.71	1.61	1.61	1.13	1.38	1.81	1.21
August 2	1.68	1.58	1.58	1.10	1.35	1.78	1.18

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 1905 and 1906:

Average monthly prices of Appalachian crude petroleum in 1905 and 1906, per barrel.

Month.	1905.					
	Tiona, Pa.	Pennsylvania.	Second sand, Pa.	Corning, Ohio.	Newcastle, Ohio.	Cabell, W. Va.
January	$1.58 1/8	$1.43 1/8	$1.33 1/8	$1.10 1/8	$1.35 1/8	$1.18 1/8
February	1.54	1.39	1.29	1.06	1.31	1.14
March	1.53 1/4	1.38 1/4	1.28 1/4	1.05 1/4	1.30 1/4	1.13 1/4
April	1.47 3/4	1.32 3/4	1.22 3/4	.99 3/4	1.24 3/4	1.07 3/4
May	1.43 3/4	1.28 3/4	1.18 3/4	.95 3/4	1.20 3/4	1.03 3/4
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	1.48 7/8	1.35 3/8	1.22 1/4	.99 1/4	1.24 1/4	1.07 1/4
October	1.67 1/2	1.57 1/2	1.39 1/2	1.09 7/8	1.34 7/8	1.17 7/8
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	1.39 3/8	1.30 1/8	1.02 3/8	1.27 3/8	1.10 3/8

Month.	1906.					
	Tiona, Pa.	Pennsylvania.	Butler and Richland.	Corning, Ohio.	Newcastle, Ohio.	Cabell, W. Va.
January	$1.68	$1.58	$1.78	$1.10	$1.35	$1.18
February	1.68	1.58	1.78	1.10	1.35	1.18
March	1.68	1.58	1.78	1.10	1.35	1.18
April	1.70 3/8	1.60 3/8	1.80 3/8	1.12 3/8	1.37 3/8	1.20 3/8
May	1.74	1.64	1.84	1.16	1.41	1.24
June	1.74	1.64	1.84	1.16	1.41	1.24
July	1.73 5/8	1.63 5/8	1.83 5/8	1.15 5/8	1.40 5/8	1.23 5/8
August	1.68	1.58	1.78	1.10	1.35	1.18
September	1.68	1.58	1.78	1.10	1.35	1.18
October	1.68	1.58	1.78	1.10	1.35	1.18
November	1.68	1.58	1.78	1.10	1.35	1.18
December	1.68	1.58	1.78	1.10	1.35	1.18
Average	1.69 3/4	1.59 3/4	1.79 3/4	1.11 3/4	1.36 3/4	1.19 3/4

The average monthly and yearly prices per barrel of the crude petroleum in the Appalachian field for the years 1902–1906 are given in the following table:

Monthly and yearly average prices of pipe-line certificates of Pennsylvania crude petroleum at wells in daily market, 1902–1906, per barrel.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
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	1.43⅓	1.39	1.38¼	1.32¾	1.28¾	1.27	1.27	1.27	1.35⅜	1.57½	1.59	1.58	1.39⅜
1906	1.58	1.58	1.58	1.60⅜	1.64	1.64	1.63⅝	1.58	1.58	1.58	1.58	1.58	1.59¾

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, 1859–1906, per barrel.

Year.	Highest.		Lowest.	
	Month.	Price.	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	.79½
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
1906	April, May, June, July.	1.64	January, February, March, April, August, September, October, November, December.	1.58

NEW YORK AND PENNSYLVANIA.

PRODUCTION.

During the year 1906 New York produced 1,243,517 barrels of oil and Pennsylvania 10,256,893 barrels. This is an increase in the production from the State of New York of 125,935 barrels and a decrease from the State of Pennsylvania of 180,302 barrels. The new production developed during the year 1906 has been small. It has come mostly from the extension of known pools in addition to a few very small new producing areas. In Clarion County, Pa., a new area of oil production has been developed in the Fourth sand under an area that had previously produced gas from the Third sand.

In the following table is shown a distribution of the production from the States of New York and Pennsylvania, by districts, from 1896 to 1906, inclusive. This information is kindly furnished by the Standard Oil Company.

Production of crude petroleum in Pennsylvania and New York, by districts, 1896–1906, in barrels.

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	7,539,807
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
1906	1,094,281	1,922,501	458,553		10,244	979,266	615,824	3,755,778

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
1906	1,287,714	902,253	261,144	390,505	44,412	(a)	11,722,475

a Included with Beaver County.

WEST VIRGINIA.

The production of West Virginia during the year 1906 was 10,120,935 barrels. This is a falling off from the quantity produced the preceding year of 1,457,175 barrels, or 12.59 per cent. There was also a falling off in the effort to develop new production by the drilling of wells. During the year about 1,400 wells were drilled within the State; of these over 36 per cent were dry. The successful wells added a new initial daily production of about 2,100 barrels.

PRODUCTION.

In the following table is given the production of crude petroleum in West Virginia in 1905 and 1906, by months:

Total production of crude petroleum in West Virginia, by months, 1905 and 1906, in barrels.

Month.	1905.	1906.	Month.	1905.	1906.
January	940,709	832,628	August	996,356	906,522
February	923,632	752,399	September	911,583	777,682
March	1,093,107	897,277	October	901,944	833,781
April	970,540	833,514	November	859,791	762,915
May	1,078,884	923,039	December	922,076	811,161
June	1,026,569	872,138			
July	952,919	917,879	Total	11,578,110	10,120,935

The quantity and value of crude petroleum produced in West Virginia from 1902 to 1906, inclusive, is shown in the following table:

Quantity and value of crude petroleum produced in West Virginia, 1902–1906.

Year.	Regular crude.			Lubricating crude.			Total.		
	Quantity (barrels).	Value.	Price per barrel.	Quantity (barrels).	Value.	Price per barrel.	Quantity (barrels).	Value.	Price per barrel.
1902	13,498,685	$17,006,469	$1.26	14,660	$33,848	$2.31	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	1.393	4,565	14,815	3.25	11,578,110	16,132,631	1.393
1906	10,111,647	16,138,811	1.596	9,288	31,482	3.39	10,120,935	16,170,293	1.598

KENTUCKY AND TENNESSEE.

The combined production in 1906 from the States of Kentucky and Tennessee was 1,213,548 barrels. This quantity is almost equal to the production of 1905. Not much effort was made during 1906 to develop new producing territory. Almost all of the new wells drilled have been in Wayne and Wolfe counties, Ky. The percentage of dry holes has not been so large in this district as in West Virginia or in southeastern Ohio.

PRODUCTION.

In the following table is given the production of crude petroleum in Kentucky and Tennessee, by months, in 1905 and 1906:

Production of crude petroleum in Kentucky and Tennessee, by months, 1905–6, in barrels.

Month.	1905.	1906.	Month.	1905.	1906.
January	77,569	115,317	August	109,562	106,936
February	71,355	101,084	September	106,469	96,561
March	103,315	109,351	October	101,559	94,385
April	100,508	103,690	November	93,817	88,483
May	114,702	102,224	December	102,848	82,804
June	118,181	106,005			
July	117,452	106,708	Total	1,217,337	1,213,548

The production of oil in Kentucky and Tennessee for the years 1901–1906, inclusive, is as follows:

Production of petroleum in Kentucky and Tennessee, 1901–1906.

1901 ....barrels..	137,259	1904 ....barrels..	998,284
1902 ....do....	185,331	1905 ....do....	1,217,337
1903 ....do....	554,286	1906 ....do....	1,213,548

In the following table are given the dates of change and the changes in prices of the different grades of petroleum produced in Kentucky and Tennessee during the years 1904, 1905, and 1906:

Fluctuations in prices, per barrel, of Kentucky and Tennessee crude petroleum in 1904, 1905, and 1906.

1904.			1905.			1906.		
Date.	Whitehouse, Somerset, Lacy, Barboursville (light).	Barboursville (heavy), Ragland.	Date.	Whitehouse, Somerset, Lacy, Barboursville (light).	Barboursville (heavy), Ragland.	Date.	Whitehouse, Somerset, Lacy, Barboursville (light).	Barboursville (heavy), Ragland.
January 1.....	$1.30	$0.66	January 1.....	$0.91	$0.58	January 1.....	$0.89	$0.49
February 12...	1.25	.61	January 5.....	.86	.58	April 13.......	.89	.49
March 1........	1.22	.66	January 11....	.83	,55	April 25.......	.91	.62
March 4........	1.19	.66	January 31....	.80	.53	July 28.........	.89	.60
March 12......	1.16	.66	April 12........	.78	.51	August 2.......	.87	.60
March 29......	1.13	.66	April 18........	.77	.50	August 28.....	.85	.55
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						

In the following table are given the average monthly prices of Kentucky and Tennessee crude petroleum, per barrel of 42 gallons, in the years 1904 to 1906, inclusive:

Average monthly prices, per barrel, of Kentucky and Tennessee crude petroleum in 1904–1906.

Month.	1904.	1905.	1906.	1904.			1905.	1906.
	Whitehouse, Somerset, Lacy.	Whitehouse, Somerset, Lacy.	Whitehouse, Somerset, Lacy.	Barboursville.		Ragland.	Ragland.	Ragland.
				Light.	Heavy.			
January..........................	$1.30	$0.84⅜	$0.89	$1.30	$0.66	$0.66	$0.55⅞	$0.49
February........................	1.27	.80	.89	1.27	.63	.63	.53	.49
March............................	1.17⅛	.80	.89	1.17⅛	.66	.66	.53	.49
April..............................	1.10½	.78	.89⅜	1.10½	.66	.66	.51¼	.51⅝
May...............................	1.07	.75⅞	.91	1.07	.66	.66	.49⅞	.62
June..............................	1.03⅝	.75	.91	1.03⅝	.66	.66	.49	.62
July...............................	.97	.75	.90¾	.97	.60¼	.60¼	.49	.61¾
August...........................	.95	.75	.86¾	.95	.58	.58	.49	.59¼
September.......................	.98¾	.78⅜	.85	.98¾	.60	.60	.49	.55
October..........................	1.01	.87½	.85	1.01	.60	.60	.49	.55
November........................	1.01	.89¾	.85	1.01	.60	.60	.49	.55
December........................	.98	.89	.85	.98	.59⅞	.59⅞	.49	.55
Average..................	1.07⅛	.80⅔	.88	1.07⅛	.62⅝	.62⅝	.50½	.55¼

OHIO.

Ohio, the State which enters into both the Appalachian oil field and the Lima-Indiana-Illinois oil field, produced a total of 14,787,763 barrels of petroleum during the year 1906. This was a decrease from the quantity produced the previous year of 1,558,897 barrels.

During the year there were about 3,200 wells drilled in the State, this number being nearly equally divided between southeastern Ohio and northwestern Ohio. The number of dry holes was very much greater in southeastern Ohio than in northwestern Ohio, though the total new initial daily production added to the fields was about equal in both sections of the State. The principal development work during the year in northwestern Ohio was in Wood, Hancock, and Sandusky counties; that of southeastern Ohio was principally in Monroe County.

PRODUCTION.

In the following table is given the production of crude petroleum in Ohio, by months and districts, for the year 1906:

Total production of crude petroleum in Ohio in 1906, by months and districts, in barrels.

Month.	Lima.	Southeastern Ohio.	Mecca-Belden.	Total.
January	912,014	431,805		1,343,839
February	802,587	377,204		1,179,801
March	860,586	426,944		1,287,550
April	854,534	416,490		1,271,024
May	884,291	427,302		1,311,613
June	870,043	414,242		1,284,295
July	853,771	403,955		1,257,746
August	831,951	427,107		1,259,078
September	751,719	400,608		1,152,347
October	798,038	412,524		1,210,582
November	743,248	389,100		1,132,348
December	718,402	379,118		1,097,540
Total	9,881,184	4,906,399	180	14,787,763

The total quantity and value of crude petroleum produced in Ohio from 1900 to 1906, inclusive, by districts, are shown in the following table:

Total quantity and value of crude petroleum produced in Ohio, 1900–1906, in 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
1906	9,881,184	9,157,641	4,906,399	7,838,387	180	972	14,787,763	16,997,000

In the following table are given the production and value of the crude petroleum in the Mecca-Belden district from 1902 to 1906, inclusive:

Output of crude petroleum in the Mecca-Belden district of Ohio, 1902–1906, in barrels.

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.
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
1906	140	392	2.80	40	580	14.50	180	972	5.40

LIMA-INDIANA-ILLINOIS FIELD.

Illinois 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, and the production from Lima, Ohio, and the central part of Indiana comes from rocks that in the geological column are far below the sandstone beds of either the Appalachian or the Mid-Continent field.

The productive horizon of the Lima, Ohio, district and the Indiana district is 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: $2CaCO_3 + MgCl_2 = CaMg2CO_3 + CaCl_2$. 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 space which gives room 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 formation. Until the year 1903 these pay streaks, as they are called, were thought to be entirely within the first 100 feet of the limestone. They usually consist of two layers—the first, from 4 to 12 feet in thickness, lies within 20 feet of the top of the Trenton; the second layer 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 below 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.

PRODUCTION OF LIMA-INDIANA-ILLINOIS FIELD.

In the following table will be found the production of the Lima-Indiana-Illinois field, by States and months, for the year 1906:

Production of crude petroleum in the Lima-Indiana-Illinois oil field in 1906, by months, in barrels.

Month.	Lima, Ohio.	Indiana.	Illinois.	Total.
January	912,014	742,478	55,680	1,710,172
February	802,587	638,211	65,208	1,506,006
March	860,586	675,066	19,352	1,555,004
April	854,534	666,213	102,862	1,623,609
May	884,291	684,618	267,746	1,836,655
June	870,043	664,031	410,655	1,944,729
July	853,771	654,349	610,401	2,118,521
August	831,951	683,458	778,464	2,293,873
September	751,719	572,489	722,168	2,046,376
October	798,038	616,556	463,819	1,878,413
November	743,248	555,639	350,985	1,649,872
December	718,402	520,369	549,710	1,788,481
Total	9,881,184	7,673,477	4,397,050	21,951,711

In the following table will be found the production of the Lima-Indiana-Illinois field from 1902 to 1906, 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-Illinois field, 1902–1906.

Year.	Production, in barrels.	Percentage of total production.	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
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
1906	21,951,711	17.35		523,544		2.33

The following table, data for which was furnished by the Standard Oil Company, gives the production of crude petroleum in the Lima (Ohio)-Indiana-Illinois oil field in the year 1906:

Production of crude petroleum in Lima (Ohio)-Indiana-Illinois oil field in 1906.

Lima (Ohio)	barrels	9,756,323
Indiana	do	7,822,581
Illinois (Casey, Crawford County, and Bridgeport)	do	4,918,605
Total		22,497,509

PRICES OF CRUDE PETROLEUM IN LIMA-INDIANA FIELD.

In the following table are given the fluctuations in prices for the various grades of Lima and Indiana oil in 1904, 1905, and 1906. The dates are those on which changes in prices were made.

Fluctuations in prices of Lima (Ohio) and Indiana crude petroleum in 1904, 1905, and 1906, per barrel.

1904.			1905.			1906.		
Date.	North Lima.	South Lima and Indiana.	Date.	North Lima.	South Lima and Indiana.	Date.	North Lima.	South Lima and Indiana.
January 1	$1.36	$1.31	January 1	$1.01	$0.96	January 1	$0.94	$0.89
February 12	1.31	1.26	January 5	.98	.93	April 13	.96	.91
March 1	1.28	1.23	January 11	.95	.90	April 25	.98	.93
March 4	1.25	1.20	January 31	.93	.88	July 28	.96	.91
March 12	1.22	1.17	March 25	.91	.86	August 2	.94	.89
March 29	1.19	1.14	April 12	.89	.84	August 15	.92	.87
April 8	1.16	1.11	April 18	.88	.83	August 28	.90	.85
April 29	1.13	1.08	April 25	.87	.82			
June 7	1.11	1.06	May 27	.86	.81			
June 17	1.08	1.03	September 12	.88	.83			
July 9	1.03	.98	September 16	.90	.85			
July 13	1.00	.95	September 19	.92	.87			
September 1	1.03	.98	September 28	.94	.89			
September 24	1.05	1.00	October 20	.96	.91			
November 10	1.07	1.02	November 11	.94	.89			
December 16	1.04	.99						
December 29	1.01	.96						

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 1904 to 1906:

Average monthly prices of Ohio and Indiana crude petroleum in 1904, 1905, and 1906, per barrel.

Month.	1904.		1905.		1906.	
	North Lima.	South Lima and Indiana.	North Lima.	South Lima and Indiana.	North Lima.	South Lima and Indiana.
January	$1.36	$1.31	$0.96¼	$0.91¼	$0.94	$0.89
February	1.33	1.28	.93	.88	.94	.89
March	1.23½	1.18½	.92½	.87½	.94	.89
April	1.16½	1.11½	.89	.84	.95⅝	.90⅝
May	1.13	1.08	.86⅘	.81⅘	.98	.93
June	1.10	1.05	.86	.81	.98	.93
July	1.02¼	.97¼	.86	.81	.97¾	.92¾
August	1.00	.95	.86	.81	.92¾	.87¾
September	1.03½	.98½	.89⅜	.84⅜	.90	.85
October	1.05	1.00	.94½	.89½	.90	.85
November	1.06⅜	1.01⅜	.94¾	.89¾	.90	.85
December	1.05⅛	1.00⅛	.94	.89	.90	.85
Average	1.12⅞	1.07⅞	.90¾	.85¾	.93⅝	.88⅝
Average of North Lima, South Lima, and Indiana	1.10⅜		.88¾		.91⅛	

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, 1901–1906, per barrel.

Year.	Highest.	Lowest.	Average.	Year.	Highest.	Lowest.	Average.
1901	[a] $0.94	[b] $0.74	$0.86	1904	[a] $1.36	[b] $0.95	1.10\frac{3}{8}$
1902	[a] 1.15	[b] .80	.88$\frac{1}{4}$	1905	[a] 1.01	[b] .81	.88$\frac{3}{4}$
1903	[a] 1.38	[b] 1.06	1.16$\frac{1}{2}$	1906	[a] .98	[b] .85	.91$\frac{1}{8}$

[a] North Lima. [b] South Lima.

INDIANA.

PRODUCTION.

During the year 1906 Indiana produced 7,673,477 barrels of petroleum. This is a falling off from the quantity produced in 1905 of 3,290,770 barrels, or 30 per cent. This is a rapid reduction in the quantity of oil produced, especially as nearly 1,200 new wells were drilled during the year, which added a new initial daily production of nearly 15,000 barrels. A large number of wells were abandoned in 1906, probably due to the encroachment of salt water. The new developments during the year were principally in Delaware, Grant, and Jay counties.

In the following table are shown the production and value of the oil produced in the State of Indiana during the years 1905 and 1906:

Production and value of petroleum in Indiana in 1905 and 1906, by kinds, in barrels.

Kind.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Trenton rock	10,951,407	$9,390,832	7,665,408	$6,760,890
Corniferous rock	8,750	9,897	8,069	9,176
Lubricating (natural)	4,090	4,180	....	....
Total	10,964,247	9,404,909	7,673,477	6,770,066

In the following table will be found a statement of the production of petroleum in Indiana from 1902 to 1906:

Production of petroleum in Indiana, 1902–1906, in barrels.

Year.	Quantity.	Total value at wells of all oil produced, excluding pipeage.	Price per barrel.
1902	7,480,896	$6,526,622	$0.87
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
1906	7,673,477	6,770,066	.882

ILLINOIS.

The rapid and profitable development of the oil field of Illinois has been the most notable feature in the oil industry east of the Mississippi River during the year 1906. The first shipments of oil from the eastern part of Illinois commenced in June, 1905; at the end of the year this field had produced and shipped but 181,084 barrels. During the year 1906 the drill was constantly at work with almost universally favorable results, the production amounting to 4,397,050 barrels, valued at $3,274,818. It is stated by the Oil City Derrick that at the end of 1906 a total of 4,185 wells had been drilled in the Illinois field, and that since March, 1906, these wells had added a new initial daily production of 112,496 barrels. The limits of the oil-producing area were materially extended during the year, the greater part of the new area added being to the southeast. The producing area at the end of the year extended from north of Casey, in Clark County, to near Bridgeport, in Lawrence County, a distance of over 50 miles. In the north part of the field there are two geologic horizons from which oil is produced. They are at depths of approximately 400 and 1,000 feet. In Lawrence County a third horizon of oil-producing sand has been found at a depth of about 1,400 feet.

The entire field is covered by the gathering lines of the Ohio Oil Company. Two 8-inch trunk lines extend from Bridgeport to Martinsville, where they are joined by the line from Casey. From Martinsville two 12-inch lines extend to Montpelier, where connection is made with the main trunk lines of the Standard Oil Company to the seaboard.

PRODUCTION.

In the following table will be found the production of petroleum and the price per barrel in Illinois during 1905 and 1906, by months:

Production of crude petroleum and price per barrel in Illinois in 1905 and 1906, by months, in barrels.

Month.	1905.		1906.	
	Quantity.	Price per barrel.	Quantity.	Price per barrel.
January			55,680	$0.79
February			65,208	.79
March			19,352	.79
April			102,862	.80⅝
May			267,746	.83
June	6,521	$0.60	410,655	.83
July	17,306	.60	610,401	.82¾
August	23,827	.60	778,464	.71⅞
September	26,586	.61	722,168	.64
October	27,589	.64	463,819	.64
November	34,611	.66	350,985	.64
December	44,644	.70	549,710	.64
Total	181,084	a .644	4,397,050	a .745

a Average.

In the following table will be found the production in Illinois from 1889 to 1906, inclusive:

Production of petroleum in Illinois, 1889-1906, in 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	1906	4,397,050

The following table shows the runs of the Ohio Oil Company during the years 1905 and 1906, by months:

Pipe-line runs of the Ohio Oil Company in Illinois in 1905 and 1906, by months, in barrels.

Month.	Pipe-line runs.	
	1905.	1906.
January	....	55,680
February	....	65,208
March	....	19,352
April	....	102,862
May	....	267,746
June	5,489	410,655
July	9,208	610,401
August	15,092	778,464
September	19,592	722,168
October	26,444	463,819
November	34,766	350,985
December	45,912	538,131
Total	156,503	4,385,471

The following table shows the quantity of crude petroleum shipped by railroad from the Illinois oil field during 1906, by months:

Shipments of crude petroleum by railroad in tank cars from Illinois oil field, in pounds and equivalent in barrels, in 1906, by months.

Month.	Pounds.	Barrels.
January	18,083,407	60,134
February	15,444,464	51,358
March	4,814,239	16,009
April	10,687,154	35,539
May	48,151,478	160,121
June	941,669,378	3,131,383
July	155,158,474	515,956
August	160,831,482	534,821
September	110,852,921	368,625
October	48,881,173	162,547
November	14,659,266	48,747
December	9,275,053	30,843
Total	1,538,508,489	5,116,082

NOTE.—Calculations are made on the basis of 7.16 pounds to the gallon.
Shipments were made from Bridgeport, Oilfield, and Stoy.
The railroads which shipped crude petroleum from Illinois were the Vandalia, the Baltimore and Ohio, the Cincinnati, Hamilton and Dayton, and the Indianapolis Southern.

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 are 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 limestone, and probably corresponding to the Keener sand in the "Big lime" of the Appalachian field.

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 Coodys 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 from the Glenn pool in the Creek Nation is dark green in color, and its gravity is from 38° to 40° 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.—A small quantity of oil in the north part of the Mid-Continent field is shipped by tank cars for fuel purposes and to local refineries. There are nine refineries, having independent gathering pipe-line systems, that collect and deliver oil within the Mid-Continent field. By far the greatest quantity of the oil of this field is handled by the pipe-line system of the Prairie Oil and Gas Company. This company buys the oil directly from the producers, and operates two main trunk pipe lines from Humboldt, Kans., to Whiting, Ind., in connection with the complete system of collecting pipe lines to all of the different pools in Kansas, Indian Territory, and Oklahoma.

During the latter part of the year 1906 financial arrangements were made by two of the large producing and refining interests of the Gulf field to build pipe lines from the Glenn pool in Indian Territory to connect with their pipe-line system in Texas. The Texas Company will construct one of these lines. The other will be constructed by the Gulf Pipe Line Company, a new Texas corporation affiliated with the J. M. Guffey Petroleum Company and the Gulf Refining Company.

The route of the Texas Company pipe line will be by way of Dallas, Tex., and thence to a connection with the existing pipe lines of that company at the Humble pool. The route of the Gulf Pipe Line Company will be by the way of Lufkin and Nacogdoches to a connection with the present lines of the affiliated companies at Sour Lake. Both lines will be built of 8-inch pipe, with an estimated capacity of 20,000 to 25,000 barrels each per day. Both companies will construct a collecting pipe-line system in the Glenn pool and build storage tanks there. Prior to the completion of the main trunk line oil will be shipped by railroad to Texas points.

PRODUCTION OF THE MID-CONTINENT FIELD.

The last four years have seen the growth of the Mid-Continent oil field from a locality of insignificant production to the most important producing area of the United States. The present value of the oil produced in the Mid-Continent field is not greater than the value of the oil from some of the other fields. The indications point, however, to a continued expansion of the Mid-Continent oil-producing area with the future discovery of more pools and a final better price for the oil produced.

During the year 1906 there were 21,718,648 barrels of oil produced in the Mid-Continent field. This is an increase of 9,705,153 barrels over the quantity produced in 1905. Besides the quantity of oil given above as being produced during the year 1906, which means taken from the wells and sold or measured, there was a considerable quantity of oil taken from the ground and held by the producers upon the leases. This is included under the head of field stocks, the actual quantity of which can not be accurately given. It has been estimated by the Oil Investors' Journal to be about 1,400,000 barrels on January 1, 1907.

Consumption.—Only a small part of the crude oil from the Mid-Continent field was consumed directly as fuel during 1906, probably not over 200,000 barrels. The shipments of the principal pipe-line companies amounted to 11,213,556 barrels, making a total consumption of 11,413,556 barrels.

Stocks.—The stocks held by the Prairie Oil and Gas Pipe Line Company at the beginning of the year 1906 were 13,250,118 barrels. The runs of the company during the year exceeded the shipments by 9,980,600 barrels. This quantity added to the previous stocks makes a total of 23,230,718 barrels. The stocks reported by the Prairie Oil and Gas Pipe Line Company at the end of the year were 22,941,034 barrels, indicating a loss of 289,684 barrels from evaporation and other causes during the year.

It has not been possible to distribute the production of the Mid-Continent field in 1906 among the different producing States.

In the following table is shown the production of the Mid-Continent field by months during the years 1905 and 1906:

Production of crude petroleum in Kansas, Indian Territory, and Oklahoma in 1905 and 1906, by months, in barrels.

Month.	1905.			1906.		
	Pipe-line runs.	Shipments of crude by rail and consumption by refineries.	Total.	Pipe-line runs.	Shipments of crude by rail and consumption by refineries.	Total.
January	793,648	4,506	798,154	1,472,214	36,311	1,508,525
February	564,482	2,778	567,260	1,352,531	27,226	1,379,757
March	695,908	4,717	700,625	1,693,182	36,443	1,729,625
April	549,339	4,302	553,641	1,779,251	34,719	1,813,970
May	784,229	5,634	789,863	1,741,941	41,711	1,783,652
June	715,397	6,853	722,250	1,688,433	47,900	1,736,333
July	1,091,000	11,788	1,102,788	2,022,215	49,546	2,071,761
August	1,212,912	16,469	1,229,381	1,779,263	47,724	1,826,987
September	1,203,362	24,455	1,227,817	1,546,719	48,046	1,594,765
October	1,380,208	27,888	1,408,096	2,009,650	57,068	2,066,718
November	1,355,012	24,931	1,379,943	1,945,195	47,729	1,992,924
December	1,509,325	24,352	1,533,677	2,163,562	50,069	2,213,631
Total	11,854,822	158,673	12,013,495	21,194,156	524,492	21,718,648

In the following table is shown the total production of crude petroleum from the Mid-Continent field from 1889 to 1906, 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, 1889–1906, in 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	
1906	21,718,648	17.17	9,705,153		80.79	

In the following table are given the pipe-line runs, the shipments, and the stocks held at the end of each year in the Mid-Continent field from 1902 to 1906, inclusive:

Pipe-line runs, shipments, and stocks in Mid-Continent field, 1902–1906, in 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
1906	21,194,156	11,213,556	22,941,034

[a] Total production for the year.

PRICES.

In the following table are given the prices paid by the Prairie Oil and Gas Company for the oils of different grades in the Mid-Continent field during the years 1905 and 1906; also the average monthly price during 1906:

Range of prices paid for petroleum by the Prairie Oil and Gas Company in Kansas and Indian Territory and Oklahoma in 1905 and 1906, per barrel.

1905.	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	....	....	....	....

1906.	32° and above.	Heavy.
January 1	$0.52	$0.35
July 28	.50	.35
August 2	.48	.35
August 9	.45	.32
August 15	.42	.29
August 28	.39	.26

[a] Heavy.

Average monthly price of Kansas, Indian Territory, and Oklahoma crude petroleum, per barrel of 42 gallons, in 1906, by months.

Month.	32° and above.	Heavy.	Month.	32° and above.	Heavy.
January	$0.52	$0.35	August	$0.43¾	$0.30¾
February	.52	.35	September	.39	.26
March	.52	.35	October	.39	.26
April	.52	.35	November	.39	.26
May	.52	.35	December	.39	.26
June	.52	.35			
July	.51¾	.35	Average	.47	.31⅝

KANSAS.

Kansas, although steadily producing oil from its old wells, did little during 1906 in the way of developing new production. The number of wells drilled within the State in 1906 was less than half the number drilled in 1905. Of the wells drilled about one-fifth were dry and about one-third produced gas.

OKLAHOMA AND INDIAN TERRITORY.

The important feature in the oil development of Oklahoma and Indian Territory during 1906 was the Glenn pool in the Creek Nation.

The Glenn pool is situated in T. 17 N., R. 12 E., in the Creek Nation of Indian Territory, about 4 miles to the southeast of Sapulpa. The pool was discovered by Robert Galbreath and Frank Chesley, who drilled in a test well during December, 1905, in sec. 10, T. 17 N., R. 12 E. From this date the development was steady and rapid during the full year 1906, in which time about 110 wells were drilled in the pool and fully 7,000 acres of land were proved as oil-producing territory. The oil of the Glenn pool comes from a sand at a depth of about 1,450 feet. This sand probably correlates with the producing sand at Bartlesville.

The total quantity of crude petroleum produced from wells on the Osage Reservation during the year 1906 was 5,219,106 barrels, of which 5,216,707 barrels were run from the field and 2,399 barrels were used as fuel.

The total number of wells in existence on December 31, 1906, based upon reports made by the operators, was 1,080, of which 716 were oil wells, 66 were gas wells, and 298 were dry holes. On June 10, 1906, at which time a record of wells was made, there was in existence a total of 862 wells drilled, of which 569 were classed as oil wells, 55 as gas wells, and 238 as dry holes. This shows an increase for the six months ending December 31, 1906, of 147 oil wells, 11 gas wells, and 60 dry holes; and it is estimated that there were drilled between January 1 and June 10, 1906, 107 oil wells, 10 gas wells, and 41 dry holes. This would give a total increase for the year of 254 oil wells, 21 gas wells, and 101 dry holes.

In the following table is given a statement of the quantity of crude petroleum produced by the Indian Territory Illuminating Oil Company and its sublessees from wells in Osage Nation, Oklahoma, from 1903 to 1906, inclusive:

Production of crude petroleum by the Indian Territory Illuminating Oil Company and its sublessees from January 1, 1903, to December 31, 1906.

1903....................barrels..	56,905	1905....................barrels..	3,421,478
1904....................do....	652,479	1906....................do....	5,219,106

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 1906, inclusive:

Oil and gas wells in the Osage Reservation, 1903–1906.

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	704	462	45	197
June 10, 1906	862	569	55	238
December 31, 1906	1,080	716	66	298

GULF FIELD.

COASTAL PLAIN AND NORTHERN TEXAS.

Geology.—Most of the oil of the Gulf field comes from that portion of Texas and Louisiana known as the Coastal Plain. The surface rocks of this area are beds of unconsolidated clay, sands, and marls, with some gravels in the upper portion, and occasional fine layers of hard limestone. These are of recent geologic age, probably Pleistocene. Below this system is a formation whose geologic age is not positively determined. Within this formation are beds of sandstone and dolomitic limestone, both porous, and each probably covering only a limited area. It is in these porous beds that the large accumulations of oil have been found. When in limestone, the cap rock is hard and impervious. Below this the rock is very porous, containing in some cases cavities of considerable size.

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 well completely. The great porosity of the reservoir rocks of this district makes the initial flow of the wells of the Coastal Plain area large, with a life that is proportionately short. Most of the indications of oil within this area are found in the vicinity of ground elevated a few feet above the general level, and spoken of as hills or mounds. The indication consists of gas and sulphur springs with seepages of asphalt.

In northern Texas, to the north and west of the Coastal Plain region, are the outcrops of the rocks that extend under the Coastal Plain. They are the Cretaceous and Tertiary. These formations have a general dip to the southeast. Oil has been found in a number of different localities in these rocks. It comes from different horizons and from rocks of both the Tertiary and the Cretaceous. The accumulations are in sandstones. The conditions of accumulation are probably similar to those of the Appalachian field.

PRODUCTION, CONSUMPTION, AND STOCKS.

Production.—The Gulf field produced 21,645,425 barrels of oil during 1906. This is a falling off of 41.6 per cent from the production of 1905. The great falling off in quantity is accounted for by the smaller production from the pools in southeastern Texas. Humble pool dropped 77 per cent; Sour Lake, 36 per cent; Spindle Top, 35 per cent, and Saratoga, 30 per cent, from the quantity produced in 1905. The pools of the Corsicana district showed an increase in the quantity of oil produced over the output of 1905. The increase was slight in the light oil district, but it was over 400 per cent in the heavy oil district, or Powell pool.

The State of Louisiana slightly increased the quantity of oil produced in 1906 over that in 1905. There was a small increase in the output from the Jennings pool, and during the last month of the year some oil was shipped from the Caddo district, in northern Louisiana.

Although the quantity of oil produced by the Gulf field during 1906 was 15,401,180 barrels less than the output of 1905, the money return was $969,829 more than in 1905. The conditions shown by these figures would indicate the necessity of a commercial balance wheel, though how to apply this wheel it seems difficult to devise. It is apparent that with the flush production from new pools the product is practically given away for a price in no proportion to its real commercial use. With the falling of production to a point which shows no surplus over consumption, the price advances until a little over one-half of the quantity of oil brings in return nearly a million more dollars.

Consumption.—The quantity of oil shipped by the railroads from the different loading racks in Texas and Louisiana in connection with that shipped by barges on the Mississippi represents fairly accurately the oil consumed for fuel in the South and West. During 1906 the quantity thus disposed of amounted to 18,250,381 barrels. This is an increase over the same class of shipments during 1905 of 2,492,706 barrels, notwithstanding the fact that the average price had risen from about 25 cents to about 47 cents per barrel.

Shipments of crude oil from Port Arthur and Sabine during 1906 amounted to 6,223,628 barrels. This is less than the quantity shipped from the same ports during 1905.

No figures have been obtained covering the oil run through the refineries during the year. This quantity is generally assumed to be between 7,000,000 and 8,000,000 barrels.

Stocks.—At the beginning of the year 1906 there were 11,297,138 barrels of oil in Texas and 1,246,253 barrels in Louisiana held in stock by the different pipe-line companies. At the end of the year there were 4,523,374 barrels in Texas and 1,207,098 barrels in Louisiana, held by the same companies. These figures show a reduction of the stocks during the year amounting to 5,730,472 barrels.

In the following table is given the production of the Gulf field for the year 1906, by months:

Production of crude petroleum in the Gulf field in 1906, by months, in barrels.

Month.	Texas.	Louisiana.	Total.
January	1,183,690	704,187	1,887,877
February	977,475	678,896	1,656,371
March	984,110	746,027	1,730,137
April	1,017,729	705,299	1,723,028
May	1,187,720	1,079,009	2,266,729
June	1,248,238	1,008,617	2,256,855
July	1,184,062	723,422	1,907,484
August	1,037,122	839,400	1,876,522
September	915,376	703,814	1,619,190
October	985,982	747,996	1,733,978
November	910,313	619,001	1,529,314
December	936,080	521,860	1,457,940
Total	12,567,897	9,077,528	21,645,425

In the following table is shown the total production and value of the crude petroleum produced in the Gulf field from 1902 to 1906, inclusive:

Production and value of crude petroleum in the Gulf field, 1902–1906, in 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
1906	12,567,897	6,565,578	9,077,528	3,557,838	21,645,425	10,123,416

In the following table is shown the production of crude petroleum in the Gulf field from 1889 to 1906 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, 1889–1906, in 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	
1906	21,645,425	17.11		15,401,180		41.57

PRICES.

Average monthly prices of crude petroleum per barrel of 42 gallons at wells in the Gulf field in the year 1906 were as follows:

Average monthly prices of crude petroleum in the Gulf field in 1906.

Month.	Spindle Top.	Sour Lake.	Humble.	Batson.	Saratoga.
January	\$0.51-\$0.52	\$0.41⅓ -\$0.464	\$0.35 -\$0.40	\$0.31⅓ -\$0.40	\$0.32½-\$0.35
February	.52- .54	.40 - .46	.34 - .3959	.30 - .40	.31 - .32
March	.57- .60	.42 - .50	.364 - .40	.34 - .46	.335- .36
April	.59- .62	.43 - .55	.40 - .44	.385 - .50	.30 - .39
May	.62- .65	.45 - .584	.44 - .484	.40 - .55	.305- .42
June	.64- .65	.45 - .60	.465 - .514	.42 - .55	.30 - .44
July	.65	.45 - .60	.48 - .52	.43 - .55	.29 - .475
August	.65	.45 - .6168	.5066- .54	.4566- .55	.34 - .51
September	.65- .67	.50 - .634	.52 - .60	.48 - .575	.39 - .57
October	.66- .68	.57 - .64	.53 - .65	.495 - .605	.44 - .58
November	.68- .73	.6355- .70	.53 - .75	.62 - .65	.51 - .655
December	.70- .75	.67 - .75	.54 - .75	.70 - .75	.56 - .75
Average	.618	.536	.486	.524	.45

Month.	Dayton.	Corsicana.	Powell.	Henrietta.	Matagorda.
January	....	\$0.89	\$0.50	\$0.65	\$0.85
February	....	.89	.50	.65	.85
March	....	.89	.50	.65	.85
April	....	.89- .91	.50- .52	.65	.85
May	....	.91	.52	65	.85
June	....	.91	.52	65	.85
July	....	.89- .91	.50- .52	.65	.85
August	....	.89	.50	.65	.85
September	....	.89- 1.00	.50- .55	.65	.85
October	....	1.00	.55- .60	.65	.85
November	....	1.00	.60	.65	.85
December	....	1.00	.60	.65	.85
Average	\$0.434	.935	.529	.65	.85

WELL RECORD.

In the following table will be found the number of wells completed in 1906 in the different districts 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 Investors' Journal, of Beaumont, Tex.

Well record in Gulf field in 1906.

Field.	Wells completed.			Abandoned.	December 31, 1906.	
	Total.	Productive.	Dry.		Drilling.	Locations.
Texas:						
Spindle Top	68	39	29	10	18	6
Sour Lake	74	54	20	31	8	0
Batson	80	76	4	14	8	3
Saratoga	64	55	9	12	10	4
Humble	345	222	123	207	9	6
Dayton	7	4	3	2	3	0
Corsicana, Powell	330	217	[a] 113	79	129	30
Hoskins Mound	11	1	10	0	1	0
Henrietta	1	1	0	0	....	....
South Bosque	4	4	0	2	1	....
Other	12	0	12	0	2	0
Total	996	673	323	357	189	49

[a] Includes 13 gas wells.

Well record in Gulf field in 1906—Continued.

Field.	Wells completed.			Abandoned.	December 31, 1906.	
	Total.	Productive.	Dry.		Drilling.	Locations.
Louisiana:						
Jennings	71	48	23	13	12	8
Welsh	2	2	0	0	1	0
Anse la Butte	10	5	5	4	1	0
Caddo	2	1	1	0	3	0
Total	85	56	29	17	17	8
Grand total	1,081	729	352	374	206	57

TEXAS.

A review of the year 1906 in the State of Texas shows a general falling off, in the quantity of oil produced, in all but 1 of the 5 principal pools of the Coastal Plain. The exception is Saratoga, which, at the end of the year, was producing more oil per month than at the beginning. This is probably due to the fact that the property holdings in the Saratoga pool are larger than in most of the other pools, and it therefore has not been sacrificed to pepper-box drilling. At Batson and Sour Lake there has been a steady falling off in production during the year. At Humble and Spindle Top, after a decrease in production for part of the year, a new oil horizon was brought in, which increased the output for a few months; but with the end of the year these pools were again on the decline. The new sources of oil at Spindle Top and Humble were from shallow sands which had been known to exist since the first discovery of the pools, but which had previously not been considered of much economic importance. It was believed that these sands did not extend generally over the area of the pools, nor contain a large quantity of oil.

In Navarro County the Corsicana district has maintained and slightly increased its output of oil. There has been a decided increase in the Powell production. This has come by an extension of the field to the south and east, thus considerably increasing the limits of that area.

Hoskins mound.—At the end of West Bay, 23 miles southwest of Galveston, is the Hoskins Ranch. In this property are two mounds, the larger of which contains something like 1,000 acres, and the smaller about 300. These hills have for a long time been considered as favorable for the location of a new oil pool.

Four or five test wells were drilled upon the west side of the big mound prior to 1905 with favorable indications but no actual production. In November, 1905, a well was drilled near one of the former tests that became a producer of considerable size. The oil is of 21° Baumé gravity. The well was capped, and a 4-inch pipe line was constructed from the mounds to Danbury Station on the St. Louis, Brownsville and Mexican Railroad, a distance of 9 miles. A 30-car loading rack was erected at Danbury, and the shipments of oil from this point commenced in the month of May, 1906. Since the drilling of the first successful well, in November, 1905, a number of other test wells have been drilled, but have not resulted in an increase of the production. The probability of a future pool in this locality is, however, good.

Hockley.—Near Hockley, in Harrison County, a determined effort has been made during the year by the Higgins World Oil Company to bring in an oil pool. In this locality are found indications in the way of sour water and gas springs with seepages of asphalt. Three wells were drilled to different depths. A very hard rock was encountered in one or two of these wells, making the progress of the sinking of the hole very slow. At the end of the year no favorable results had been obtained.

PRODUCTION.

In the two following tables will be found the production of crude petroleum in Texas, by districts and months, for the years 1905 and 1906:

Production of crude petroleum in Texas, 1905–1906, by districts and months, in barrels.

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	317,794	350,398	23,068	10,132
March	170,247	341,024	344,851	334,829	27,517	9,912
April	144,489	337,756	392,875	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

1906.

Month.	Spindle Top.	Sour Lake.	Batson.	Saratoga.	Corsicana.	Powell.
January	113,180	225,083	214,926	148,183	26,686	17,470
February	121,609	185,441	206,942	139,946	30,232	21,872
March	75,014	193,183	206,991	173,159	28,330	31,640
April	77,398	202,781	202,410	162,189	26,541	43,915
May	99,096	196,479	207,460	208,417	28,260	59,779
June	78,259	183,608	191,733	193,645	27,103	71,198
July	78,069	177,933	198,675	188,608	26,858	78,083
August	71,477	154,138	194,528	183,941	26,204	76,242
September	77,044	135,910	171,837	180,740	27,926	72,228
October	88,662	186,001	171,605	208,906	30,275	74,786
November	95,687	148,984	149,837	201,882	24,377	65,253
December	101,997	166,469	172,563	192,441	29,830	60,755
Total	1,077,492	2,156,010	2,289,507	2,182,057	332,622	673,221

[a] Includes 26,069 barrels of oil which were on hand and unsold on December 31, 1905.
[b] Average.

Production of crude petroleum in Texas, 1905–1906, by districts and months, in barrels—Continued.

1906.

Month.	Humble.	Matagorda and Hoskins Mound.	Henrietta.	Dayton.	Other.	Total.
January	413,117	300	10,221	14,439		1,183,690
February	250,731	300	10,096	10,221		977,475
March	256,756	300	9,983	8,669		984,110
April	285,627	300	9,913	6,570		1,017,729
May	359,521	9,687	9,854	9,082		1,187,720
June	448,871	38,870	8,776	6,090		1,248,238
July	406,579	14,004	9,113	6,055		1,184,062
August	306,309	9,422	8,927	5,849		1,037,122
September	233,422	2,460	8,865	4,859		915,376
October	210,748	1,523	8,631	4,760		985,982
November	209,041	1,785	8,552	4,830		910,313
December	190,723	1,640	8,141	11,426		936,080
Total	3,571,445	80,591	111,072	92,850	[a]1,030	12,567,897

[a] Includes production in Bexar, Jack, and McLennan counties.

The production of petroleum in Texas from 1896 to 1906, inclusive, has been as follows:

Production of crude petroleum in Texas, 1896–1906, by districts, in barrels.

Year.	Corsicana.	Powell.	Spindle Top.	Sour Lake.	Saratoga.	Batson.
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
1906	332,622	673,221	1,077,492	2,156,010	2,182,057	2,289,507
Total	4,864,882	1,125,971	35,779,081	26,899,841		16,973,603

Year.	Dayton.	Matagorda.	Henrietta.	Humble.	Other.	Total.
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
1906	92,850	[a]80,591	111,072	3,571,445	1,030	12,567,897
Total	153,144	278,998	252,119	19,165,755	3,540	105,496,934

[a] Includes the production of Hoskins Mound.

The following table gives a statement of the production and value of crude petroleum at wells in Texas in 1905 and 1906, by districts:

Production and value of petroleum in Texas in 1905 and 1906, by districts, in barrels.

District.	1905.			1906.		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Spindle Top	1,652,780	$612,282	$0.370	1,077,492	$666,287	$0.61[illegible]
Sour Lake	3,362,153	1,117,261	.332	2,156,010	1,155,475	.53[illegible]
Saratoga	3,125,028	872,285	.281	2,182,057	985,543	.45
Coriscana	311,554	258,590	.83	332,622	310,941	.93[illegible]
Powell	132,866	66,433	.50	673,221	356,144	.52[illegible]
Batson	3,774,841	1,025,025	.272	2,289,507	1,199,625	.52[illegible]
Humble	15,594,310	3,528,768	.226	3,571,445	1,736,165	.48[illegible]
Dayton	60,294	18,255	.303	92,850	40,265	.43[illegible]
Henrietta	75,592	35,906	.475	111,072	72,197	.65
Matagorda	46,471	16,677	.360	[a]80,591	41,556	.51[illegible]
Other	300	780	2.60	1,030	1,380	1.3[illegible]
Total	28,136,189	7,552,262	.268	12,567,897	6,565,578	.52[illegible]

[a] Includes the production of Hoskins Mound.

Prices of Corsicana and Powell oil.—The following tables show the prices of Corsicana and Powell oil from 1903 to 1906, inclusive:

Fluctuations in prices of Corsicana light oil, 1903–1906, per barrel.

1903.	
January 2	$1.06
April 22	1.08
July 16	1.10
July 23	1.12
September 28	1.14
September 30	1.16
October 8	1.18
October 13	1.20
October 17	1.22
October 24	1.24
October 28	1.26
November 20	1.29
December 2	1.31
December 9	1.32
December 29	1.27

1904.	
January 1	$1.27
January 12	1.17
January 20	1.07
February 12	1.02
March 1	.99
March 4	.96
March 12	.93
March 29	.90
April 8	.87
April 29	.84
June 7	.81
June 17	.78
July 9	.73
July 13	.70
August 12	.80

1904—Continued.	
September 1	$0.8[illegible]
1905.	
January 5	.8[illegible]
May 27	.8[illegible]
September 12	.8[illegible]
September 16	.8[illegible]
September 19	.8[illegible]
September 28	.8[illegible]
October 20	.9[illegible]
November 11	.8[illegible]
1906.	
April 25	.9[illegible]
July 28	.8[illegible]
September 12	1.0[illegible]

Fluctuations in prices of Powell heavy oil, 1903–1906, per barrel.

1903.	
January 2	$0.35
January 20	.50
May 2	.60
December 29	.55
1904.	
January 1	.55

1904—Continued.	
January 12	$0.45
January 20	.40
August 12	.45
September 1	.50
1905.	
	.50

1906.	
April 25	$0.5[illegible]
July 28	.5[illegible]
September 12	.5[illegible]
October 29	.6[illegible]

Average monthly prices of Corsicana and Powell oil at wells, 1903–1906, per barrel.

Month.	Corsicana.				Powell.			
	1903.	1904.	1905.	1906	1903.	1904.	1905.	1906.
January	$1.06	$1.162	$0.82⅜	$0.89	$0.413	$0.462	$0.50	$0.50
February	1.06	1.04	.82	.89	.50	.40	.50	.50
March	1.06	.94⅛	.82	.89	.50	.40	.50	.50
April	1.066	.87½	.82	.89	.50	.40	.50	.50
May	1.08	.84	.81⅞	.91	.596	.40	.50	.52
June	1.08	.80⅕	.81	.91	.60	.40	.50	.52
July	1.097	.72¼	.81	.91	.60	.40	.50	.52
August	1.12	.763	.81	.89	.60	.43⅛	.50	.50
September	1.123	.85	.844	.96	.60	.50	.50	.53
October	1.206	.85	.898	1.00	.60	.50	.50	.55
November	1.27	.85	.897	1.00	.60	.50	.50	.60
December	1.311	.85	.89	1.00	.594	.50	.50	.60
Average	1.14	.87–	.83+	.92	.5716	.43+	.50	.52½

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 1906, by months.

Month.	Wells.				
	Completed.	Producing.	Gas.	Dry.	Abandoned.
January	15	11	3	1	11
February	12	10		2	1
March	23	17		6	5
April	37	23	1	13	
May	47	19	3	25	2
June	37	27	1	9	1
July	37	20	4	13	9
August	29	18		11	5
September	22	18		4	2
October	26	21		5	4
November	21	15	1	5	4
December	24	18		6	35
Total	330	217	13	100	79

Well record in the Corsicana and Powell oil districts, 1898–1906.

Year.	Wells.							Rigs.	
						Drilling.			
	Completed.	Producing.	Dry.	Gas.	Abandoned.	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
1906	330	217	100	13	79				

[a] Includes 2 artesian wells.
[b] Includes 56 wells in heavy oil district.
[c] Includes 10 wells in heavy oil district.
[d] Includes 2 wells in heavy oil district.

SHIPMENTS.

In the following table is given the shipment of crude petroleum by railroad in tank cars from the different stations of Texas during the year 1906:

Quantity of crude petroleum shipped by railroad in tank cars from the oil fields of Texas, at the stations named, by months, during the year 1906, in barrels.

Month.	Spindle Top.	Sour Lake.	Humble and Trice.	Saratoga.	Big Hill and Danbury.	Total.
January	14,453	54,450	407,513	68,401	....	544,817
February	16,551	58,440	349,843	195,606	....	620,440
March	8,534	93,086	303,397	174,146	....	579,163
April	6,725	196,044	218,133	232,309	....	653,211
May	7,989	104,864	294,836	230,713	11,247	649,649
June	7,760	69,721	313,552	179,799	33,557	604,389
July	2,040	115,041	248,396	164,740	14,968	545,185
August	1,121	126,791	266,610	105,646	11,657	511,825
September	2,472	161,391	315,937	189,197	1,409	670,406
October	892	238,566	294,077	181,391	1,701	716,627
November	2,103	137,142	329,071	166,710	2,932	637,958
December	4,678	122,794	319,236	303,164	2,093	751,965
Total	75,318	1,478,330	3,660,601	2,191,822	79,564	7,485,635

NOTE.—These are the official figures furnished by the railroads which shipped the crude petroleum. Calculations were made in reduction of pounds to barrels on the basis of 310.8 pounds to a barrel.

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 1906, by months:

Shipments of Texas petroleum in 1906 from Port Arthur, Sabine Pass, and Galveston, by months and by cargoes.

Month.	Port Arthur.		Sabine Pass.		Galveston.		Total.	
	Number of cargoes.	Quantity in barrels.	Number of cargoes.	Quantity in barrels.	Number of cargoes.	Quantity in barrels.	Number of cargoes.	Quantity in barrels.
January	16	364,600	11	347,148	....	....	27	711,748
February	26	590,780	13	385,339	....	....	39	976,119
March	26	561,197	13	350,144	a 2	139	41	911,480
April	20	548,590	9	182,579	2	464	31	731,633
May	27	577,903	12	318,669	b 4	461	43	897,033
June	27	584,084	15	394,918	3	745	45	979,747
July	35	705,846	11	308,857	2	700	48	1,015,403
August	27	578,249	10	241,717	c 6	710	43	820,676
September	31	563,690	10	290,110	2	247	43	854,047
October	18	481,073	6	203,000	6	884	30	684,957
November	24	552,740	9	222,858	2	200	35	775,798
December	27	505,830	14	489,619	d 2	682	43	996,131
Total	304	6,614,582	133	3,734,958	31	5,232	468	10,354,772

a From Texas City 1 cargo—121 barrels.
b From Texas City 1 cargo—119 barrels.
c From Texas City 2 cargoes—120 barrels.
d From Texas City 1 cargo—100 barrels.

Shipments of Texas petroleum, by ports, in 1906, by months, in barrels.

Port.	January.	February.	March.	April.	May.	June.	July.
Baltimore, Md		27,106	27,000	44,950		25,000	25,000
Beverly, Mass		3,000		31,650			29,890
Gretna, La				3,350	3,171	3,134	
Marcus Hook, Pa	35,714	59,524	59,524	83,334	130,504	105,808	80,952
New Orleans, La	6,397	13,324	15,572	6,125	6,250	2,868	70,859
New York, N. Y	264,215	416,948	340,357	332,128	371,859	370,592	306,215
Philadelphia, Pa	257,332	121,551	104,010	18,600	43,905	102,062	112,167
Tampa, Fla	53,530	21,994	67,344	20,000	21,460	40,346	59,619
Bayonne, N. J	31,313	64,347	91,429	40,529	66,062	101,556	33,310
Boston, Mass		32,000					
Gibsons Point, Pa			68,797	51,217	110,603	71,354	170,835
Wilmington, Del					58,418	23,714	66,109
Maurer, N. J							
Dover, England		152,261	71,552	94,204	70,770		59,747
Manchester, England	63,247						
London, England			22,649			38,926	310
Liverpool, England			205			342	
Queenstown, England							
Birkenhead, England		21,250					
Rouen, France		20,706					
Dunkirk, France							390
Cette, France							
Nantes, France							
Hamburg, Germany				452	299		
Antwerp, Belgium		22,108				51,818	
Rotterdam, Netherlands						400	
Habana, Cuba			37,894				
Nuevitas, Cuba				12	43	3	
Manzanillo, Cuba							
Coatzacoalcos, Mexico			5,008	5,082	13,689	41,824	
Tampico, Mexico			18				
Veracruz, Mexico			121				
Progreso, Mexico							
Total	711,748	976,119	911,480	731,633	897,033	979,747	1,015,403

Port.	August.	September.	October.	November.	December.	Total.
Baltimore, Md		16,466		26,000	16,800	208,322
Beverly, Mass	20,100	29,678		20,626	40,836	175,780
Gretna, La	3,180	3,150			3,750	19,735
Marcus Hook, Pa	61,904	142,048	54,214	128,333	67,095	1,008,954
New Orleans, La	3,117	88,546	35,863	8,500	13,316	270,737
New York, N. Y	273,208	263,063	204,977	146,953	335,834	3,626,349
Philadelphia, Pa	64,642	48,524	26,190	63,905	78,690	1,041,578
Tampa, Fla	35,850	34,650	19,260	70,358	45,730	490,141
Bayonne, N. J	142,811	114,771	29.890	89,619	69,990	875,627
Boston, Mass						32,000
Gibsons Point, Pa	74,146	19,374	71,899	92,066	97,648	827,939
Wilmington, Del	21,548	23,247	43,548	72,020	63,813	372,417
Maurer, N. J		9,800			8,545	18,345
Dover, England	69,973		68,703		95,346	682,556
Manchester, England			120			63,367
London, England				27,423		89,308
Liverpool, England			286			833
Queenstown, England			59,681			59,681
Birkenhead, England			27,850			49,100
Rouen, France						20,706
Dunkirk, France						390
Cette, France		23,179		29,795		52,974
Nantes, France					4,459	4,459
Hamburg, Germany	360	240	466	180	582	2,579
Antwerp, Belgium	20	37,304	19,845		28,249	159,344
Rotterdam, Netherlands	436					836
Habana, Cuba	27,765					65,659
Nuevitas, Cuba	10					68
Manzanillo, Cuba		7	12	20		39
Coatzacoalcos, Mexico	21,486		22,153		25,348	134,590
Tampico, Mexico						18
Veracruz, Mexico	100				100	321
Progreso, Mexico	20					20
Total	820,676	854,047	684,957	775,798	996,131	10,354,772

EXPORTS.

In the following tables are given the exports of crude petroleum and its products from Texas, by months and kinds and by customs districts:

Exports to foreign countries of crude and refined petroleum from all ports of Texas in 1906, by months, in gallons.

Month.	Crude.		Naphtha.		Illuminating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	862,365	$43,419	1,194	$187	1,095,972	$68,532
February	5,340,602	266,484	807	124	21,205	3,826
March	1,963,344	96,478	1,340	200	3,993,517	214,339
April	1,663,022	83,157	883	136	2,548,079	168,932
May	3,776,481	188,394	2,955	456	32,326	5,171
June	2,112,831	105,737	1,709	217	1,652,437	102,954
July	639,113	22,070	1,112	148	1,278,914	79,577
August	5,873,381	289,737	2,755	421	33,473	5,141
September	12,450	251	1,510	514	1,083,173	77,151
October	4,470,257	204,210	1,899	420	2,572,556	164,336
November	7,604	450	10,887	1,193	2,544,709	164,918
December	5,970,669	298,655	15,855	2,250	300,964	30,993
Total	32,692,119	1,599,042	42,906	6,266	17,157,325	1,085,870

Month.	Residuum.		Lubricating and paraffin.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	884,003	$26,519	26,762	$5,419	2,870,296	$144,076
February	2,880,150	86,404	964,215	136,608	9,206,979	493,446
March			146,007	24,717	6,104,208	335,734
April			86,037	17,647	4,298,021	269,872
May			57,143	10,931	3,868,905	204,952
June	1,287,608	38,628	1,009,374	144,128	6,063,959	391,664
July	1,242,300	37,269	68,717	10,879	3,230,156	149,943
August	12,272	1,100	109,684	17,683	6,031,565	314,082
September	923,149	28,128	718,211	99,446	2,738,493	205,490
October	903,756	27,113	638,447	89,451	8,586,915	485,530
November			199,939	35,039	2,763,139	201,600
December	286,639	8,950	145,942	27,795	6,720,069	368 643
Total	8,419,877	254,111	4,170,478	619,743	62,482,705	3,565,032

Exports of crude and refined petroleum from Texas, by customs districts, in 1906, in gallons.

Kind.	Brazos de Santiago.		Corpus Christi.		Galveston.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Crude, including all natural oils, without regard to gravity			2,590,835	$110,874	30,045,185	$1,486,298
Refined:						
Naphthas, including all lighter products of distillation	310	$61	3,673	538		
Illuminating	45,943	6,857	447,050	63,303	16,519,394	993,751
Lubricating and heavy paraffin.	300	155	691,283	127,561	3,249,545	454,941
Residuum, including tar and all other from which the light bodies have been distilled					8,415,971	253,744
Total	46,553	7,073	3,732,841	302,276	58,230,095	3,188,734

Exports of crude and refined petroleum from Texas, by customs districts, in 1906, in gallons—Continued.

Kind.	Paso del Norte.		Saluria.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Crude, including all natural oils, without regard to gravity			56,099	$1,870	32,692,119	$1,599,042
Refined:						
Naphthas, including all lighter products of distillation	29,129	$4,620	9,794	1,047	42,906	6,266
Illuminating	59,778	7,146	85,160	14,813	17,157,325	1,085,870
Lubricating and heavy paraffin.	164,431	25,212	64,919	11,874	4,170,478	619,743
Residuum, including tar and all other from which the light bodies have been distilled			3,906	367	8,419,877	254,111
Total	253,338	36,978	219,878	29,971	62,482,705	3,565,032

LOUISIANA.

Jennings.—The output of oil from the Jennings pool was well maintained during the year, the quantity being greater in 1906 than in any previous year. In May and June the quantity of oil delivered from the field was over 1,000,000 barrels a month. From June on there was a gradual falling off in the production each month, in December only 513,425 barrels of oil being produced. There were 71 wells drilled in the Jennings pool in 1906, of which 48 were productive and 23 dry.

Caddo district.—The first shipments of oil from the Caddo pool were made in December, 1906. This district is situated in northwestern Louisiana, in Caddo Parish. Caddo Island is 22 miles north of the city of Shreveport. The island is 3 miles long, north and south, and 2 miles wide, east and west. It is traversed by the Kansas City Southern Railway, the station of Caddo being nearest to the oil and gas developments.

Favorable indications in the way of gas from shallow wells and springs have been known in this locality for a number of years. In the latter part of 1904 wells were drilled by the Latex Oil and Pipe Line Company. These wells demonstrated the existence of two horizons of favorable indication—one at about 900 feet and the other at about 1,500 feet. In March, 1905, the Caddo Lake Oil and Pipe Line Company sank a well to a depth of 1,556 feet and procured a showing of oil which filled the casing for 1,200 feet. The gravity of this oil was from 35° to 37° Baumé. The results of this well caused much development work.

The Producers' Oil Company of Texas entered the field and drilled a well to the southeast of the Caddo Lake Oil and Pipe Line Company's well, which resulted in a good gas well. The second effort of the Producers' Oil Company resulted in a blow-out of the ground about the well. The gas was strong enough to form a large hole, in which the derrick and machinery used for drilling were entirely swallowed up; the surface water flowed into this hole, and a boiling cauldron was formed from the escaping gas. The gas afterwards caught fire and burned for some months. The third well of this company was no more successful than the second, resulting in another blow-out. At the end of the year 1905, 3 successful gas wells had been completed, 2 by the Caddo Lake Oil and Pipe Line Company and 1 by Messrs. Brown Brothers. The Producers' Oil Company's well No. 1 was then being drilled deeper.

During the first months of 1906 a number of successful gas wells were completed. A gas line was laid by the Citizen's Oil and Pipe Line Company from the field to Shreveport, where the gas was delivered for local consumption. During the latter half of 1906 a well was drilled to the west of the railway on Caddo Island to a depth of 2,285 feet. At this depth strong indications of 27° gravity oil were found. At this same time the Producers' Oil Company secured a well at about the same depth on Pine Island. This well flowed by heads. From existing knowledge it seems probable that there are 3 profitable horizons in the Caddo district, a light gas horizon at about 900 feet, a very strong gas horizon with some oil at about 1,500 feet, and a horizon with 27° gravity oil between 2,200 and 2,300 feet.

PRODUCTION, VALUE, AND SHIPMENTS OF LOUISIANA PETROLEUM.

In the following table will be found the quantity of crude petroleum produced in Louisiana from 1902 to 1906, inclusive, by months:

Production of petroleum in Louisiana, 1902–1906, by months, in barrels.

Month.	1902.	1903.	1904.	1905.	1906.		
					Jennings.	Other.	Total.
January		46,560	35,242	876,096	701,357	2,830	704,187
February		65,108	37,720	778,852	676,066	2,830	678,896
March		82,900	37,446	979,010	743,197	2,830	746,027
April		83,725	66,239	768,686	702,469	2,830	705,299
May	25,000	75,279	88,152	623,283	1,074,917	4,092	1,079,009
June	60,000	97,137	86,585	764,392	1,000,854	7,763	1,008,617
July	75,000	95,473	82,356	661,064	719,353	4,069	723,422
August	92,894	78,017	341,282	731,820	835,465	3,935	839,400
September	68,723	67,345	521,191	632,351	699,051	4,763	703,814
October	81,257	66,630	530,502	747,636	744,778	3,218	747,996
November	70,707	63,994	557,565	661,682	614,242	4,759	619,001
December	75,036	95,603	574,678	685,544	513,425	8,435	521,860
Total	548,617	917,771	2,958,958	8,910,416	9,025,174	52,354	9,077,528

In the following table is given a statement of production and value of crude petroleum in Louisiana, 1902 to 1906, by fields:

Production and value of petroleum in Louisiana, 1902–1906, by districts, in 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
1906	9,025,174	3,525,879	23,996	17,405	[a] 28,358	14,554	9,077,528	3,557,838

[a] Includes the production of Caddo district.

Average monthly price of crude petroleum per barrel at wells in the Jennings oil field in 1904, 1905, and 1906.

Month.	1904.	1905.	1906.
January	$0.30	$0.15-$0.20	$0.2339-$0.25
February	.30	.15- .20	.2414- .25
March	.40	.15- .22	.25 - .2761
April	$0.40- .50	.12- .22	.2565- .31
May	.46- .50	.12- .22	.30 - .33
June	.50- .52	.12- .20	.3404- .35
July	.45- .57	.12- .20	.3467- .38
August	.40- .50	.16- .20	.3525- .43
September	.30- .44	.18- .20	.3611- .48
October	.30- .46	.18- .23	.4026- .55
November	.22- .35	.20- .25	.448 - .60
December	.18- .33	.20- .27	.615 - .65
Average	.3589	.1788	.3906

The following table gives a statement of shipments of crude petroleum from stations on the line of the Louisiana Western Railroad Company and Kansas City Southern Railway in Louisiana during the year 1906, by months:

Rail shipments of crude petroleum from Jennings, Mermentau, Egan, Lake Charles, and Caddo stations, Louisiana, during the year 1906, by months, in barrels of 42 gallons.

Month.	Jennings.		Mermentau.		Egan.		Lake Charles.		Total.	
	Cars.	Quantity.	Cars.	Quantity.	Cars.	Quantity.	Cars.	Quantity.	Cars.	Quantity.
January	2,040	447,985	837	180,879	312	77,529	4	572	3,193	706,965
February	1,864	409,704	796	172,000	314	80,114	2	347	2,976	662,165
March	2,002	447,611	841	182,619	854	196,460	207	38,268	3,904	864,958
April	2,128	455,291	415	86,581	684	140,049	933	168,533	4,160	850,454
May	2,148	489,691	400	81,494	848	172,174	1,106	197,123	4,502	940,482
June	1,635	406,969	243	60,940	1,387	294,765	935	177,563	4,200	940,237
July	1,497	357,631	740	162,359	1,282	286,535	1,067	206,642	4,586	1,013,167
August	1,614	370,378	606	143,054	964	219,465	648	125,965	3,832	858,862
September	1,762	382,114	320	72,377	484	99,047	57	11,186	2,623	564,724
October	829	164,625	171	41,350	334	67,519	48	9,529	1,382	283,023
November	906	207,750	141	26,697	316	61,770	90	19,144	1,453	315,361
December	1,188	293,511	159	33,403	232	48,378	[a] 238	51,292	1,817	426,584
Total	19,613	4,433,260	5,669	1,243,753	8,011	1,743,805	5,335	1,006,164	38,628	8,426,982

[a] Includes 8 cars shipped from Caddo (Ananias).

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 conditions under which oil is prospected for in California are different from those in the other great oil fields of the United States. In California oil outcrops, or seepages of oil, have led to the discovery and development of most of the important districts.

The principal oil-bearing formations of California are of Tertiary age in the Miocene and Pliocene periods. These formations are of great thickness, amounting to many thousands of feet. They consist principally of shale, sandstones, and clays. These rocks are generally soft, although occasionally hard streaks, called "shells," are found, which usually contain some calcareous material. Sandstones are the porous medium in which the petroleum is mostly accumulated. Separate sandstone beds are often many hundreds of feet in thickness, though not uniformly saturated with petroleum throughout their full mass.

The sedimentary formations of California have been much disturbed owing to the thrusting up through them of the granite côres of the Sierra Nevada and the Coast Ranges. Along the flanks of these mountain ranges the sedimentary formations lie in tilted and distorted conditions. This tilted condition has brought the different beds to the surface, and it is along these outcrops that the indications of petroleum occur. These indications consist of rocks whose pores are completely filled by asphalt or by slowly seeping springs of petroleum. Faults and fissures in a formation often form seepages of petroleum from saturated porous strata below, which do not appear on the surface.

WELL DRILLING IN CALIFORNIA.

The conditions in California are unfavorable for the economical drilling of wells. The hard shells which exist in the soft rocks, and which must be passed through at an angle, have a tendency to change the direction of the holes, causing much expense and trouble from crooked holes. Most of the formations between the hard shells may be classified from the driller's point of view as "caving material." It is seldom that rock is found that will stand up and form good walls during the drilling of any considerable depth. To overcome these difficulties a number of changes are made in the rig and machinery used in California from the standard rig used in the eastern fields. The machinery is all heavier; the casing used is heavier; the rig is built with corner posts from base to crown, and is reenforced in a number of ways. In front of the band wheel is a second bull wheel, called the "calf wheel," from which runs a cable over an extra sheaf in the crown of the derrick. The "calf wheel" is used for handling the string of casing.

The caving condition of the material penetrated makes it necessary for the casing to follow immediately after the drill. The well is therefore drilled 20 or 30 feet, and then the sides of the holes below the casing are underreamed out and the casing is lowered. To keep the casing free and prevent it from binding by material lodged at the hard shells passed through, the full string of casing is moved up and down at short intervals. The extra weight and strength of the material and the increase of labor in underreaming and moving casings add greatly to the expense of the wells. In the Coalinga field wells between 2,000 feet and 3,000 feet in depth cost between $20,000 and $30,000.

DEVELOPED OIL AREAS.

The principal developed oil areas of California are within four counties—Kern and Fresno counties in the San Joaquin Valley and Santa Barbara and Los Angeles counties near the coast; in other counties, as Ventura, Orange, San Mateo, and San Luis Obispo, oil pools exist, but the production from them is comparatively small.

KERN COUNTY.

Kern County contains important oil pools upon both the west and the east side of the San Joaquin Valley. Upon the east side of the valley is the Kern River pool, and along the foothills of the Coast Range, on the west side of the valley, are the three districts of Sunset, Midway, and McKittrick.

Kern River pool.—The Kern River pool is situated 5 miles north of the city of Bakersfield, the surface being in the low foothills north of Kern River. This pool is one of the most important in the State, considered with reference to the quantity of oil already produced. The area was first prospected in June, 1899, and was rapidly developed during the remainder of that year and in 1900. At that time the limits of the pool were pretty well defined. The area now included within the oil-producing limits is about 4,800 acres.

The oil accumulation is found in a number of very loose sands lying from 450 to 1,000 feet below the surface. The material passed through before reaching the oil sands is first alluvium or drift, and then strata of blue clay, and of sands which carry water. Directly above the oil sands is a stratum of blue clay of variable thickness in different parts of the field. It is in this clay stratum that the casing shutting off the upper water is landed.

The combined thickness of the different oil sands is estimated in some cases to be as much as 300 feet. It is probable, however, that this estimate is excessive and that a thickness of less than 100 feet would be ample for the average of the field. Below the oil sands is a second water-carrying sand.

Within the pool, on January 1, 1907, there were 845 wells, of which 52 had been drilled during 1906. The drilling is not evenly distributed over the acreage, but is in bunches along property lines and upon the smaller leases. Of the total 4,800 acres about 2,600 acres may be said to be drilled.

In the different parts of the field water has entered the oil sands. It is probable that in some cases this water comes from the water stratum above the oil sands and finds its way down along the larger casing through the clay stratum above the oil; in other cases from the water stratum below the oil sands where the wells have been drilled too deep. The effect of the water is to add to the expense of producing the oil. A territory having gone to water can not be abandoned, as the water area would then rapidly enlarge. The continuous pumping of wells whose production is nine-tenths water is an expense that must be added to the cost of the production of oil from other wells. The final result of the entrance of water into the sand will be to improve the production in those parts of the field which are high, while the lower areas of oil-producing sand will go permanently to water. The area which now shows water within the oil sand is in all about 160 acres, divided into four different spots within the pool.

Sunset, Midway, and McKittrick pools.—The Sunset, Midway, and McKittrick oil pools are to the southwest of Bakersfield, about 40 miles across the San Joaquin Valley. They together extend for a distance of about 25 miles along the foothills of the mountains in a northwest-southeast direction. The oil is procured from light-colored siliceous shale, or from rocks adjacent to the shale. These formations have a dip of about N. 30° E. and are at an angle of inclination of 20° to 80°.

Sunset, the southernmost of these pools, furnishes a very heavy oil of from 10° to 12° Baumé. This oil is almost entirely consumed in the manufacture of asphalt and in the building of roads. Within the Sunset district are about 1,700 acres that may be considered as proved oil territory. The production from this field is shipped by tank cars on a branch of the Southern Pacific Railroad.

The Midway pool is the extension to the northwest from the Sunset. The area that will probably produce oil in the Midway pool is roughly determined as being between 10,000 and 12,000 acres. No oil from this area has been delivered to the market up to the present time. Negotiations are now in progress which will probably result in the laying of a pipe line into this field by the Standard Oil Company of California during the summer of 1907.

The McKittrick pool is to the northwest of Midway, although probably not a direct extension of that pool. The area that may be considered within the defined oil limits of this pool is about 2,000 acres. The oil produced at McKittrick is shipped by tank cars over a branch of the Southern Pacific Railroad.

FRESNO COUNTY.

The oil pools of Fresno County that have been developed up to the present time are at the eastern edge of the foothills of the Coast Range and on the western boundary of the San Joaquin Valley in the vicinity of Coalinga.

Coalinga district.—The Coalinga district may be divided into 3 separate pools—the Oil City pool, the East Side pool, and the West Side pool. These different pools derive their oil from different horizons and produce oil different in character and gravity.

The Oil City pool is situated in N. ½ sec. 20, T. 19 S., R. 15 E. The limits of the accumulation have been well defined, the total producing area covering about 160 acres. The depths of wells in this pool are from 900 to 1,700 feet, and they produce oil from sandstone of the Eocene period. The oil is of a clear, green color and of about 33 degrees gravity. The location of this pool is to the north and west of the outcrops of the formation which produces oil in the East Side and West Side pools.

The oil-producing formation of the East Side pool outcrops through secs. 2, 10, 16, and 21, and the south corner of sec. 20, T. 19 S., R. 15 E. From the south corner of sec. 20 a break in the formation extends in a southeast direction through secs. 28, 33, and 34. To the southeast of this outcrop and to the northeast of the break is the area of East Side pool. Within this area oil is produced from two horizons in the formation of the middle Neocene period, the oil of the upper horizon being from 26° to 28° gravity and of the lower horizon from 20° to 22° gravity. The formations dip from the outcrop to the southeast. On January 1, 1907, there were 149 wells within the East Side pool, mostly situated in secs. 22, 27, 28, and 34. The outlying wells have virtually proved a total of 3,600 acres, with the probability that this acreage will be doubled.

The outcrop of the oil-bearing formation of the West Side pool extends over sec. 20, T. 19 S., R. 15 E., through sec. 30, and into sec. 36, T. 19 S., R. 14 E. Thence south through the second tier of sections to the eastern edge of the township, and through sec. 1, T. 21 S., R. 14 E. Within this area, 2 miles to the east of the outcrop, is the West Side pool. The oil of this pool comes from loose sand formation, probably of the middle Neocene. The oil is black in color, and from 16 to 18° gravity, the oil growing lighter down the dip of the sand. On January 1, 1907, there were 137 wells in the West Side pool, mostly in sec. 31, T. 19, secs. 16 and 17, T. 19, and secs. 1 and 2, T. 20 S., R. 14 E. Within the oil-defined limits there are about 2,800 acres.

SANTA BARBARA COUNTY.

The Santa Maria pool is the most important in Santa Barbara County. It is situated 6 miles south of the town of Santa Maria. The structure of the formation is a completed dome upon an anticlinal ridge, which extends from northwest to southeast. Within the area of the oil pool are 2 horizons from which oil is produced. The first is at a depth of from 1,500 to 1,700 feet, and the second at a depth of from 2,400 to 3,200 feet. The lower horizon has produced some wells of enormous daily capacity. Within the Santa Maria pool, as now developed, is an area of about 2,800 acres.

South of the Santa Maria pool and north of the town of Lompoc an area has been tested and shown to be oil-bearing in paying quantities over a number of acres. This is known as the Lompoc pool, one that will probably furnish a large quantity of oil in the future, but up to the present time it has not been extensively developed. At Summerland, to the east of the city of Santa Barbara, oil has been produced for a number of years. This pool lies along the coast. It is defined in area and partly exhausted, the production for the year of 1906 being only 81,848 barrels.

LOS ANGELES COUNTY.

Los Angeles County has a number of oil pools. They are at Whittier, Puente, Los Angeles city, Salt Lake, and Newhall. The most important is at Salt Lake, situated to the west of the city of Los Angeles. The ground surface at this pool is covered with alluvial drift, and no information can be obtained as to the condition of the structure of the oil formation prior to the drilling of the wells. The first wells were drilled, owing to the presence of a large seepage and deposit of asphalt. During the year 1906 a number of wells were drilled in this pool with generally favorable results, though an increased production is not shown by the reports of the company operating within the field. The oil pools of Los Angeles County have maintained the general average of production during the year 1906 with but little new development work.

PRODUCTION AND CONSUMPTION.

During the year 1906 there were 33,098,598 barrels of oil produced within the State of California. This is a decrease of 328,875 barrels from the quantity produced during the preceding year. This falling off was in no way caused by exhaustion in the fields. For the five years preceding 1906, the quantity of oil produced each year in California increased at the rate of from about 4,000,000 to 10,000,000 barrels per year. The growth in consumption did not keep up with this tremendous rate of increase. The consequence was an accumulation of stocks and a resultant fall in price until the 33,427,473 barrels produced in the year 1905 sold for an average price of 24.5 cents per barrel. This price was less than the cost of production in the smaller pools and did not justify development in the larger pools. With this condition existing, great energy was displayed by those interested in the oil business to increase the market. This was shown in the establishment of a line of tank steamers for the transportation of crude oil and in the building by the Union Oil Company of a pipe line across the Isthmus of Panama to furnish cheap transportation for California oil to the Atlantic. The low price and the energy of those seeking contracts for the future delivery of crude oil soon raised the rate of consumption beyond that of production, making the year 1906 notable for increased consumption.

Contracts have been entered into for a large export trade with Japan, Hawaii, and Chile at prices not generally known. These contracts will call for millions of barrels to be delivered each year for some years to come. California has a large area from which oil can be produced, but when the cost of developing the pools and the future cost of raising the oil from the ground are considered, it is doubtful if the area is very large within which there will be a profit at a price less than $1 per barrel at the wells. At the present time a number of the pools are new and have the advantage of the gas pressure to assist in raising the oil, but this condition can not last for many years. The expense of pumping will probably be large in most of the great pools because of the loose sand from which the oil is procured and which may soon necessitate bailing instead of pumping.

The domestic consumption of oil is sure to increase, and will easily take care of the production as long as the price does not rise to a point where coal can be used upon the Pacific coast in competition.

During the year 1906 there were within the United States 10,290 miles of railroad operated by fuel oil, and 868 miles on which fuel oil was used in part. The total consumption of oil for this purpose amounted to 15,577,677 barrels. Exact figures as to how much of the oil thus consumed was produced in California are not obtainable, but a close estimate credits California with 9,563,314 barrels thus consumed. The use of petroleum as fuel in metallurgy is but just started; the consumption of oil for the maufacture of illuminating gas is already very large. All of these uses, with the ever increasing demand for fuel as a generator of steam, indicate that the domestic consumption of California fuel oil might easily grow to 50,000,000 barrels a year within the next few years. This quantity would in fifty years equal the enormous total of 2,500,000,000 barrels, which is many times the present probable supply.

In the following table will be found the production and value of crude petroleum in California for the years 1905 and 1906, by counties:

Production and value of crude petroleum in California in 1905 and 1906, by counties.

County.	1905.			1906.		
	Quantity (barrels).	Value.	Price per barrel.	Quantity (barrels).	Value.	Price per barrel.
Fresno	10,967,015	$2,657,009	$0.24	7,991,039	$1,848,300	$0.231
Kern	14,487,967	2,694,563	.186	14,520,854	3,342,760	.230
Los Angeles	3,469,433	930,349	.268	3,449,119	1,584,613	.459
Orange	1,429,688	673,383	.471	2,032,637	1,014,337	.499
Santa Barbara	2,684,837	1,015,620	.378	4,774,361	1,633,215	.342
Ventura	337,970	212,973	.63	299,124	119,275	.399
San Mateo / Santa Clara	50,563	17,949	.355	} 31,464	10,930	.347
San Luis Obispo	....	....	....			
Total	33,427,473	8,201,846	.245	33,098,598	9,553,430	.289

The following table shows the production of crude petroleum in California, by counties, from 1902 to 1906, inclusive:

Production of crude petroleum in California, 1902–1906, by counties, in barrels.

Year.	Fresno.	Kern.	Los Angeles.	Orange.	Santa Barbara.	Ventura.	Santa Clara.	San Mateo.	Total.
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
1906	7,991,039	14,520,864	3,449,119	2,032,637	4,774,361	299,124	[a] 31,464		33,098,598

[a] Includes oil produced in San Luis Obispo county.

WELL RECORD.

In the following table will be found the number of wells drilled in the different counties of California during the year 1906, with the number producing in each county at the beginning and the end of the year:

Well record in California, 1906, by counties.

County.	Wells January 1, 1906.			Wells drilled in 1906.		Wells abandoned in 1906.	Wells January 1, 1907.			Wells drilling January 1, 1907.
	Active	Idle.	Total.	Producing.	Dry.		Active.	Idle.	Total.	
Fresno	244	12	256	33	2	1	274	12	286	18
Kern	855	170	1,025	59	0	11	901	172	1,073	0
Los Angeles	695	137	832	42	3	126	711	37	748	5
Orange	161	0	161	14	0	2	173	0	173	1
Santa Barbara	228	30	258	17	0	0	245	30	275	36
Ventura	152	84	236	1	0	0	167	70	237	3
San Mateo / San Luis Obispo	4	6	10	1	2	0	5	6	11	....
Total	2,339	439	2,778	167	7	140	2,476	327	2,803	63

OTHER STATES.

WYOMING.

The oil developments in Wyoming during the year 1906 have been at a standstill. Fields capable of producing oil in commercial quantities are known in different parts of the State, but the lack of transportation facilities for the heavier grades of oil prevented any increase of production during 1906.

At Spring Valley, near the Union Pacific Railroad, a field capable of producing a light oil is known. The lack of a market has prevented development. A refinery is building in this district which will probably furnish a future market for the crude oil.

In the following table is found the production of petroleum in Wyoming from 1894 to 1906, inclusive:

Production of petroleum in Wyoming, 1894–1906.

1894	barrels..	2,369	1901	barrels..	5,400
1895	do....	3,455	1902	do....	6,253
1896	do....	2,878	1903	do....	8,960
1897	do....	3,650	1904	do....	11,542
1898	do....	5,475	1905	do....	8,454
1899	do....	5,560	1906	do....	[a] 7,000
1900	do....	5,450			

COLORADO.

The production of crude petroleum in Colorado during 1906 showed a decrease of 48,656 barrels as compared with the output of 1905.

In the following table is given the production of crude petroleum in the Florence and Boulder fields, by months, in 1905 and 1906:

Production of crude petroleum in the Florence and Boulder fields in 1905 and 1906, by months, in barrels.

Month.	1905.			1906.		
	Florence.	Boulder.	Total.	Florence.	Boulder.	Total.
January	36,063	950	37,013	23,561	2,618	26,179
February	31,721	961	32,682	23,225	2,834	26,059
March	33,338	1,280	34,618	25,515	2,334	27,849
April	32,629	1,600	34,229	24,475	2,740	27,215
May	32,122	640	32,762	25,730	2,904	28,634
June	29,358	1,100	30,458	24,011	2,173	26,184
July	27,691	730	28,421	25,435	3,290	28,725
August	29,188	943	30,131	24,122	6,415	30,537
September	29,583	405	29,988	20,445	5,728	26,173
October	28,268	946	29,214	20,208	4,990	25,198
November	27,075	565	27,640	19,316	4,630	23,946
December	28,700	382	29,082	22,587	8,296	30,883
Total	365,736	10,502	376,238	278,630	48,952	327,582

[a] Estimated shipments.

In the following table will be found the production and value of crude petroleum from the Boulder and Florence fields in Colorado from 1902 to 1906, inclusive:

Production and value of crude petroleum in Colorado, 1902–1906, by districts, in barrels.

Year.	Boulder.		Florence.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902	11,800	....	385,101	....	396,901	$484,683
1903	36,722	....	447,203	....	483,925	431,723
1904	18,167	$20,034	483,596	$558,001	501,763	578,035
1905	10,502	11,502	365,736	326,104	376,238	337,606
1906	48,952	53,847	278,630	208,828	327,582	262,675

MISSOURI AND MICHIGAN.

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 asphalt base. The oil of Jackson County is also of lubricating quality. It is very black in color and almost entirely free from grit.

At Port Huron, St. Clair County, Mich., 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.

Production of petroleum in Missouri, 1901–1906.

1901	barrels	[a] 2,335	1904	barrels	[b] 2,572
1902	do	[b] 757	1905	do	[b] 3,100
1903	do	[b] 3,000	1906	do	[b] 3,500

HAWAIIAN ISLANDS.

In the following table are given the exports of petroleum products to the Hawaiian Islands from 1903 to 1906, inclusive:

Exports of petroleum products to Hawaii from the United States, 1903–1906, in gallons.

Year.	Crude.		Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	21,858,588	$726,974	262,682	$33,412	1,372,570	$203,803	131,445	$50,232
1904	18,470,010	640,957	243,063	29,709	1,015,828	168,490	139,640	52,658
1905	31,904,340	i,112,939	320,703	39,069	892,094	142,313	195,850	61,605
1906	38,883,100	871,830	550,975	71,954	1,225,864	199,443	241,567	76,134

[a] Includes the production of Michigan and Oklahoma Territory.
[b] Includes the production of Michigan.

PHILIPPINE ISLANDS.

The following table shows the exports of petroleum products to the Philippine Islands in the fiscal years 1903 to 1906, inclusive:

Exports of petroleum from the United States into the Philippine Islands in the years ending June 30, 1903–1906, by kinds of oil, in gallons.

Year.	Naphtha.		Illuminating.		Lubricating.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	29,000	$5,715	2,803,101	$265,624	57,006	$8,309	2,889,107	$279,648
1904	50,210	9,995	3,294,020	385,171	102,721	23,717	3,446,951	418,883
1905	105,000	16,384	7,358,810	750,817	161,734	31,799	7,625,544	799,000
1906	450	82	1,641,178	169,978	232,017	40,044	1,873,645	210,104

PORTO RICO.

The following table shows the variety, quantity, and value of the petroleum products exported from the United States to Porto Rico in the years 1903 to 1906:

Exports of petroleum products from the United States to Porto Rico in the years 1903–1906, in gallons.

Year.	Crude.		Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903			3,463	$602	1,063,041	$123,947	98,520	$15,432
1904			14,515	2,073	1,096,751	132,656	117,702	23,185
1905			49,493	7,697	1,365,446	140,569	93,513	20,253
1906	16,585	$1,224	79,841	17,766	1,315,589	151,013	196,732	41,777

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 years ending December 31, 1905 and 1906:

Exports of mineral oils from the United States in 1905 and 1906, in gallons.

Port and kind.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
CRUDE.				
Delaware	71,012,602	$3,673,869	25,911,771	$1,473,863
New York	109,754	9,420	71,871	5,500
Philadelphia	10,034,152	612,207	62,636,172	3,812,319
Galveston	21,108,117	1,055,446	30,045,185	1,486,298
Other districts	23,920,562	734,650	29,380,316	953,246
Total	126,185,187	6,085,592	148,045,315	7,731,226
NAPHTHA.				
Baltimore	3,100	540	1,000	200
Boston and Charlestown	2,006	275	5,220	875
Delaware	110,697	9,810	41,565	3,824
New York	9,463,119	956,237	12,512,596	1,235,841
Philadelphia	17,248,998	1,091,486	12,553,774	969,880
Galveston	536	54		
Other districts	1,591,474	156,207	2,430,784	277,781
Total	28,419,930	2,214,609	27,544,939	2,488,401

Exports of mineral oils from the United States in 1905 and 1906, in gallons—Continued.

Port and kind.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
ILLUMINATING.				
Baltimore	26,346,654	$2,111,779	1,422,416	$114,485
Boston and Charlestown	502,637	58,216	338,603	42,018
Delaware	136,267	10,252	2,625	251
New York	496,113,191	34,278,624	499,427,210	34,301,950
Philadelphia	314,170,691	15,807,194	310,016,971	16,860,418
Galveston	21,560,273	1,352,445	16,519,394	993,751
Other districts	22,620,675	1,282,139	50,546,885	2,545,439
Total	881,450,388	54,900,649	878,274,104	54,858,312
LUBRICATING AND PARAFFIN.				
Baltimore	2,870,846	367,646	4,958,839	610,492
Boston and Charlestown	110,908	19,114	176,077	31,895
New York	77,564,888	10,175,530	94,329,314	12,358,999
Philadelphia	29,343,447	3,011,787	44,001,460	4,345,237
Galveston	1,011,417	133,088	3,249,545	454,941
Other districts	2,828,699	605,218	4,553,287	888,058
Total	113,730,205	14,312,383	151,268,522	18,689,622
RESIDUUM.				
Boston and Charlestown	428,712	21,507	535,000	26,750
Delaware	....	....	1,515,740	40,622
New York	15,500,729	472,918	13,428,198	421,510
Philadelphia	45,937,183	1,321,213	39,397,584	1,167,341
Galveston	4,865,327	147,746	8,415,971	253,744
Other districts	3,995,926	164,312	1,352,272	61,338
Total	70,727,877	2,127,696	64,644,765	1,971,305
Grand total	1,220,513,587	79,640,929	1,269,777,645	85,738,866

RECAPITULATION BY KINDS, IN GALLONS.

	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Crude petroleum	126,185,187	$6,085,592	148,045,315	$7,731,226
Naphtha	28,419,930	2,214,609	27,544,939	2,488,401
Illuminating oil	881,450,388	54,900,649	878,274,104	54,858,312
Lubricating oil and paraffin	113,730,205	14,312,383	151,268,522	18,689,622
Residuum	70,727,877	2,127,696	64,644,765	1,971,305
Total	1,220,513,587	79,640,929	1,269,777,645	85,738,866

RECAPITULATION BY PORTS, IN GALLONS.

Baltimore	29,220,600	$2,479,965	6,382,255	$725,177
Boston and Charlestown	1,044,263	99,112	1,054,900	101,538
Delaware	71,259,566	3,693,931	27,471,701	1,518,560
New York	598,751,681	45,892,729	619,769,189	48,323,800
Philadelphia	416,734,471	21,843,887	468,605,961	27,155,195
Galveston	48,545,670	2,688,779	58,230,095	3,188,734
Other districts	54,957,336	2,942,526	88,263,544	4,725,862
Grand total	1,220,513,587	79,640,929	1,269,777,645	85,738,866

Exports of mineral oils from the United States in 1906, by months, in gallons.

Month.	Quantity.	Value.
January	105,388,501	$7,181,075
February	83,419,308	5,903,950
March	121,057,768	8,254,308
April	102,709,172	7,086,456
May	97,719,615	6,628,878
June	101,792,884	7,269,580
July	97,769,026	6,504,755
August	118,850,290	7,797,486
September	110,519,609	7,210,036
October	112,135,050	7,614,155
November	112,173,412	7,311,543
December	106,243,010	6,976,644
Total	1,269,777,645	85,738,866

The following table exhibits the total production of crude petroleum from 1901 to 1906, 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 1901 to 1906, inclusive, in gallons.

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.	
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
1906	126,493,936	5,312,745,312	148,045,315	7,731,226	27,544,939	2,488,401

Year.	Exports.				Exports.			
	Mineral, refined or manufactured.							
	Illuminating.		Lubricating (heavy paraffin, etc.).		Residuum (tar, pitch, and all other, from which the light bodies have been distilled).		Total exports.	
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
1906	878,274,104	54,858,312	151,268,522	18,689,622	64,644,765	1,971,305	1,269,777,645	85,738,866

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, 1906:

Exports of petroleum in its various forms from the United States for the fiscal years 1903–1906, by countries and kinds, in gallons.

Country and kind.	Year ending June 30—			
	1903.	1904.	1905.	1906.
CRUDE.				
Europe:				
France	82,192,041	66,212,481	47,015,325	55,103,511
Germany	6,338,191	3,990,063	5,669,934	6,543,989
Netherlands	....	1,266,406	774,085	....
Spain	11,095,516	8,066,482	11,822,756	13,490,077
United Kingdom	17,769,325	12,021,692	14,075,577	19,131,352
Other Europe	8,166	100	529	1,250
Total	117,403,239	91,557,224	79,358,206	94,270,179
North America:				
Mexico	9,859,154	10,938,441	14,036,517	14,366,495
Cuba	5,119,813	6,212,648	7,440,234	6,266,626
Dominion of Canada	....	5,862,148	22,220,665	23,882,943
Other North America	2,505,014	3,580	3,073	45,192
Total	17,483,981	23,016,790	43,700,489	44,561,256
South America	4,950	....	315	850,180
All other countries	....	2,906	....	7,000
Total crude	134,892,170	114,576,920	123,059,010	139,688,615
REFINED.				
Naphtha.				
Europe:				
France	5,550,675	7,147,327	8,980,020	8,417,101
Germany	1,866,357	....	3,258,042	3,782,176
Sweden	....	284,302	268,354	259,648
United Kingdom	2,376,877	5,942,545	11,806,289	12,888,828
Other Europe	295,713	6,822	2,393,251	1,884,941
Total	10,089,622	13,380,996	26,705,956	27,232,694
North America	1,642,869	2,198,312	1,645,855	1,980,814
West Indies	23,231	34,601	32,042	80,338
South America	292,066	298,769	502,955	1,095,499
Asia and Oceania	913,336	794,264	1,572,965	1,664,071
Africa	178,104	203,179	356,882	703,278
Total	3,049,606	3,529,125	4,110,699	5,524,000
Total naphtha	13,139,228	16,910,121	30,816,655	32,756,694
Illuminating.				
Europe:				
Belgium	44,141,816	38,569,610	39,526,415	43,478,987
Denmark	17,566,033	22,162,981	15,550,986	18,120,251
France	5,326,633	3,843,527	9,875,589	22,739,414
Germany	111,336,427	113,069,001	126,577,304	110,336,514
Italy	24,175,999	12,736,187	23,048,026	28,979,309
Netherlands	116,817,141	111,328,359	110,037,453	123,208,276
Sweden and Norway	24,914,630	28,588,783	25,447,181	25,626,562
United Kingdom	149,281,493	165,248,727	174,057,928	190,383,239
Portugal	3,069,654	1,466,082	4.482,064	6,021,243
Other Europe	2,858,717	1,417,570	1,336,875	3,569,867
Total	499,488,543	498,430,827	529,939,821	572,463,662
North America:				
British North America	18,485,915	20,085,691	13,767,128	11,263,304
Central America	1,057,131	1,331,845	1,462,787	2,014,071
Mexico	342,000	409,266	461,266	2,095,939
West Indies—				
British	2,891,930	2,488,025	2,538,784	2,679,322
Other	2,723,404	2,912,099	3,728,017	2,901,690
Other North America	622,370	683,418	709,500	573,702
Total	26,122,750	27,910,344	22,667,482	21,528,028

Exports of petroleum in its various forms from the United States, etc.—Continued.

Country and kind.	Year ending June 30— 1903.	1904.	1905.	1906.
REFINED—continued.				
Illuminating—Continued.				
South America:				
Argentina	12,107,291	12,216,938	15,818,832	14,430,159
Brazil	20,116,287	19,403,726	21,389,827	24,198,146
Chile	4,679,976	5,756,672	5,945,330	7,263,136
Uruguay	3,027,675	3,185,700	2,918,600	4,286,600
Venezuela	825,059	1,263,622	1,259,776	1,236,512
Other South America	3,026,178	3,772,257	3,391,885	3,520,193
Total	43,782,466	45,598,915	50,724,250	54,934,746
Asia:				
Chinese Empire	19,321,930	40,614,179	89,368,014	54,376,377
Hongkong	16,971,990	22,308,570	18,660,090	5,561,590
East Indies—				
British	10,130,090	9,667,103	24,853,070	38,204,743
Dutch	9,210,520	10,924,890	9,798,770	12,039,360
Other East Indies	1,327,720	3,872,450	1,242,000	....
Japan	32,547,509	46,007,530	26,824,694	42,787,890
Other Asia	849,415	918,574	4,194,710	11,923,490
Total	90,359,174	134,313,296	174,941,348	164,893,450
Oceania:				
British Australasia	22,953,588	18,212,764	21,633,821	20,618,140
Philippine Islands	2,803,101	3,294,020	7,358,810	1,641,178
Other Oceania	12,435	11,056	4,770	1,370
Total	25,769,124	21,517,840	28,997,401	22,260,688
British Africa	12,287,696	10,609,429	11,621,470	13,477,323
Other Africa	1,997,448	3,186,435	3,990,181	14,803,313
Total illuminating	699,807,201	741,567,086	822,881,953	864,361,210
Lubricating.				
Europe:				
Belgium	5,431,086	4,473,379	6,212,754	12,719,017
France	8,622,352	6,793,879	8,755,856	19,007,626
Germany	11,670,529	11,421,404	12,385,112	19,229,818
Italy	2,925,126	2,961,857	3,528,671	4,974,497
Netherlands	6,161,447	5,424,718	6,569,410	9,485,260
United Kingdom	34,854,074	33,890,901	35,571,115	46,245,278
Other Europe	2,740,415	2,864,739	3,514,778	5,736,974
Total	72,405,029	67,830,877	76,537,696	117,398,470
North America	2,606,388	2,709,577	2,603,403	3,244,991
West Indies	616,721	830,913	786,106	941,191
South America	3,115,266	3,470,324	3,621,853	4,840,251
Asia and Oceania	12,569,338	11,864,610	11,798,775	16,622,725
Africa	2,005,515	2,103,829	2,009,363	3,063,074
Total	20,913,228	20,979,253	20,819,500	28,712,232
Total lubricating	93,318,257	88,810,130	97,357,196	146,110,702
Residuum (barrels).				
Europe	532,880	511,779	1,101,804	1,688,741
North America	9,654	24,131	59,768	95,451
All other countries	359	1,245	3,889	2,280
Total residuum	542,893	537,155	1,165,461	1,786,472

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 1906, in bulk and cases at New York and in barrels at Philadelphia, in 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 6	4.70	10.35	7.60	July 7	4.60	10.35	7.80
January 13	4.70	10.35	7.60	July 14	4.60	10.35	7.80
January 20	4.70	10.35	7.60	July 21	4.60	10.35	7.80
January 27	4.70	10.35	7.60	July 28	4.60	10.35	7.80
February 3	4.70	10.35	7.60	August 4	4.50	10.15	7.60
February 10	4.70	10.35	7.60	August 11	4.50	10.15	7.60
February 17	4.70	10.35	7.60	August 18	4.50	10.15	7.60
February 24	4.70	10.35	7.60	August 25	4.50	10.15	7.65
March 3	4.70	10.35	7.60	September 1	4.40	10.05	7.50
March 10	4.70	10.35	7.60	September 8	4.40	10.05	7.50
March 17	4.70	10.35	7.60	September 15	4.40	10.05	7.50
March 24	4.70	10.35	7.60	September 22	4.40	10.05	7.50
March 31	4.70	10.35	7.61	September 29	4.40	10.05	7.50
April 7	4.70	10.35	7.60	October 6	4.40	10.05	7.50
April 14	4.70	10.35	7.60	October 13	4.40	10.05	7.50
April 21	4.70	10.35	7.60	October 20	4.40	10.15	7.50
April 28	4.70	10.35	7.60	October 27	4.40	10.15	7.50
May 5	4.70	10.35	7.60	November 3	4.40	10.15	7.50
May 12	4.70	10.35	7.80	November 10	4.40	10.15	7.50
May 19	4.70	10.35	7.80	November 17	4.40	10.15	7.50
May 26	4.60	10.35	7.80	November 24	4.40	10.15	7.50
June 2	4.60	10.35	7.80	December 1	4.40	10.15	7.50
June 9	4.60	10.35	7.80	December 8	4.40	....	7.50
June 16	4.60	10.35	7.80	December 15	4.40	....	7.50
June 23	4.60	10.35	7.80	December 22	4.40	....	7.50
June 30	4.60	10.35	7.80	December 29	4.40	....	7.50

Wholesale prices of refined petroleum at New York at the first of each month, 1902–1906.

Month.	1902. Date.	1902. Cents per gallon. In barrels.	1902. Cents per gallon. In cases.	1903. Date.	1903. Cents per gallon. In barrels.	1903. Cents per gallon. In cases.	1904. Date.	1904. Cents per gallon. In barrels.	1904. Cents per gallon. In cases.	1905. Date.	1905. Cents per gallon. In barrels.	1905. Cents per gallon. In cases.	1906. Date.	1906. Cents per gallon. In barrels.	1906. Cents per gallon. In cases.
January	1	7.20	8.30	7	8.30	10.60	6	9.10	11.80	4	7.65	10.35	3	7.60	10.30
February	5	7.20	8.30	4	8.20	10.50	3	9.10	11.80	1	7.25	9.95	7	7.60	10.30
March	5	7.20	8.30	4	8.20	10.50	2	8.75	11.40	1	7.25	9.95	7	7.60	10.30
April	2	7.20	8.30	1	8.35	10.50	6	8.50	11.20	5	7.15	9.85	4	7.60	10.30
May	6	7.40	8.50	6	8.35	10.50	4	8.15	10.85	3	6.95	9.65	2	7.60	10.30
June	4	7.40	8.50	3	8.55	10.50	1	8.15	10.85	7	6.90	9.60	6	7.80	10.30
July	2	7.40	8.50	1	8.55	10.50	6	7.95	10.65	5	6.90	9.60	6	7.80	10.30
August	6	7.20	8.50	5	8.55	10.50	3	7.70	10.40	2	6.90	9.60	2	7.80	10.30
September	3	7.20	8.50	3	8.55	10.50	7	7.85	10.55	6	6.90	9.60	7	7.50	10.00
October	1	7.20	8.50	7	8.80	11.50	5	7.95	10.65	4	7.60	10.30	6	7.50	10.00
November	5	7.45	8.75	4	9.20	11.90	2	7.95	10.65	1	7.70	10.40	3	7.50	10.00
December	3	7.90	9.20	2	9.50	12.20	7	7.95	10.65	6	7.60	10.30	1	7.50	10.00

Monthly average prices, in cents per gallon, of petroleum exported from the United States in bulk, 1903–1906.

Month.	1903.		1904.		1905.		1906.	
	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.
January	5.4	7.4	6.4	8.1	5.3	6.6	5.4	6.4
February	3.9	7.1	6.1	8.7	5.4	6.2	5.3	6.2
March	6.0	7.0	5.9	8.3	5.3	6.8	5.3	6,4
April	4.8	7.2	6.3	7.5	4.5	7.0	5.2	6.5
May	5.4	7.4	5.7	7.8	4.6	5.9	5.1	6.2
June	5.6	6.9	5.8	7.8	4.9	5.9	5.2	6.3
July	5.4	7.1	5.9	7.1	4.8	5.9	5.1	6.8
August	5.7	7.0	5.4	7.5	4.1	6.1	5.3	6.3
September	4.5	7.3	5.0	7.9	4.7	5.8	4.9	6.2
October	5.7	8.0	5.6	7.7	4.8	6.2	5.2	6.0
November	6.1	7.9	5.2	7.1	4.5	6.5	5.2	6.3
December	5.5	8.6	5.8	6.9	5.1	6.4	5.3	5.9

Prices of American refined petroleum at Antwerp, Bremen, London, and Liverpool in 1905 and 1906.

	Antwerp (francs per 100 kilograms).		Bremen (marks per 50 kilograms).		London (pence per imperial gallon).		Liverpool (pence per imperial gallon).	
	1905.	1906.	1905.	1906.	1905.	1906.	1905.	1906.
January 1 to 15	19	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{2}$	$6\frac{7}{8}$–$6\frac{1}{4}$	$6\frac{1}{4}$	....
January 15 to 31	19 –$18\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{2}$–$5\frac{3}{8}$	$6\frac{1}{4}$	$6\frac{1}{4}$–6	....
February 1 to 14	$18\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{3}{8}$	$6\frac{1}{4}$–6	6	....
February 14 to 29	$18\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{3}{8}$–$5\frac{1}{8}$	6	6	....
March 1 to 15	$18\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$	6	6	....
March 15 to 31	$18\frac{1}{2}$–$18\frac{1}{4}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$	6	6	....
April 1 to 15	$18\frac{1}{4}$–$17\frac{3}{4}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$	6 –$6\frac{1}{4}$	6 –$5\frac{3}{4}$	....
April 15 to 30	$17\frac{3}{4}$–$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$	$6\frac{1}{4}$	$5\frac{3}{4}$	....
May 1 to 15	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$	$6\frac{1}{4}$	$5\frac{3}{4}$	....
May 15 to 31	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$	$6\frac{1}{4}$	$5\frac{3}{4}$	....
June 1 to 15	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{8}$–$5\frac{1}{4}$	$6\frac{1}{4}$	$5\frac{3}{4}$	....
June 15 to 30	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{4}$–$5\frac{1}{2}$	$6\frac{1}{4}$	$5\frac{3}{4}$–6	....
July 1 to 15	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{1}{2}$–$5\frac{7}{8}$	$6\frac{1}{4}$	6– $5\frac{7}{8}$	....
July 15 to 31	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{7}{8}$–$5\frac{3}{4}$	$6\frac{1}{4}$	$5\frac{7}{8}$–6	....
August 1 to 15	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{3}{4}$–$5\frac{5}{8}$	$6\frac{1}{4}$–$6\frac{1}{2}$	6	....
August 15 to 31	$17\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$5\frac{5}{8}$–$5\frac{3}{4}$	$6\frac{1}{2}$	6	....
September 1 to 15	$17\frac{1}{2}$–18	$19\frac{1}{2}$	6.35	6.35	$5\frac{5}{8}$–$5\frac{3}{4}$	$6\frac{1}{2}$	6	....
September 15 to 30	18 –19	$19\frac{1}{2}$	6.35	6.35	$5\frac{5}{8}$–$6\frac{7}{8}$	$6\frac{1}{2}$	6	....
October 1 to 15	19	$19\frac{1}{2}$	6.35	6.35	$5\frac{7}{8}$–7	$6\frac{1}{2}$	6 –$6\frac{3}{4}$	....
October 15 to 31	19 –$19\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$6\frac{3}{4}$–$6\frac{7}{8}$	$6\frac{1}{2}$	$6\frac{3}{4}$–$6\frac{7}{8}$	....
November 1 to 15	$19\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$6\frac{3}{4}$–$7\frac{1}{8}$	$6\frac{1}{2}$	$6\frac{7}{8}$–$7\frac{1}{4}$	....
November 15 to 30	$19\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$7\frac{1}{8}$–$7\frac{5}{8}$	$6\frac{1}{2}$	$7\frac{1}{4}$–8	....
December 1 to 15	$19\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$7\frac{5}{8}$–$6\frac{7}{8}$	$6\frac{1}{2}$	8	....
December 15 to 31	$19\frac{1}{2}$	$19\frac{1}{2}$	6.35	6.35	$6\frac{7}{8}$–$6\frac{5}{8}$	$6\frac{1}{2}$	8 –$7\frac{1}{2}$	....

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.

PRODUCTION OF FOREIGN COUNTRIES OF THE WESTERN HEMISPHERE.

CANADA.

Production.—In the following table is given the total production of crude petroleum in Canada from 1902 to 1906, inclusive, as reported by the Geological Survey of Canada:

Production of crude petroleum in Canada, 1902–1906.

Year.	Quantity (barrels).	Value.	Average price per barrel.
1902	[illegible]	[illegible]	[illegible]
1903	[illegible]	[illegible]	[illegible]
1904	[illegible]	[illegible]	[illegible]
1905	[illegible]	[illegible]	[illegible]
1906	[illegible]	[illegible]	[illegible]

Prices.—The average monthly prices per barrel from 1904 to 1906, 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, 1904–1906.

Month.	1904.	1905.	1906.	Month.	1904.	1905.	1906.
January	[illegible]	[illegible]	[illegible]	August	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	September	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	October	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	November	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	December	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]				
July	[illegible]	[illegible]	[illegible]	The year	[illegible]	[illegible]	[illegible]

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 1906:

Production of petroleum in Zorritos oil field of Peru, 1901–1906, in gallons.

Year.	Crude petroleum.	Refined.	Benzine and gasoline.
1901	[illegible]	[a] [illegible]	[illegible]
1902	[illegible]	[a] [illegible]	[illegible]
1903	[illegible]	[a] [illegible]	[illegible]
1904	[illegible]	[a] [illegible]	[illegible]
1905	[illegible]	[a] [illegible]	[illegible]
1906	[illegible]	[a] [illegible]	[b] [illegible]

[a] Kerosene. [b] Includes [illegible] gallons of benzine.

FOREIGN COUNTRIES OF THE EASTERN HEMISPHERE.

RUSSIA.

In the following table is given the total production from the Russian oil fields of Baku and Groznyi in poods,[a] and also in barrels, for the years 1903 to 1906. This table shows an increase in the year 1906 as compared with 1905 of 4,083,559 barrels.

Production of crude petroleum in Russia, 1903–1906, by fields.

Year.	Baku.		Groznyi.		Total.	
	Poods.	Barrels of 42 gallons.	Poods.	Barrels of 42 gallons.	Poods.	Barrels of 42 gallons.
1903	596,581,155	71,618,386	33,094,000	3,972,870	629,675,155	75,591,256
1904	614,115,445	73,723,290	40,095,331	4,813,365	654,210,776	78,536,655
1905	414,762,000	49,791,356	43,057,052	5,168,914	457,819,052	54,960,270
1906	447,520,000	53,723,889	39,594,100	4,753,193	[a] 491,835,100	59,043,829

[a] Includes 4,721,000 poods, or 566,747 barrels, produced in Bereki and Tchimion oil fields in 1906.

The total production of crude petroleum in the Apsheron Peninsula and the shipments of the chief petroleum products from Baku to all points from 1902 to 1906 have been as follows:

Total production of crude petroleum on the Apsheron Peninsula and shipments of petroleum products from Baku, 1902–1906, in barrels.

Year.	Production.	Shipments from Baku.					
		Illuminating.	Lubricating.	Other products.	Residuum.	Crude oil.	Total.
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
1906	53,723,889	8,941,125	1,847,799	179,289	22,697,667	4,001,441	37,667,321

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, 1902–1906, in barrels.

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
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
1906	8,142,017	18,739,015	11,489,796	15,317,647	35,414	53,723,889

[a] 8.33 poods crude=1 United States barrel of 42 gallons.
8 poods illuminating oil=1 United States barrel of 42 gallons.
8.18 poods lubricating oil=1 United States barrel of 42 gallons.
9 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.

The following table shows the deliveries of petroleum and petroleum products from the Groznyi district in 1906:

Deliveries of petroleum and petroleum products from the Groznyi district in 1906.

Crude oil ....barrels..	150, 825	Benzine..............barrels..	178, 568
Kerosene...............do....	363, 649	Residuals...............do....	2, 462, 484

The shipments from Novorossisk are estimated at 901,798 barrels in 1906 against 1,770,363 barrels in 1905.

Well record.—In the table following is given a statement of the number and condition of the wells on the Apsheron Peninsula on December 31, 1905 and 1906:

Number and condition of wells in the Baku fields in years ending December 31, 1905 and 1906.

Condition of wells.	Balakhani-Sabunchi.		Romani.		Bibi-Eibat.		Total.	
	1905.	1906.	1905.	1906.	1905.	1906.	1905.	1906.
Completed	98	107	23	40	33	29	154	176
Producing	607	1,863	110	366	151	372	[a] 880	[a] 2,613
Trial pumping	9	395	1	108	4	124	14	627
Drilling	63	345	27	96	51	270	141	711
Drilling deeper	41	104	27	28	23	77	91	209
Cleaning out and repairing	14	336	18	163	14	178	46	677
Standing idle	1,936	1,243	286	227	194	329	[b] 2,423	1,799
Rigs up, ready for drilling	33	122	7	30	13	44	53	196
New wells sunk	74	155	30	37	36	57	140	249
Length of wells drilled, in feet	117,285	164,976	48,475	57,694	83,881	114,058	249,641	336,728

[a] Includes 12 wells in Binagadi. [b] Includes 7 wells in Binagadi.

Stocks in Baku field.—The stocks of petroleum and petroleum products in the Baku field at the close of 1906 were as follows:

Stocks of petroleum in Baku, January 1, 1907.

At oil wells: Crude....................barrels..	930, 965
At refineries:	
Crude....................do....	2, 187, 339
Illuminating....................do....	953, 751
Lubricating....................do....	387, 217
Residuals....................do....	4, 669, 882
Other products....................do....	92, 762
Total....................do....	9, 221, 916

Stocks at Batum.—The following were the stocks of petroleum products held at Batum at the close of the years 1905 and 1906, in poods and barrels:

Stocks of petroleum at Batum, December 31, 1905 and 1906.

	1905.			1906.	
	Poods.	Barrels.		Poods.	Barrels.
Kerosene	2,834,901	308,140	Illuminating	4,408,999	551,125
Distillate	18,804	2,040	Lubricating	1,160,168	141,830
Solar oil	430,993	46,850	Residuals	257,217	28,580
Machine oil	33,035	14,460			
Machine distillate	19,642	2,790			
Cylinder oil	19,859	2,160			
Lubricating oil	14,192	1,540			
Mazoot	207,213	20,721			
Crude oil	5,597	650			
Total	3,584,236	399,351	Total	5,826,384	721,535

Prices.—The range of prices per barrel of petroleum at Baku in 1906 was approximately as follows: Refined petroleum for the inland trade was quoted at $3.90 per barrel early in January, rose to $4.90 about the middle of April, fell gradually to $3.76 early in June, rose to $6.27 in the middle of August, and fell to $4.07 in December, closing at that rate. Refined petroleum for the export trade was quoted at $4.50 per barrel on March 6, rose to $4.62 about April 1, fell to $3.76 by June 5, rose to $6.34 about the middle of August, and fell gradually during the remainder of the year, closing at $3.96 in December. Crude petroleum was quoted at about $3.34 per barrel during January, rose gradually during February and March to $4.73 on March 27, fell during April and May to $3.75 on June 5, rose during June, July, and August to $5.55 on August 28, and fell gradually to $3.58 on November 27, closing on December 25 at $3.75. Residuals sold on January 9 at $3.35 per barrel, rose to $5.46 by the first of April, fell gradually to $4.58 on June 5, rose to $6.30 about the middle of September, fell to $3.96 in November, and rose again slightly, closing with the end of the year at $4.27.

AUSTRIA-HUNGARY.

In the following table is given the production of petroleum in Galicia during the year 1906, by districts and months:

Production of crude petroleum in Galicia in 1906, by districts and months, in metric tons.[a]

District.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Boryslaw	41,586	37,559	46,042	50,718	45,360	46,100	48,790	44,270	48,270	50,703	53,800	49,000	562,198
Schodnica	4,290	4,127	4,294	4,140	4,270	4,120	4,070	4,250	3,620	3,340	3,280	3,350	47,151
Urycz	1,400	1,226	1,247	1,240	1,270	1,240	1,220	1,140	1,470	1,510	1,480	3,587	17,930
Other eastern districts	1,150	1,220	1,170	1,130	1,080	1,070	1,170	1,200	1,090	1,220	1,200	1,130	13,830
Potok	1,611	1,374	1,704	1,418	1,310	1,290	1,370	1,210	1,110	1,224	1,294	1,410	16,325
Rogi	1,168	1,647	2,154	1,935	1,152	855	790	640	460	349	170	132	11,452
Rowne	146	115	81	89	191	133	93	145	128	178	117	120	1,536
Tarnawa	2,548	2,344	2,305	1,504	1,528	1,781	2,920	2,250	2,040	2,020	2,120	1,510	24,870
Krosno	3,383	2,694	3,119	2,618	4,919	3,170	2,500	2,400	2,140	2,359	2,898	2,068	34,268
Other western districts	2,848	2,985	2,627	2,678	2,900	2,880	2,800	2,600	2,240	2,210	2,225	1,790	30,883
Total	60,130	55,291	64,743	67,470	63,980	62,639	65,723	60,105	62,568	65,113	68,584	64,097	760,443

[a] The following are the equivalents in weight:
1 metric ton=2,204.62 pounds.
1 metric ton=7.1905 barrels of crude petroleum of 42 gallons=2,204.62 pounds.
1 metric centner / 1 quintal } =100 kilograms (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.

In the following table is given a statement of the production of crude petroleum in Galicia from 1901 to 1906, inclusive, as ascertained by the statistical bureau of the Galizischer Landes-Petroleum-Verein, Lemberg:

Production of crude petroleum in Galicia, 1901–1906.

Year.	Metric centners.	Barrels of 42 gallons.	Year.	Metric centners.	Barrels of 42 gallons.
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
1903	7,279,710	5,234,475	1906	7,604,432	5,467,967

ROUMANIA.

Production.—In the following table is given the production of Roumania, by districts and months, during the year 1906, in metric tons:

Production of crude petroleum in Roumania in 1906, by districts and months, in metric tons.[a]

Month.	District Prahova.					Dimbovitza.	Buzeu.	Bacau.	Total.
	Bustenari.	Campina-Poiana.	Moreni.	Other.	Total.				
January	37,767	7,032	8,040	2,165	55,004	1,606	1,037	787	58,434
February	35,337	6,067	5,840	4,692	51,936	1,639	867	773	55,215
March	40,897	7,434	10,095	5,807	64,233	1,548	1,031	792	67,604
April	38,675	12,896	13,329	6,810	71,710	1,372	994	713	74,789
May	43,678	8,956	12,642	9,685	74,961	1,568	967	721	78,217
June	42,798	10,226	12,441	6,668	72,133	1,524	1,025	570	75,252
July	44,256	10,306	13,431	6,384	74,377	1,590	1,155	736	77,858
August	44,565	7,417	14,391	6,210	72,583	1,593	989	826	75,991
September	44,861	7,319	15,995	5,134	73,309	1,507	947	793	76,556
October	45,535	7,061	18,679	6,515	77,790	1,471	903	797	80,961
November	44,996	8,958	16,878	6,792	77,624	2,136	908	787	81,455
December	46,630	8,476	21,045	4,378	80,529	2,588	857	785	84,759
Total	509,995	102,148	162,806	71,240	846,189	20,142	11,680	9,080	887,091

[a] 1 metric ton=7.19 barrels of 42 gallons.

This total of 887,091 metric tons is equivalent to 6,378,184 barrels of 42 gallons.

The production of crude petroleum in Roumania in the last five years has been as follows:

Production of crude petroleum in Roumania, 1902–1906.

Year	Unit	Quantity
1902	barrels	2,059,935
1903	do	2,763,117
1904	do	3,599,026
1905	barrels	4,420,987
1906	do	6,378,184

Consumption and export.—The domestic consumption of Roumania in 1906 is reported as approximately 2,215,156 barrels. The exports for the year are reported as approximately 2,128,573 barrels of refined oils and 383,759 barrels of crude, residuum, etc., a total of 2,512,332 barrels.

GERMANY.

In the following table is shown the quantity and value of petroleum produced in the German Empire, by States, from 1901 to 1906, inclusive:

Production and value of petroleum in the German Empire, 1901–1906, by states.

Year.	Alsace-Lorraine. Quantity.	Prussia and Bavaria. Quantity.	Total. Quantity.		Total value.	
	Metric tons.	*Metric tons.*	*Metric tons.*	*Barrels (42 gallons).*	*Marks.*	*Dollars.*
1901	19,997	24,098	44,095	313,630	2,950,478	702,213
1902	20,205	29,520	49,725	353,674	3,351,000	797,538
1903	20,947	41,733	62,680	445,818	4,334,000	1,031,492
1904	22,016	67,604	89,620	637,431	5,805,000	1,381,590
1905	21,128	57,741	78,869	560,963	5,207,000	1,239,266
1906	....	....	81,419	579,101	5,040,000	1,199,520

1 metric ton, crude=7.1126 barrels.

ITALY.

In the following tables will be found the production of crude petroleum in Italy from 1901 to 1905, 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, 1901–1905.

Year.	Number of wells in operation.	Quantity. Metric tons.	Quantity. United States barrels.	Value. Lire.	Value. Dollars.	Number of workmen employed.
1901	9	2,246	16,150	671,065	129,515	227
1902	9	2,633	18,933	778,163	150,185	252
1903	10	2,486	17,876	737,293	142,298	282
1904	10	3,543	25,476	1,053,294	203,286	367
1905	9	6,123	44,027	1,826,802	352,573	367

GREAT BRITAIN.

Oil shale.—In the following table is shown the production of oil shale in Great Britain in 1904 and 1905, taken from the Mineral statistics of the United Kingdom:

Quantity and value of oil shale in Great Britain, 1904–1905, in long tons.

Country.	1904. Quantity.	1904. Value.	1905. Quantity.	1905. Value.
England	....	....	2,000	$2,920
Scotland	2,331,885	$2,695,302	2,493,081	2,881,343
Wales	1,177	2,146	1,704	2,900
Total	2,333,062	2,697,448	2,496,785	2,887,163

The production of crude petroleum in the United Kingdom amounted to 46 long tons, valued at $336, in the year 1905. This was obtained from Dumbartonshire, Scotland.

Imports of refined oil from the United States.—As reported by the Bureau of Statistics of the Department of Commerce and Labor, the exports of refined petroleum from the United States to the United Kingdom during the last three years have been as follows: 1904, 201,242,284 gallons (United States), valued at $14,307,351; 1905, 248,411,214 gallons, valued at $14,804,301; 1906, 249,804,745 gallons, valued at $15,445,423.

INDIA.

The following table gives the production of petroleum in India from 1902 to 1906, in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1902-1906.

Year.	Quantity.		Value.	
	Imperial gallons.	Barrels (42 United States gallons).	Rupees.[a]	Dollars.
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
1906	140,553,122	4,015,803	8,613,576	2,790,799

[a] The value of the rupee is taken as 32.4 cents.

Imports of refined petroleum from the United States.—The Bureau of Statistics of the Department of Commerce and Labor reports the exports of refined petroleum from the United States to the British East Indies during the last three years as follows: 1904—24,724,560 gallons (United States), valued at $2,672,485; 1905—38,196,195 gallons, valued at $2,891,376; 1906—47,233,652 gallons, valued at $3,204,552.

DUTCH EAST INDIES.

In the following table is given the production of crude petroleum in the Dutch East Indies for the last four years:

Production of crude petroleum in Dutch East Indies for the years 1903 to 1906, inclusive.

1903	barrels..	6,640,000	1905	barrels..	7,334,310
1904	do...	6,316,169	1906	do...	7,399,024

The production of Java in 1906 is reported as 807,681 barrels, against 798,498 barrels in 1905 and 793,091 barrels in 1904.

JAPAN.

No official figures have been received from Japan for the production of crude petroleum in 1906. The estimated production was 1,341,157 barrels. The production from 1902 to 1905, inclusive, has been reported as follows:

Production of crude petroleum in Japan, 1902-1905.

1902	barrels..	1,193,038	1904	barrels..	1,418,767
1903	do...	1,209,371	1905	do...	1,341,157

WORLD'S PRODUCTION.

The following table gives the figures of the world's production of crude petroleum from 1902 to 1906, inclusive. The slight decrease in production noted in 1905 as against 1904 appears also in 1906 as against 1905. This is due in 1906 chiefly to the decrease in output in the United States.

World's production of crude petroleum, 1902-1906.

[Barrels of 42 United States gallons.]

Country.	1902.	1903.	1904.	1905.	1906.
United States	88,766,916	100,461,337	117,080,960	134,717,580	126,493,936
Russia	80,540,045	75,591,256	78,536,655	54,960,270	59,043,829
Sumatra, Java, and Borneo	5,860,000	6,640,000	6,316,169	7,334,310	7,399,024
Galicia	4,142,159	5,234,475	5,947,383	5,765,317	5,467,967
Roumania	2,059,935	2,763,117	3,599,026	4,420,987	6,378,184
India	1,617,363	2,510,259	3,385,468	4,137,098	4,015,803
Japan	1,193,038	1,209,371	1,418,767	1,341,157	[a] 1,341,157
Canada	530,624	486,637	552,575	634,095	569,753
Germany	353,674	445,818	637,431	560.963	579,101
Peru	59,274	49,048	49,524	37,720	42,419
Italy	18,933	17,876	25,476	44,027	[a] 50,000
All others	26,000	30,000	40,000	[a] 30,000	[a] 30,000
Total	185,167,961	195,439,194	217,589,434	213,983,524	211,411,173

[a] Estimated.

CEMENT.

ADVANCES IN CEMENT TECHNOLOGY, 1906.

By Edwin C. Eckel.

INTRODUCTION.

The year 1906 was a prosperous and satisfactory year for the American cement industry, being marked by increases both in production and in profits. The year was notable, moreover, for certain developments of both industrial and technologic importance, which seem calculated to have an important effect on the future of the industry. In a later section of this report the statistics of production and value, arranged by States, are presented in tabular form. In the present section an attempt will be made to use these statistics as a basis for discussion of points which seem of general interest and importance.

GROWTH OF THE PORTLAND-CEMENT INDUSTRY.

Before taking up matters which relate specificially to the Portland-cement industry, it will be of interest to compare its growth with that of a nearly related industry—the manufacture of pig iron. This is done graphically in fig. 2, reproduced in revised form from the Engineering Magazine, which shows what may be called the "growth curves" of the two industries for the period 1890–1906, inclusive. The figures on which this diagram is based are official, except for the present year, where estimated quantities are given.

The diagram is, of course, distorted to the extent that, while the pig-iron production is given in long tons (of 2,240 pounds), the cement output is stated in barrels (of 380 pounds). But this distortion does not affect the value of the diagram when used for its present purpose—a comparison of the form of the two growth curves.

On examination it will be seen that the cement curve rises steadily at an increasing ratio each year, showing no downward flexures or relapses. This is the normal form for the growth curve of a young and rapidly expanding industry. The iron curve, on the other hand, though showing a decided gain for the period covered, also shows at intervals depression flexures, typical of a mature industry, whose annual output must now depend on the general financial and industrial condition of the country.

The cement output, as yet, has not suffered markedly from financial depressions. Prices have fallen off in poor years, it is true, but the annual output has always increased. The rise in yearly output from

1885 to 1906 has not only been continuous, but has even shown a tendency to increase its *rate* of increase. Of course, such a condition of the industry can not be expected to continue indefinitely. Within a few years we must expect to see the rate of increase lowered, and finally, in some period of business depression, some year will show a lower output than the preceding year. This will mark the end of the youth of the cement industry and the beginning of its period of maturity. Though the present condition of the industry is as prosperous as might be desired, it is entirely possible that the change in rate of growth may be near at hand. The new construction of 1906 and plants to be built in 1907 will provide a great increase in mill capacity. If the succeeding years are generally good this increase will be taken up without difficulty, but a general financial depression in 1908 would probably result in a temporary and, perhaps, a severe check to the cement industry. So far as can be estimated now, the plants which will be in operation before the end of 1907 will turn out cement at the rate of over 55,000,000 barrels per annum, and it is doubtful whether such an output could be absorbed if the business affairs of the United States were not in a generally prosperous condition.

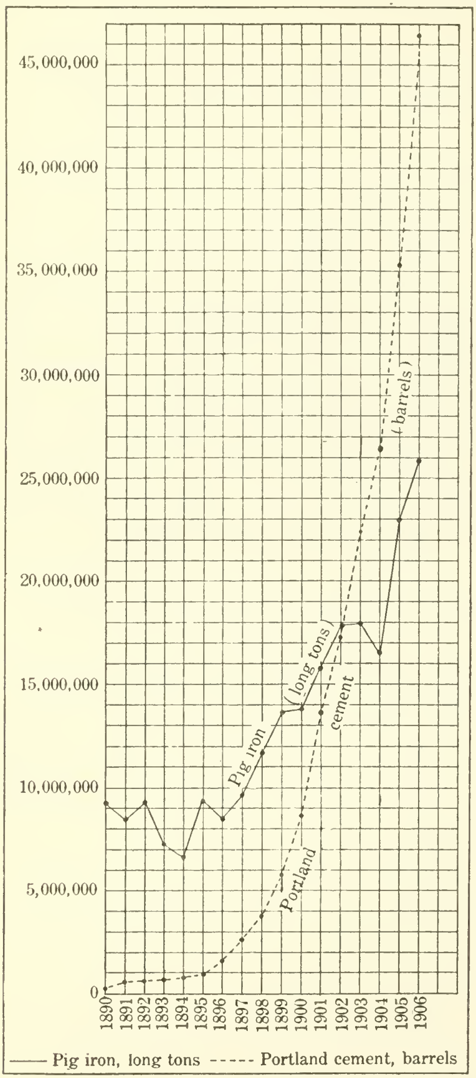

FIG. 2.—Comparison of Portland cement and pig-iron production, 1890–1906.

RAW MATERIALS IN USE.

For a number of years past the writer has published annually, at first in the columns of Engineering News and later in Mineral Resources of the United States, tables showing the quantities and the percentages of the total Portland-cement output produced from different raw materials. The table following is a continuation of this series, though it has been rearranged so as to be more suited to the apparent trend of trade conditions. The production from chalk and clay has been combined with that from ordinary limestone and clay, as the former showed no tendency to increase. On the other hand, the Portland cement produced from slag and limestone is this year given separately. Practically all of this last class is and has been produced by the United States Steel Corporation, and the fact that it is possible to present these figures without violation of confidence is due entirely to the peculiarly frank and open manner in which the affairs of that corporation are conducted. The figures given are quoted from recently published official statements, and can be accepted as approximating closely to the total production of Portland cement from slag and limestone.

The production is grouped as follows:

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 made from a mixture of comparatively pure limestone with clay or shale. This mixture is employed at many plants all over the United States.

Type 3 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 4 includes Portland cement manufactured from a mixture of limestone and blast-furnace slag.

Production, in barrels, and percentage of total output of Portland cement in the United States according to type of material used, 1898–1906.

Year.	Type 1. Argillaceous limestone (cement rock) and pure limestone.		Type 2. Limestone and clay or shale.		Type 3. Marl and clay.		Type 4. Slag and limestone.	
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.
1898	2,764,694	74.9	365,408	9.9	562,092	15.2	....	....
1899	4,010,132	70.9	546,200	9.7	1,095,934	19.4	....	....
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,209	16.1	2,001,200	15.7	164,316	1.3
1902	10,953,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	55.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1905	18,454,902	52.4	11,172,389	31.7	3,884,178	11.0	1,735,343	4.9
1906	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5

The figures for 1906, given in this table, show a continuation of movements which have been in existence for some time. The production from "cement rock" is very slowly falling off in relative importance, that from marl is falling off rather rapidly in percentage, while the production from limestone-clay and limestone-slag mixtures is rapidly increasing. From what is known of the present condition of the marl and slag plants, and of plans for future changes and new construction, it is probably safe to say that within four years more Portland cement will be made from slag than from marl. It must be recognized that marl plants operate under serious natural disadvantages, that these disadvantages are masked by general high prices during such prosperous seasons as we have recently experienced, but that they become painfully apparent during years of general depression. When cement sells at 85 cents or less per barrel at mills in the

Middle West, as it may very well do in 1908 or 1909, it will be an even more serious matter to have water in the raw mixture than to have it in the stock.

KILNS AND KILN PRACTICE.

The statistical inquiry card for 1906 contained a number of questions relating to technologic matters which have heretofore been neglected. The questions relative to number and length of kilns were answered by practically all the cement producers of the country, and the results so obtained are summarized below.

Total number of kilns.—Tables showing the number and types of kilns in use at various dates have been published in preceding volumes of Mineral Resources. Omitting vertical or stationary kilns, these figures, with the data collected this year, may be summarized as follows:

Rotary kilns, 1902, 1905, 1906.

	1902.	1905.	1906.
Operated	456	722	793
Idle	9	23	2
Building	46	42	104
Total number of rotary kilns	511	787	899

In this table the kilns listed as "operated" were those actually in operation during part or all of 1906; the "idle" kilns were those at mills which were not in operation at any time during the year, but which are still in good condition; the "building" kilns include only those which are in plants actually under construction and sufficiently far advanced to be able to enter the 1907 production.

Average output per year.—As noted in last year's report, there is not only a marked increase annually in the number of kilns in existence, but a very decided increase in the length of these kilns. Data on this point are presented in the next section, reference being made to it here merely to explain the increase in average output per kiln. In 1902 each active rotary kiln averaged 36,909 barrels during the year; in 1905 this average was increased to 48,118 barrels; in 1906 the average output per active rotary rose to 58,901 barrels. It is probable that the annual average per kiln for 1907 will exceed 60,000 barrels, and with the increased number of kilns then in operation the Portland-cement output of 1907 may reach 55,000,000 barrels.

Length of kilns in use and under construction.—The data obtained as to the length of kiln in both operating and new plants are summarized in the following table. As will be seen by comparison of the totals in this table with those of the preceding table, the statistics as to length are almost complete:

Length of kilns.

Length of kiln.	Number of kilns operated in 1906.	Number of kilns under construction.	Length of kiln.	Number of kilns operated in 1906.	Number of kilns under construction.
60 feet and less	398		105 to 110 feet	80	24
70 to 78 feet	40		120 feet	17	16
80 feet	69		125 feet and longer	57	30
85 to 90 feet	66				
95 to 100 feet	52	22	Total	779	92

This table brings out very sharply the rapidity with which kilns are lengthening, and also the diversity of opinion which still exists as to the relative merits of the various lengths above 100 feet.

Variation in output with length of kiln, etc.—The statistical data received from each plant this year included information as to total output, number and length of kilns, and duration of total shut downs. By means of these data, which cover a very wide range of material, practice, and operating conditions, it seems probable that average results of fair accuracy can be deduced as to the effect of raw material and length of kiln on the output. This has, at any rate, been attempted, and the results are presented in the following table. In explanation of this table it may be said that the average annual output of a 60-foot kiln, fired with powdered coal and working on a dry mixture of limestone and clay, is taken at 100 per cent. The average outputs of similar and longer kilns working on various raw materials is then referred to this standard, the results being expressed in percentage.

Percentage of variation in output with length of kiln, raw materials, etc.

Raw materials.	Length of kiln.			
	60 feet.	80 feet.	90 feet.	110 feet.
Cement rock and limestone	126	164	182	216
Limestone and clay	100	150	166	190
Marl and clay	54	76		

These averages plot into a fairly smooth curve, and seem worthy of attention. Unfortunately the results obtained from kilns fired with oil, natural gas, and producer gas were too few and too uneven to be considered in this connection, so that the table refers only to coal-fired kilns. The results in running on a slag-limestone mixture are omitted for obvious reasons, but they fully justify everything that has been said regarding the remarkable kiln efficiency which can be attained in a plant using this mixture.

LOCALIZATION OF THE INDUSTRY.

The Portland-cement industry exhibits the same tendency toward geographic centralization, though to a less degree, that has given Pittsburg its preeminence as an iron producer. In the case of the Portland-cement industry the concentration of plants is in the so-called Lehigh district of Pennsylvania, with its New Jersey continuation. Here, 18 plants made almost 23,000,000 barrels, or almost exactly half of all the cement produced in the United States in 1906. The Lehigh district was the point where American Portland-cement manufacture was first undertaken, and it owes its continued preeminence to the possession of good raw materials, good labor, good and fairly cheap fuel, and excellent transportation facilities to large eastern markets.

Taking a general view of the matter, 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, Arizona, and Utah. On the Pacific coast are the three active California plants and one recently started in Washington. The "South" includes Virginia, West Virginia, Georgia, Alabama, Arkansas, Texas, and Kentucky.

Geographic distribution of Portland-cement industry in 1905 and 1906.

	Number of plants operating.		Output, in barrels.		Percentage of total output.	
	1905.	1906.	1905.	1906.	1905.	1906.
East	30	31	19,589,675	25,483,025	55.6	54.9
Central	32	34	10,723,802	14,030,665	30.4	30.2
West	7	8	2,470,349	3,834,656	7.0	8.2
Pacific coast	3	4	1,225,429	1,310,435	3.5	2.8
South	7	7	1,237,557	1,804,643	3.5	3.9
Total	79	84	35,246,812	46,463,424	100.0	100.0

The year shows a slight relative increase in the Western and Southern States as compared with conditions in 1905. Western areas will be supplied much better than they are at present. A powerful impetus in this direction was given by the destruction of San Francisco, which called to the attention of investors in the Eastern States and in England the fact that the Pacific Coast States could normally absorb much more cement than was made on the coast. In the face of the San Francisco disaster the few western plants in operation were not capable of making much impression on the immense and instant demand.

In the South, too, there is an excess of demand over supply, and the few plants now actually under construction in the Southern States will hardly reduce this excess. It is probable that the States south of the Potomac and the Ohio and east of the Mississippi could use, at profitable prices, about five times as much cement as is now made in that district; and for a long time this field will be one of the most profitable ones for the cement manufacturer. Fuel is cheap, raw materials are abundant and good, and the demand is steadily increasing.

THE DIFFICULTY OF MONOPOLY.

Perhaps the most marked feature of American economic history during the last decade has been the manner in which industry after industry has become consolidated in control, so as to approach more or less closely to monopoly. This has been particularly well marked in the iron and steel industries, and it is worth considering how far a similar evolution is likely to affect the cement industry. At present the cement industry is the most individualistic of the larger branches of manufacture. No "trust," nor even any approach to a monopoly, is now in existence, newspaper statements to the contrary notwithstanding; and in the writer's opinion the nature of the cement industry renders it impossible that any such large degree of consolidation of interest can take place as to result in permanently or unfairly high prices for the product.

When the history of both successful and unsuccessful "trusts" is examined it will be seen that the only way in which a permanent monopoly can be secured and retained by any consolidation is by the control of the supply of raw material, by the absolute control of basic patents, or by the control of transportation. Any trust which disregards this history, and is content with simply consolidating all or most of the existing manufacturing plants, is in line for disaster; for, supplies of raw materials being still available for outsiders, the first advance in prices will be the signal for the erection of competitive plants. If, on the other hand, the raw materials can be cornered, or processes can be monopolized, or transportation can be controlled, there is no possibility of competition. This experience, though unobserved or disregarded a decade ago, is now generally borne in mind.

The bearing of these facts upon the future of the cement industry is obvious enough. If there is any possibility that one large cement corporation can acquire control of most of the available deposits of cement material in the United States, it will be possible to form a real American "cement trust," to defy competition, and to raise prices to an unwarranted level. If, on the other hand, it is impossible to form such a corner in cement rock or in cement-making processes, or permanently to control transportation, it will be impossible for any consolidation to raise prices permanently above the normal.

On careful consideration of the matter it will be seen that only one answer is possible. It is safe to say that more than 20 per cent of the entire area of the United States is underlain by raw materials out of which cement could be made if prices were forced high enough. The Standard Oil Company, the United States Steel Corporation, and the United States Government could not, by combining their financial resources, hope to acquire control of any large fraction of this immense reserve of raw material.

Since the supply of limestone and clay can not be cornered, since no essential parts of the processes of manufacture are covered by exclusive patents, and since transportation companies will seek freight, it is reasonable to believe that no cement combination can succeed in permanently raising prices to unfair rates. As already stated, there is nothing in existence at present even remotely approaching a cement trust. The trouble is rather in the other direction. The prosperity of the last few years, with reports of enormous profits earned by existing companies, has led to the building of many new cement plants. A fair proportion of these are either too small, badly located, faulty in design, or badly managed; and with the first general business depression and the commencement of falling prices such plants will necessarily become a danger to the entire industry. The condition at present is therefore marked by excess rather than lack of competition.

At present, indeed, the only limitation on unprofitable increase in the number of cement plants arises from the fact that even the smallest units are expensive to construct and operate. In any district where competition could be expected, for example, it would usually be inadvisable to build a smaller than a 4-kiln plant. This plant would have an output of 1,500 barrels or more per day; but its construction would cost $350,000 to $450,000, and it would require a working capital of $125,000 to $175,000 in addition. Evidently, therefore, the cement industry is not one in which individuals or small firms can find much of an opening.

NORMAL GROWTH AND CONCENTRATION.

Although, as already stated, it is impossible that the cement industry should ever become a monopoly based on control of deposits of raw materials, another phase of the subject requires consideration. The cement industry is essentially one in which brains and money are far more important than raw materials, and consequently cement plants with intelligently directed capital will rapidly increase in size, while poorer or ill-managed plants either remain stationary or expand very slowly. This of itself operates to cause a gradual concentration of interest; the stronger plants grow at the expense of the weaker.

Most of the larger companies which now produce the bulk of the American cement output were originally concerns of only average size. Their growth has taken place in a natural manner, not by the absorption of competitive plants, but by using part of the profits of the business to increase the size of the original plant. In a strongly held and well-managed company this course of action is possible. In a company less strongly owned or less intelligently directed the tendency is always to sacrifice the prospects of ultimate success to the certainty of immediate returns. A company owned by a number of small stockholders can rarely withstand the pressure to pay out all the profits of an unusually prosperous year as dividends.

The larger company, growing by accretion, has also a certain advantage in the matter of advertising its products. When a new plant is established by an old company there is no difficulty in introducing the cement from the new plant, for it sells under an already well-known brand name, and has behind it the accumulated prestige of all the older plants.

During the year 1906 progress toward concentration of interests has been marked. The formation of the North American Cement Company in the East and the Iola consolidation in the West have attracted general attention to this phase of the cement industry.

CAPITALIZATION AND PROMOTION.

From two evils more serious than monopoly — over-capitalization and fraudulent promoting—the American cement industry has been fairly free, though there are signs that this happy immunity is not destined to continue. So far as the first is concerned, figures obtained unofficially from various sources indicate that the total authorized capitalization of all the American Portland-cement plants operating in 1906 falls within 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. On the whole, therefore, it can be accepted as representing very fairly the total capitalization of the entire industry, and can not be considered excessive.

Considering the matter broadly, it can be said that in the East, including the plants from New York to Illinois, there has been little attempt at over-capitalization or fraud. Most of these older companies were organized by persons familiar with the business, and the necessary capital was secured more or less privately, with little attempt to raise money by selling stock to the public. Michigan, apparently, was the first State in which the promoter found an opportunity to display his peculiar talents, and for a number of years that State was dotted with prospective cement plants. Most of these flotations were capitalized excessively, owing to the fact that for the first time in the history of the industry the stock was being sold to the public by promoters. Advertisements of stock for sale at 10 cents or $1 per share, with promises of 20 to 60 per cent dividends and with wonderful miscalculations as to operating costs, filled the papers of the Middle West during this period.

After the Michigan boom had collapsed, leaving behind it a few good plants, a few poor ones, and a much larger number which had never come into existence other than in the prospectus, the promoter was for a few years scarcely seen or heard of. His reappearance took place when the Iola plant proved the profits in making cement in the natural-gas belt in Kansas, and for the last few years there have been exaggerated statements of the profits awaiting the erection of cement plants in the States west of the Mississippi, notably in Kansas and Iowa.

STATISTICS OF CEMENT INDUSTRY IN 1906.[a]

By L. L. Kimball.

INTRODUCTION.

GENERAL CONDITIONS.

The cement industry, as a whole, in 1906 was in a very prosperous state. Prices continued good throughout all parts of the United States, and in several localities they increased materially over those prevailing in 1905. The market was steady, and though the supply was greater than that of any preceding year, the demand kept pace with it, and in most localities exceeded it. The year closed with a gratifying indication of prosperity in the immediate future.

The greatest and most prosperous branch of the industry is, of course, the Portland-cement branch. The phenomenal growth of the Portland product has been noted before in these reports; but it may be made more impressive to the general public by stating that twenty years ago, in 1887, when the Portland output of the entire country stood at about 250,000 barrels, as against a production of somewhat more than 6,900,000 barrels of natural cement, the first attempt was made in the United States to use the Ransome process of burning cement—that is to say, to introduce the rotary kiln for the manufacture of Portland, instead of the vertical, or dome-shaped, kiln used at that time. The attempt was made near Portland, Oreg., and although that effort was not successful, it resulted in the improvement and adoption of the rotary kiln in this country. One difference between the process as it was then and as it is now used is this: In 1887 the company exploiting the new process proudly claimed an ability to produce 30,000 barrels of cement per annum, which would be tripled as soon as the necessary machinery for grinding should be added. To-day a company does nothing extraordinary in announcing that its plant will produce 3,000, 4,000, or 5,000 barrels of Portland cement a day, while the per annum production of the large plants run well into millions of barrels. It was ten years later, 1897, before the production of Portland cement had increased to 2,500,000 barrels; but in the next decade it went forward with tremendous strides.

The quantity of cement exported by the United States to foreign countries is not yet as large as it should be. This condition may be due to the great demand for it in the United States. But with the continued increase in the number of plants, and the consequent increase in production, foreign trade can not long be neglected. There are a

[a] Prepared under the direction of Edwin C. Eckel.

dozen States in which new plants are actually being built to be ready for operation late in 1907 or early in 1908, and more than that number in which plants are projected. When the plants that are in process of erection (not including those which as yet are but planned) begin to produce, the output for the entire country will be again greatly increased. In view of these conditions, it would certainly seem wise to make at least an effort to build up a profitable trade with foreign countries.

The decline of the natural cement industry has been gradual, but as steady as the increase of the Portland branch. In 1906 the effect of this decline seemed to be even more widespread than in the preceding year, extending far into States which have not before felt its influence as strongly as have the eastern centers of natural cement production. No new States appeared as producers of this variety of cement, nor were any new plants built for producing it. The owners have for the most part allowed their kilns to remain idle, apparently waiting for a turn in the tide. Some have turned their attention to the burning of lime and kindred employments, and a few have dismantled the old plants and put in buildings and machinery for making Portland cement. Since the limestone which is known as "cement rock," from which natural cement is made, sometimes forms an equally good base for Portland cement, the latter course seems to be the logical and wise one where the financial part of such transition can be arranged. The business affairs of the Louisville district are in the same condition as they were last year.

The growth of the slag, or puzzolan, branch of the cement industry is interesting because of its steadiness. For about twenty years it has been doing a little, but for the last three years one new plant in a new State has been built annually to produce puzzolan cement. New works are being erected in Pennsylvania at the present time, and those which were built in Kentucky and in New York are both profitable producers. Of course the process of making this kind of cement is not nearly so expensive nor so extensive as the process required for burning and grinding Portland cement.

The rotary kilns necessary for producing Portland cement have been increased in size and otherwise improved to an extent which precludes a low price for them. Whereas in earlier years a 60-foot rotary was considered excessively large, to-day the extreme length is 150 feet. The increase in diameter has been only small. In the manufacture of puzzolan cement rotary kilns are not used.

ACKNOWLEDGMENTS.

In making acknowledgments for the courtesies so universally extended in 1905, the writer had occasion to call attention to the fact that the statistics of production in this report are based entirely upon the actual returns sent from the different cement plants in the United States and that those used in the preliminary statement issued in advance of the full report are also based on such returns; that, such being the case, it is impossible to issue the statement until practically all the returns are in; and that therefore the date of the issue depends largely on the manufacturers themselves.

Since the statement is requested at an early date by people who are not producers, each year, and since letters are always received by this

Bureau from cement makers asking for the statement as soon as possible, this matter is again touched upon. It seems as easy to send the information in response to a first request as to a third or fourth request. In other words, if the statement is to be sent in at all, it should not be delayed a day, because any delay prevents every other producer from receiving the earliest possible statement of the annual production.

The writer is indebted to cement producers in most of the States from New Jersey to California for many courtesies during personal visits to their plants, and these remarks are made solely with a desire to be able to comply with the wish of the producers and to issue the figures at an early date.

The returns for 1906 are particularly full and complete. In no case were the figures refused, and in most instances every question was answered. Such cooperation is productive of the best results, and for it much appreciation and hearty thanks are hereby tendered.

PRODUCTION.

The statement made last year that 1905 was the record year thus far in gain in total production of hydraulic cements in the United States over a preceding year applies equally this year to 1906.

The increase for 1905 over 1904 was above 8,000,000 barrels in quantity and $9,000,000 in value; but the gain of 1906 as compared with 1905 is 10,898,137 barrels of cement in quantity and $19,370,744 in value.

The total production of cement in 1906 was 51,000,445 barrels, valued at $55,302,277; the total production in 1905 was 40,102,308 barrels, valued at $35,931,533.

The production of Portland cement in 1906 was 46,463,424 barrels, valued at $52,466,186.

The production of natural cement in 1906 was 4,055,797 barrels, valued at $2,423,170.

The production of puzzolan cement in 1906 was 481,224 barrels, valued at $412,921.

These amounts are somewhat greater than those given in the preliminary statement of cement production issued by this Bureau earlier in the year. The difference is due to the fact that some of the returns from plants were received too late for use in the first statement. Such preliminary statements, however, are always issued with the understanding that while the amounts reported will not be decreased they may be somewhat increased.

The prices at which cement was sold in 1906 were higher than those which prevailed in 1905. They were not inflated, however, but were on a healthy normal basis. The producers made no complaint of prices, but from nearly every State in the Union protests were made as to the grave difficulty of obtaining sufficient car service for the delivery of orders.

PORTLAND CEMENT.

PRODUCTION.

The following table is designed to show the quantity and value of the Portland cement made in those States which were producers in 1904, 1905, and 1906:

Production, in barrels, of Portland cement in the United States in 1904–1906, by States.

State.	1904.[a]			1905.[a]			1906.[b]		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of active works.	Quantity.	Value.
Alabama	1	....	....	1	....	....	1	....	....
Arizona	....	....	....	....	....	....	1	....	....
California	3	1,014,558	$1,446,909	3	1,225,429	$1,671,816	3	1,310,435	$2,110,294
Colorado	1	490,294	638,167	1	786,232	1,172,027	1	1,146,396	2,034,382
Georgia	1	....	....	1	....	....	1	....	....
Illinois	5	1,326,794	1,449,114	5	1,545,500	1,741,150	4	1,858,403	2,461,494
Indiana	4	1,350,714	1,232,071	6	3,127,042	3,134,219	6	3,951,836	4,964,855
Kansas	2	2,643,939	2,134,612	4	....	....	4	3,020,862	3,908,708
Kentucky	1	....	....	1	....	....	1	....	....
Michigan	16	2,247,160	2,365,656	16	2,773,283	2,921,507	14	3,747,525	4,814,965
Missouri	2	....	....	2	3,879,542	4,164,974	2	3,350,000	3,260,000
New Jersey	3	2,799,419	2,099,564	3	3,654,777	2,775,768	3	4,423,648	4,445,364
New York	11	1,362,514	1,257,561	11	2,111,411	2,044,253	9	2,414,362	2,725,744
Ohio	7	910,297	987,899	8	1,312,977	1,390,481	8	1,422,901	1,709,918
Pennsylvania	17	11,496,099	8,969,206	18	13,813,487	11,195,940	19	18,645,015	18,598,439
South Dakota	1	....	....	1	....	....	1	....	....
Texas	2	....	....	3	....	....	2	....	....
Utah	1	....	....	1	....	....	1	....	....
Virginia	1	864,093	774,360	1	1,017,132	1,033,732	1	1,172,041	1,432,023
Washington	....	....	....	1	....	....	1	....	....
West Virginia	1	....	....	1	....	....	1	....	....
Total	81	26,505,881	23,355,119	89	35,246,812	33,245,867	84	46,463,424	52,466,186

[a] The States combined for 1904 and 1905 are mentioned in the text of the reports for those years.
[b] The States combined for 1906 are given in the text below.

As heretofore, tne production of those plants which are the only ones in their States are so combined that the figures may not be published in a form which will reveal individual production.

The cards of request for figures and information annually issued by this office state that all facts and data sent in are regarded as confidential unless there is a special understanding to the contrary. Individual figures showing quantity or value of production are very seldom published, and if in rare instances such a publication is considered desirable it is never made without express permission from the producer.

In the foregoing table the outputs of Alabama, Georgia, West Virginia, and Virginia are combined; the production of Kentucky is given with that of Missouri; Colorado, Utah, Texas, South Dakota, and Arizona are combined; and in each instance the total sum of the combined figures is placed against the name of the State that contributed the largest quantity of cement to that total.

In 1906 there was great activity in the Portland-cement industry. States which have heretofore not produced cement began the erection of Portland-cement plants; mills that were making their initial runs did well; and some of the centers of activity increased their productive capacity, either by constructing new plants or by remodeling old ones.

Indian Territory, Iowa, and Arizona appear in 1906 for the first time in the list of cement-producing States.

In Kansas four new companies erected plants near the Iola center, which offers great inducements to capitalists by reason of its vast limestone deposit and its natural-gas belt. In addition to this fact the State is centrally located and can find a profitable market in any direction. In Pennsylvania, that great center of Portland-cement making, where the largest plants in the world are operating, five additional plants are now being built; Kentucky and Tennessee, in the South; Utah, Michigan, and Wisconsin, in the North and West; and Montana and Washington, in the extreme Northwest, are all either actively building or are planning to build new Portland-cement plants; while Missouri, which already has a large production, is now adding three plants to her present capacity. California has changed from being a large importer to being a large producer, and is increasing the capacity of present plants as well as constructing new ones.

The rank of the Portland-cement-producing States remains as it was in 1905 so far as place goes, though the record as to the proportion of the production that gave each State its place has changed considerably. Pennsylvania, of course, is at the head of the list; but while in 1905 her lead was a little above 10,000,000 barrels this year her surplus above New Jersey, her closest competitor, is well over 14,000,000 barrels, and in spite of the great increase in the output of the entire country Pennsylvania manufactures 40.1 per cent of the total product. This percentage is a little larger than it was in 1905 and in that year it was less than in 1904, but that falling off merely indicated a great increase in the total production, and not a decrease in Pennsylvania's output.

In 1906 New Jersey, although she has but three producing plants, still holds her place as second largest producer of Portland cement. Her lead over the other States standing next is not very large, however, and the increase in the capacity of the plants of the Western States may result in displacing her within a short time. Her production this year amounted to 9.5 per cent of the total output.

Indiana approaches New Jersey a little more closely in 1906 than in 1905, and leads Michigan by a diminished quantity. For the last few years the difference between the production of these two States has not been large. Indiana's output in 1906 was much greater than that for the preceding year, and her production was 8.5 per cent of the whole. These three States, which head the list, made more than 58 per cent of all the Portland cement produced in the country in 1906.

Michigan still holds fourth place, as in the previous year.

The table which follows shows the growth of the cement industry in the United States. Its form was originally determined by the fact that the cement production was confined mainly to certain well-defined centers, but changes in conditions since 1900 have necessitated a change in form.

Under "all other sections" is included the production of Alabama, Arizona, California, Colorado, Georgia, Illinois, Indiana, Kansas, Kentucky, Missouri, South Dakota, Texas, Utah, Virginia, West Virginia, and of other counties in Pennsylvania than Lehigh and Northampton counties.

Development of the Portland-cement industry in the United States since 1890.

Section.	1890. Number of works.	1890. Quantity (barrels).	1890. Percentage.	1900. Number of works.	1900. Quantity (barrels).	1900. 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.	1905. Number of works.	1905. Quantity (barrels).	1905. Percentage.	1906. Number of works.	1906. Quantity (barrels).	1906. Percentage.
New York	11	2,111,411	6.0	9	2,414,362	5.2
Lehigh and Northampton counties, Pa.	15	13,713,910	38.9	17	18,360,965	39.5
New Jersey	3	3,654,777	10.4	3	4,423,648	9.5
Ohio	8	1,312,977	3.7	8	1,422,901	3.1
Michigan	16	2,773,283	7.9	14	3,747,525	8.1
All other sections	36	11,680,454	33.1	33	16,094,023	34.6
Total	89	35,246,812	100.0	84	46,463,424	100.0

THE PORTLAND-CEMENT INDUSTRY, BY STATES.

Alabama.—In 1906 there was but one active Portland-cement factory in Alabama, the new plant of the Standard Portland Cement Company not having been completed and started until just after the close of the year. The active plant ran continuously for the greater part of the year, having been idle for a short time only, owing to a lack of car service. The plant produced practically double the quantity of cement made during 1905. A project to establish a large plant for the manufacture of Portland cement at Ragland is reported, but the erection of the factory is not yet commenced.

Arizona.—The only cement plant in Arizona, that of the United States Reclamation Service is located at Roosevelt, and made its initial run in 1906, producing a quantity of Portland cement sufficiently large to fill the stock bins, when, by reason of that fullness, as well as of a shortage in oil for fuel, it shut down for a time. The success of the plant has apparently stimulated the hitherto unworked cement industry in this State, as a plant for the production of Portland cement, it is reported, is about to be established at Prescott.

Arkansas.—There is but one cement plant in Arkansas, and its latest production of Portland cement was made in 1903. A plan is now being formed to modernize the plant, beginning with a capacity of 1,500 barrels a day, and building with the expectation of doubling this output very soon after the mills are started.

California.—The cement industry in California was very prosperous in 1906, notwithstanding the earthquake. The three active plants reported in 1905 were in operation in 1906, and an additional plant was completed at Davenport, but did not produce any cement until the year had closed. One of the two plants near San Francisco ran ahead of its production for 1905, and the other fell slightly behind by reason of a strike among the workmen. Both of these companies suffered the loss of their offices, which were located in San Francisco, but their factories were not injured. One factory installed ten additional kilns. The plant at Colton, which has offices in Los Angeles, ran far ahead of its production for 1905. Two of the three active companies in the State sold their product at prices in advance of those for 1905. One company in the State is about to build a large plant in Washington. The new plant at Davenport opened with a capacity of 6,000 barrels a day, which output is to be doubled after a short run. All cement manufacturers in this State use oil as fuel.

Colorado.—The single cement plant in Colorado ran on full time throughout the season. The overhauling and remodeling accomplished early in 1906 resulted in a much increased production, the figures showing larger results than those of 1905 as to both quantity and value per barrel. There is no immediate prospect that other mills will be erected in this State and no new projects are reported, the project attempted in 1905 having been abandoned.

Georgia.—Better prices, a greatly increased output, and a successful season formed the record in 1906 for the Portland-cement plant in Georgia. The company owning this factory made practically the same record in 1905, when it greatly increased its production over that of the preceding year. The output reported each year since the opening of the mill has shown an advance over that for the preceding year.

Illinois.—Four plants were engaged in the production of Portland cement in Illinois in 1906, and their output was nearly 2,000,000 barrels. The record in this State was in accord with the almost universal rule of better prices and increased output for 1906. The production of each of the four plants was greater than that for the previous year, although the increase was not in the same ratio.

In October the Universal Portland Cement Company took over the cement plants and cement business of the Illinois Steel Company. The new company is building an additional plant in Indiana and a new one in Pennsylvania, each of which will be in operation early in 1907. All the factories operated by this company make Portland cement from slag and limestone, which, after being thoroughly dried and ground together in proper proportions, are burned to clinker in rotary kilns.

The plant reported to this Bureau by the Sandusky Portland Cement Company as about to be erected at Dixon, Ill., is still under construction and will probably be in operation in 1907.

Indiana.—The Portland-cement industry is a growing one in Indiana. The production in 1906 was the output of six plants, and was sufficient to keep Indiana in the third place among the Portland-cement-producing States, a rank attained only in 1905. The new plant at Speeds was in operation, and the combined production of the State amounted to nearly 1,000,000 barrels more than that for 1905. Of the five older factories, all but two ran ahead of their output in 1905. One of these two reported the same production as for 1905, but the price obtained was greater. The second plant ran considerably behind its previous record. The other three made from 100,000 to 700,000 barrels more than in 1905. There were no important shut downs during the year, the necessary repairing being the greatest cause of brief delays in manufacture. Only one entirely new factory is reported for Indiana, though in 1907 there will be two, and possibly three, additional plants in operation. The first new mill is being erected by the Universal Portland Cement Company at Buffing-ton near its No. 1 mill. This older plant was a part of the cement interests of the Illinois Steel Company, all of which were taken over in 1906 by the Universal Portland Cement Company. The second mill, located at Kimmel, Ind., which is just completed and now in operation, will report a production at the close of 1907. The third plant, which is a possible producer for 1907, is a nearly completed mill at Marengo.

Indian Territory.—For the first time Indian Territory appears in the text of the cement report. Two cement plants in this Territory are now being erected, one at Ada, by the Oklahoma Portland Cement Company, and one at Dewey, by the Dewey Portland Cement Company. The first company expects to have its mills in operation late in the summer or early in the fall of 1907. Both the plant and its main offices will be located at Ada. Machinery will be installed for a production of 1,000 barrels of cement a day; but the buildings will be erected to accommodate a 2,000-barrel plant. The factory is located only a short distance south of the Canadian River, in the southern portion of the State. The second company has built its plant at Dewey, and has constructed it with a capacity of 2,500 to 3,000 barrels of Portland cement a day. The mills will be in active operation in the fall of 1907.

Iowa.—Like Indian Territory, Iowa appears for the first time in this report as a cement-producing State. The Northwestern States Portland Cement Company is now constructing a large plant at Mason City for the manufacture of high-grade Portland cement. The factory is to have a capacity of 3,000 to 3,500 barrels of cement a day, and will be built in the general fashion of the mills owned by this company at Independence, Kans. Twelve large rotaries, 110 feet long, will be installed, and the grinding machinery will consist of ball and tube mills, Kent mills, etc. The plant will be finished and ready for work by October, 1907.

Kansas.—Each of the four Portland-cement plants in this State produced an output in 1906 which was in advance of that for the preceding year. One of these plants made more than eight times as large a quantity in this, its second year, as it made in 1905, while the other year-old plant made over fourteen times more than in its initial year. In 1905 the older plants naturally produced more cement than the new ones, and therefore their increase in 1906, although marked, is not so far in advance of the preceding year's output as that of the new mills. Three of the factories ran on practically full time during 1906, and one was idle for nearly six months repairing and remodeling. It is reported that six new cement plants will be in operation or completing construction in 1907. One is to be located at Iola, and will probably start during the fall or early in the winter. One is to be at Fredonia, and will perhaps be in running order by June at the latest. This company will start with two kilns, at least 110 feet long, and the buildings will all be constructed with a view to enlarging the capacity of the plant later. The third plant is to be at Elk City, in Montgomery County, and will have a capacity of about 2,000 barrels a day. Preliminary excavation and grading is now being done, but the mills will not be ready for work before 1908. The fourth plant will be erected about 3 miles east of Mapleton, in Bourbon County. It will start with a capacity of about 2,000 barrels of cement a day, with six kilns, 125 feet long by 8 feet in diameter; the mills will be in operation late in 1907 or early in 1908. The fifth plant is under construction at Yocemento, and is to begin producing Portland cement in November, 1907. The mills will start with two rotaries, each 125 feet in length. Oil will be the fuel used, and shale, lime, and chalk the materials. The sixth of the new plants is being built at Bonner Springs, and its first section, capable of producing about 800 barrels of Portland cement a day, will be in working order by January, 1908. The other section, which will exactly double the capacity of the mills, will be completed later in that year. With more than double her present number of plants, Kansas bids fair to reach a high place in the list of cement-producing States, for already she has risen from a record of no Portland-cement production prior to 1900 to the sixth place in the list in 1906, with over 3,000,000 barrels to her credit.

Kentucky.—Only one plant was actively engaged in the production of Portland cement in Kentucky in 1906, and it made a remarkably good showing for its second output. There was no cause for idle mills, and the plant was active all the year, using its four rotaries constantly.

A new plant is now under construction at Stanton, in this State, which will have its main offices in Lexington. It will not become active before the fall of 1907. The property of this company is nearly 1,000 acres in extent. The fuel for supplying light and power is to be natural gas, of which there is an abundant supply. Transportation facilities are excellent.

Michigan.—The Portland cement manufactured in this State in 1906 was produced at 14 plants, and the output amounted to nearly 1,000,000 barrels more than that of 1905. This advance was not sufficient, however, to restore Michigan to third rank in the list of Portland-cement-producing States, which was the position she held from 1900 to and including 1904. Many of the plants produced cement through the entire season, running on full time. Several closed down during the winter months for repairs; some of the mills were inactive for a short period because of inability to get coal, due to a coal strike. One plant increased its size, and one was reconstructed. The Hecla factory was reopened in July, and was in active operation through the rest of the year.

Of the remaining companies reporting from this State, four are erecting mills which are in various stages of construction. All of these four plants have heretofore been reported to this Bureau. One of these, it is expected, will be complete and ready for work next season. The other three are apparently not quite so far advanced, no dates for completion being mentioned. One plant which was active for a short time is now idle. Of the five other companies reporting, three state that they are still striving to attain tangible existence, one states that it has not yet sought to do more than organize but may build in a few years, and a third reports that the work of perfecting titles to land and erecting large Portland-cement plants in 3 other States, has thus far prevented the erection of a plant in Michigan. One entirely new company is building a plant in the northern part of the State, and expects to be in operation about 1908, with a capacity of 3,000 barrels of Portland cement a day.

Missouri.—In many respects the records of this State for 1905 and 1906 are similar, for in 1906 two plants produced the entire output of

Portland cement made in Missouri, and each of these increased its production over that of the preceding year, as in 1905. The plant located just outside of Kansas City was reconstructed to produce an output about three times as large as that originally intended, and it is still undergoing the process of enlargement. The mills of the Louisiana plant are not yet put up and the organizers are unable to give any indication as to when they will be erected or become active. A new plant at Courtney, about 10 miles east of Kansas City, on the main line of the Atchison, Topeka and Sante Fe Railway, will probably be put into active operation within a year. Seven kilns, 125 feet long by 8 feet in diameter, wlll be installed, with a minimum capacity of 2,500 barrels of Portland cement a day. The company will also install machinery of capacity sufficient to grind a week's or ten days' supply of raw material ahead, and the same provision will be made at the finishing end of the process. The continued yearly increase in production of the factory at Hannibal is notable. This year it fell only about 25,000 barrels below 1,000,000 barrels more than the output for 1905. Another new plant is being erected at a place about 4 miles west of Carondelet, a suburb of St. Louis, by a company that is now engaged in the manufacture of cement in one of the Eastern States. The plant is located on a tract of land covering about 150 acres, which is traversed by Gravois Creek. A well-known brick company of St. Louis has been making brick and quarrying stone on this property for years, and has stripped off quantities of clay, and opened a quarry face of large extent, thus making cement materials readily available. The rock is all above the level of the mills, and the materials will be moved to the factory by gravity. The plant will start with six rotary kilns, each 110 feet in length by 8 feet in diameter, and will have a daily producing capacity of 3,000 barrels. The power will be electrical.

New Jersey.—In 1906 New Jersey maintained the rank she has so long held, the second in the list of Portland-cement-producing States in this country. There were no additional cement plants opened, though projected factories were reported. The output was made, as heretofore, by the three large plants which have been manufacturing New Jersey's Portland cement for several years. The output of two of these factories was larger than in 1905, while that of the third ran far ahead of its previous production. The combined increase shows figures that are more than 750,000 barrels in advance of those for 1905. All the mills were in operation throughout the entire year.

New York.—The record of New York for 1906, so far as its production of Portland cement is concerned, practically duplicates its record for 1905. Nine plants were in operation, and nearly all of them manufactured a larger quantity than during the preceding year. One of the plants was shut down for several months in order to undergo extensive enlargement and improvement. Of the others, some ran almost continuously and some were closed down a short time for necessary repairs. One factory that has for years successfully produced Portland cement by burning it in the old-style dome or vertical kiln, changed its method of manufacture to the newer kiln, and installed large size rotaries, the result of the change being an increased production. Some of the plants increased their output over that of the preceding year; some of them decreased it slightly. One mill which has for many years reported a production of both Portland

and natural cement, in 1906, for the first time, made only Portland cement. No new Portland-cement factories are reported from this State in 1906.

Ohio.—The cement industry has grown and is growing in Ohio. All three of the varieties reported in this pamphlet are produced in this State, but the chief cement produced is Portland. Eight plants were active in 1906, and two new factories, designed to produce Portland cement in large quantities, were nearing completion at the close of the year. Seven of the eight active mills ran a few thousand barrels ahead of their production for 1905, and the eighth mill ran about 1,200 barrels behind. The variation from the record of 1905 was not marked, either one way or the other, in any plant, and the State total showed only a small increase over that reported in 1905. At one of the plants a fire caused a shut down for about forty days. At another mill production was suspended for about three months in order to make extensive improvements. The other plants ran on full time except for a few weeks when necessary repairs were being made.

One of the new plants is located at Portsmouth, and will be started up in the summer or fall of 1907, with a capacity of 1,500 barrels of cement a day. The kilns are 100 feet in length, and the plant is so arranged as to allow an immediate increase in capacity of 500 to 1,000 barrels a day. The other new plant is at Center Furnace, in Lawrence County, and will be put into operation during the summer of 1907. It is built with a capacity of 2,000 barrels a day and has four kilns installed, each 125 feet in length. At both plants the materials used will be limestone and shale. Of the eight active factories, five use limestone and three use marl.

Pennsylvania.—From 1890, when with six plants Pennsylvania produced less than 250,000 barrels of Portland cement, to 1906, when with nineteen active plants its record of production exceeds 18,500,000 barrels, this State has stood at the head of the Portland-cement-producing States in this country. It has inexhaustible deposits of limestone and cement rock—the materials most commonly used in the manufacture of Portland cement in this locality—and its production has this year gone ahead of that of any other State by more than 14,000,000 barrels. There were nineteen plants engaged in the manufacture of this output, of which fifteeen produced exclusively Portland cement, and the remaining four produced both Portland and natural cement. A mill owned by one of the larger companies in the State was damaged by fire, and its output was lessened by the lack of production during repairs. In another mill owned by the same company extensive alterations caused a shut down of several months. The company is now building another large and well-equipped plant at Fogelsville, which will be in active operation next year. Two companies suffered losses by fire and three others were idle for a part of the year because of alterations and improvements made in their plants. The majority of the mills ran steadily throughout the year with only the delays caused by necessary repairs. Satisfactory initial productions were made by the new mills that started in 1906, and five plants now under construction will be producing before or during 1908 if their present plans are carried out. One of these factories is being built at Nazareth by the Atlantic Portland Cement Company; another is the new factory to be erected by the Crescent Portland Cement Company at Wampum, which will be finished as soon as possible. The third plant is to be located at Chestnut Hill, in Monroe County, and will be built by the Monroe Portland Cement Company. Its minimum capacity will be 1,000 barrels of cement a day, and the company now proposes to manufacture, in addition to Portland cement of the usual high grade made in this State, a pure white Portland of the same quality as any first-class Portland cement. This, it is specifically stated, is an entirely new product. The fourth new plant is that now being built by the Universal Portland Cement Company at Universal near North Bessemer. This factory will use the slag from the Carnegie Steel Company's furnaces at the Homestead works, whence also electric power will be transmitted to the plant. The rotary kilns will be 120 feet long by 7 feet 6 inches in diameter. All the buildings, including the bins for raw material, the dryer building, raw material mill, burner building, finishing mill, stock houses, and miscellaneous buildings—such as the office, laboratory, and machine shop—are being built entirely of steel and concrete. The cement made by this company goes through all the processes required for producing a true Portland cement, and the finished product meets all the requirements for such an article. It should not be confused with slag cement, which is not burned in rotary kilns and is not at all the same as Portland cement.

The fifth new enterprise reported from this State is the plant now under construction by the Conestoga Portland Cement Company in Lancaster County, about 7 miles from Lancaster, on the Conestoga and Cocalico rivers. The beginning of the building operations was somewhat delayed by the fact that the company was compelled to wait for a line to be constructed by the Lancaster and Northern Railway giving connection with the Pennsylvania and the Reading railroads. The factory will have a daily capacity of 2,000 barrels of Portland cement, and will be started with four kilns 100 feet in length by 8 feet in diameter; the buildings are to be so arranged as to leave space for additional kilns and machinery which will increase the output to 3,000 barrels a day. The company expects to be operating late in the spring or early in the summer of 1908.

One company which has reported a production for several years past was adjudged bankrupt and has sold its plant and holdings to a new company, which will continue the business under a new name in 1907. The present year was given to remodeling and repairing the plant.

In this State four factories were reported as idle during 1906.

South Dakota.—The plant which produced the Portland-cement output of this State in 1906 continues to be the only cement mill in South Dakota. Since it has been rebuilt its production has been considerably greater than in 1905, although the output for that year was more than four times as large as any ever before reported from this mill. The factory was in operation throughout the year.

The erection of a second plant has been postponed for a time by the promoters, who last year reported that the project was well under way.

Tennessee.—This State, which has not figured in the reports of this office on the production of cement since 1890, is about to become again a producer of Portland cement. Late in 1906 the erection of a plant was begun by a company having large interests in cement production in Kansas, and it expects to begin operating the new plant within a year from the time building was commenced. There will be ten rotary kilns installed, each 110 feet in length by 8 feet in diameter, with about 4,000 horsepower of steam engines and boilers. In the vicinity of the plant, which is located near Copenhagen, there is an abundance of coal, and this will be the fuel used.

Texas.—In 1906 two plants in Texas were producing Portland cement. One of these manufactures a well-known brand of natural cement, as well as Portland, while the other is engaged exclusively in making Portland cement. The first plant reported a production of Portland cement which was very slightly less than its output for the preceding year; the second plant reported a large output, nearly double that for 1905, and many times greater than the Portland production of the other factory. This is only the second output reported from this plant since it was remodeled. It ran on full time throughout the year, and had only a few thousand barrels of cement in stock when the year closed.

Utah.—The construction of the new Portland-cement plant near Ogden, in Utah, was slower than the company expected, and therefore its first production will be reported for 1907 instead of 1906. The mills will be completed late in the spring and will be active the rest of the year. The one plant in Utah which has been a steady producer of Portland cement since 1891, when its first output was reported by this Bureau, is located in Salt Lake City. Its production in 1906 was greater than that for the preceding year. This record is the usual one, however, as the production of this plant has steadily increased for a number of years. Except for a few weeks during which the mills underwent the regular annual overhauling, this factory was continuously active during the year. The company formed in 1905 to build a second plant in or near Salt Lake City was dissolved and the project was abandoned in 1906.

Virginia.—In Virginia there is only one Portland-cement-producing plant, and that one is entirely successful. Its customary yearly increase in production was marked in 1906, and the mills were active throughout the entire year, except on several holidays. The company is now installing three additional kilns, 125 feet long, and the grinding machinery necessary to keep them active. When the alterations are completed, the factory will be capable of producing 1,000,000 barrels of Portland cement a year. The plant projected in this State by a cement company now active in Pennsylvania has not yet been carried far enough to permit building operations.

Washington.—The new plant built in 1905 and 1906 in Washington is now ready for use, but was not in operation last year. It is very favorably located, and the town that has grown from it is called Concrete. This is the first factory erected in the extreme Northwest, and its initial production will be of interest. Its nearest neighboring cement plants are in North Dakota, Utah, and California, to reach which, from Washington, either Montana, Idaho, or Oregon must be crossed.

West Virginia.—At the only active Portland cement-mill in West Virginia in 1906 the reported production decreased by reason of idleness during the installation of new machinery and additional kilns to increase capacity. The enlarged factory will have an output for next year much in advance of that for previous years, if nothing unforeseen occurs. Two other plants which were located in this State have been discontinued. One has failed to produce any cement for several years, and the other was never wholly completed.

Wisconsin.—This state has long been a producer of natural cement, but until now has never had a plant for producing Portland cement. At present, however, such a plant is under construction near Baileys Harbor, in Door County. The material used will be marl of very high grade. This plant will have a capacity at the start of 2,000 barrels of cement a day. The increase of the plant's capacity depends on the success of the venture.

NATURAL CEMENT.

The natural-cement industry in 1906 declined in production as compared with the output of the preceding year. This industry fluctuated between a production of 7,000,000 and 8,000,000 barrels from 1900 to 1904, when it fell to a little more than 4,500,000. In 1905 it decreased to a little less than 4,500,000 and in 1906 it stood at just above the 4,000,000 mark.

It seems unlikely that this form of cement making will ever revive to a very marked extent, because, although there will always be work for which natural cement can be used with perfectly satisfactory results, there are many kinds of work for which it is unsuited. Besides that, the result of the process of making natural cement is always uncertain, depending on chance to a great degree, while the result of making cement in rotary kilns, with the machinery which produces a scientific mixture of ingredients that varies only between well-defined limits, is nearly certain.

A number of natural-cement companies have changed their mills entirely, installing rotary kilns preparatory to Portland production; a few have added Portland mills to their natural-cement mills, and several plants that formerly produced both kinds of cement have abandoned, at least for the present, the production of the natural variety and in 1906 produced Portland cement only. A large number of plants which for years made big records as producers of natural cement, during the year even stood idle in the States where this industry has been most flourishing.

PRODUCTION.

The total production of natural cement in the United States in 1906 amounted to 4,055,797 barrels, and had a value of $2,423,170. This quantity is less than 500,000 barrels below the production for the preceding year, but it shows a larger falling off than was then shown. However, although the quantity of natural cement produced was so much smaller than the quantity of Portland, yet the reports from the factories from various parts of the country seem to indicate that the percentage of natural cement left in the bins unsold at the close of the year was less, proportionately, than that which remained unsold of the Portland output.

The following table shows the quantity and the value of the natural cement made in the United States in 1904, 1905, and 1906:

Production, in barrels, of natural cement in 1904, 1905, and 1906, by States.

State.	1904.			1905.			1906.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
Georgia	2	66,500	$37,750	3	89,167	$51,040	3	[a] 180,500	$98,075
Illinois	3	360,308	113,000	3	368,645	116,549	3	365,843	118,221
Indiana	13	735,906	367,953	12	527,600	211,040	12	600,000	240,000
Kansas	2	210,922	79,456	2	230,686	110,750	2	238,311	129,781
Kentucky	2	264,104	132,052	2	207,500	83,000	2	170,194	95,539
Maryland	4	65,000	32,500	4	55,324	28,694	4	[a] 63,350	32,675
Minnesota	2	138,000	65,620	2	115,314	57,643	2	....	....
Nebraska	1	....	....	1	....	....	1	....	....
New York	19	1,911,402	1,138,667	16	1,926,837	1,332,809	16	[a]1,515,866	1,055,785
North Dakota	1	....	....	1	....	....	1	....	....
Ohio	1	....	....	1	64,791	51,235	1	....	....
Pennsylvania	5	770,897	298,533	5	748,057	306,555	4	744,403	560,534
Texas	1	....	....	1	....	....	1	....	....
Virginia	2	93,292	59,619	2	....	....	1	....	....
West Virginia	1	....	....	1	....	....	0	....	....
Wisconsin	2	250,000	125,000	2	139,128	63,737	2	177,330	92,560
Total	61	[b]4,866,331	2,450,150	58	[c]4,473,049	2,413,052	55	4,055,797	2,423,170

[a] As shown by the returns to this office, a small quantity of hydraulic lime was produced in Georgia, Maryland, and New York. The combined output of these States is 40,800 barrels, valued at $19,300, and is included in the total of natural cement production for 1906.
[b] The States combined for 1904 and 1905 are noted in the text of the reports for those years.
[c] The States wherein the cement product was combined with that of some other State for 1906 are given in the text below.

The combinations of figures for total State productions necessary to conceal individual outputs in 1906 are as follows:

Wisconsin, North Dakota and Minnesota are grouped together; Kentucky, Ohio, and Virginia form a second group; and Texas and Kansas complete the combinations. As is the custom, the State making the largest contribution to the total in these groups carries the entire quantity.

New York ranks first, as always, in this production, with Pennsylvania second, and Indiana third.

THE NATURAL-CEMENT INDUSTRY, BY STATES.

The following statement includes only States which have plants that actually manufactured natural cement in 1906, or which have plants that are reported as likely to become active at any time. In a number of States that have for years reported productions of this oldest of all cements, only idle plants now exist; and in several States, as in Florida, the works are completely dismantled. Thus the States recorded do not include all those in which abundant materials for this and other varieties of cement may be or have been found.

Georgia.—There were three plants producing natural cement in Georgia in 1906, and they all had a prosperous year. Two of them were closed long enough to install new machinery and to make necessary repairs. Practically the entire output of these plants was sold, so that but a small number of barrels were left on hand at the close of the year, though they all ran ahead of their productions for 1905. No new plants were reported for 1906.

Illinois.—In Illinois there are three natural-cement plants, and all of them were active in 1906. Of the two older plants, one was a continuous producer throughout the year, but its production was not so large as that for 1905; and the other, though idle a part of the time because of a scarcity of labor, still ran slightly ahead of its 1905 output. The third plant produced more cement than was made in 1905. It was closed down three months for repairs, and had some of its stock left in the bins at the close of 1906.

Indiana.—The condition of the cement industry in Indiana remains practically the same as it was in 1905. Most of the mills in what is known as the Louisville district, which for many years was one of the great centers of production for natural cement, now find it more profitable to remain inactive and allow their "quota" to be burned and ground in one of the big mills, and handled by the general selling agent for the various companies, than to make and sell their product as individuals. There were, however, several mills besides those which made cement for the idle plants that were active in 1906, but none of them ran for more than a few months. The prospect of converting a number of these factories into Portland-cement plants is being seriously considered in this region. The quantity of natural cement manufactured in this State was slightly above that produced during 1905. The sale of the output was readier and less of it remained in stock at the end of the year than in 1905.

Kansas.—The natural-cement industry in Kansas is much older than the manufacture of Portland cement, and the two plants that produced natural cement in 1906 ran ahead of the output for 1905, though the increase was but slight. One plant was closed down for a few weeks in order to dispose of the stock on hand and avoid over production; and the other ran continuously. In each only a small percentage of the output was left on hand at the close of the year. One of these companies is contemplating the enlargement of the factory to produce Portland as well as natural cement, as an abundance of suitable material for such a production is available, but no final steps have yet been taken in the matter.

Kentucky.—The two mills in Kentucky which make natural cement were active in 1906. They are situated on a ledge of rock on the Kentucky side of the Ohio River, and are owned by the same company. Their output during 1906 was not quite equal to that of 1905. They ran continuously throughout the year.

Maryland.—Only two natural-cement mills were active in Maryland in 1906. Two others were idle, one of them reporting that it has closed down permanently. The other was idle because there was no demand for natural cement which it could supply. The active mills produced small outputs, and neither of them ran continuously throughout the year. One of the four companies in Maryland has under consideration the erection of a mill to produce Portland cement, but the plant, if built, will be located in a neighboring State.

Minnesota.—Owing to a lack of plants in neighboring States, the production of natural cement in Minnesota has continued to be profitable, even after the industry waned in other localities, but in 1906 there was but a small production in the State, and a lack of trade is reported. Both of the two plants were active, and their production ran a few thousand barrels in advance of that for 1905. Each of the mills was idle for a short period in the winter months, partly because of the severe weather and partly because the demand was not good.

Nebraska.—The plan to start up the single cement factory in Nebraska and make natural cement in 1906 was not carried out and the plant was idle through the year, because there was no demand for natural cement in this State.

New York.—The natural-cement output for the State of New York was made by nine plants in 1906, this fact showing very clearly the extent to which this branch of the cement industry has declined in the Rosendale district, which was for many years to the natural-cement production what Pennsylvania now is to the Portland output. Nearly every one of the nine active plants produced less cement than in 1905. One company was overhauling its mills throughout nearly the whole season; a number of the plants were idle during the winter months; another company reports that a shut down of one-third of the usual time of activity was due to lack of orders; still another reports several months' idleness for the same reason. The companies that were active ran their plants on about half time for at least a portion of the season. Six companies report that their factories were closed down throughout the year, and one company which in former years invariably recorded a large production reports that the plant has practically ceased to make cement and has turned to the manufacture of lime and other similar products.

North Dakota.—The single cement plant in North Dakota reported a small production in 1906, being idle part of the season on account of the scarcity of labor. No cement is produced here through the winter months, because of the severity of the weather.

Ohio.—Two natural-cement plants were idle and one was active in Ohio in 1906. One of these plants is idle because the owner does not desire to run his factory, neither does he wish to sell. The other plant stood idle through the year because of the small profit to be had by running the factory. The third plant was active through the entire year, except a short time for necessary repairs, made a fine production, and sold it all, closing the year with empty storage bins.

Pennsylvania.—In Pennsylvania there were no plants devoted exclusively to the production of natural cement in 1906. The entire quantity produced there was made by plants that were also engaged in manufacturing Portland cement, and at all of these the production of Portland was much larger than that of natural-rock cement. These plants, four in number, produced an output smaller than that of the preceding year by only a few thousand barrels. They were all active continuously, except where it was necessary to close down a few weeks for repairs, and the product was almost completely disposed of when the year closed. One plant that had a suitable equipment for the production of natural cement remained idle all the year, so far as that part of the plant was concerned. No new natural-cement plants are reported.

Texas.—The natural cement made in Texas in 1906 was manufactured by a plant which also had a production of Portland cement. In 1906 its production of natural cement ran ahead of that for 1905, though such was not the case with its other output. The remaining factory for producing natural-rock cement was idle throughout the year. It has not been active for several years, and it is doubtful if it will ever be fired again as it now stands.

Virginia.—In 1906 the natural-cement industry in Virginia was not very prosperous, though the output of its one active plant was but little less than double its output in 1905. The plant was idle during some bad winter weather, and also by reason of the limited demand for this variety of cement. However, at the close of the year, only a small portion of the product was unsold. The other plant which was active in the early part of last year, became idle late in 1905 and remained so through 1906. It is reported that this factory has permanently abandoned the natural-cement industry. The total production of the State in 1906 was somewhat in excess of that for 1905.

West Virginia.—Neither of the plants in West Virginia which have in the past produced natural cement was active in 1906. One seems to have been abandoned completely and the other is reported to be involved in litigation.

Wisconsin.—Two natural-cement plants have been active in Wisconsin for many years until 1906, when one of them was idle continuously by reason of the lack of demand for this variety of cement. This plant may be offered for sale to a company projecting the erection of a factory to produce Portland cement. The other mill was active during the greater part of the year and made a large quantity of cement. This production, however, fell short of that for 1905 by a few thousand barrels. It was sold before the close of the year, but the failing demand for this variety of cement was apparent in Wisconsin as in other States.

PUZZOLAN CEMENT.

The slag-cement industry continues to be of slow growth, for in 1906 only one plant for making puzzolan or slag cement was finished and started to work. It is located in New York State. This is the first time this variety of cement has been made in New York. An advantage of the slag-cement industry lies in the fact that it utilizes and consumes a product of steel and iron foundries which has for years been troublesome to dispose of and regarded as a waste product. The variety of cement known as puzzolan, or simply as slag cement, is not burned in rotary kilns, and should not be confused with Portland cement made with slag as a basis and burned in rotaries.

PRODUCTION.

Although eight States were engaged in producing the 481,224 barrels of puzzolan cement, which made the total production in 1906, yet it is impossible to place the individual output against each State in the table, because six of the eight States have only one slag-cement plant. The other two States have each two plants, and so, in combination with another State production, their figures may be given without revealing individual figures.

The combinations made in the following table are: Two plants in Alabama, one in Kentucky, and one in Illinois, two plants in Ohio and one in Pennsylvania, and one plant each in Maryland, New Jersey, and New York.

The following table shows the total production of puzzolan or slag cement in the United States in 1904, 1905, and 1906, together with the number of plants in each State:

Production, in barrels, of slag cement in the United States in 1904–1906, by States.

State.	1904.			1905.			1906.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
Alabama	2	187,677	$141,402	2			2		
Illinois	1			1	106,236	$80,616	1	175,942	$168,160
Kentucky				1			1		
Maryland	1			1			1		
New Jersey	1			1			1	54,161	60,478
New York							1		
Ohio	2	115,368	85,249	2	276,211	191,998	2	251,121	184,283
Pennsylvania	1			1			1		
Total	8	303,045	226,651	9	382,447	272,614	10	481,224	412,921

THE PUZZOLAN-CEMENT INDUSTRY, BY STATES.

The record of slag-cement-producing plants in the States which contributed to the quantity of this variety of cement made in the United States in 1906 is as follows:

Alabama.—There were two active puzzolan-cement plants in Alabama in 1906, and together they produced an output which was nearly twice as large as that for 1905. These plants are managed and run by one company, though but one of them is owned by that company. The people owning the second plant have leased it for the past few years to the company now running both plants. No idleness is reported in these mills, beyond the closing down for needed repairs, which comes to nearly all factories. Better prices, as well as an increased production, was the rule for these plants in 1906.

Illinois.—But one plant in Illinois manufactures slag cement, and its output in 1906 was considerably larger than that for the preceding year, as in that year, however, the entire quantity of puzzolan cement manufactured was consumed by the company itself in its construction work. Slag cement for commercial purposes is no longer made by this plant, and its whole period of manufacture for the year did not exceed five months.

Kentucky.—The single plant in Kentucky which produced slag cement in 1906 was started up in 1905; it was described in the report on cement for that year. This year the company reported a good production. Kentucky now contributes her quota to each of the three varieties of cement reported by this Bureau.

Maryland.—There has never been more than one puzzolan-cement plant in Maryland, and in 1906 it was active for only a short time, producing but a small output. It was then adjudged bankrupt, and a trustee was appointed.

New Jersey.—The one slag-cement plant in New Jersey was active in 1906 and ran continuously except for the three winter months. Its output was a little less in quantity than that for the previous year, but a higher price was obtained for it than could be had in 1905.

New York.—The plant of the Niagara Cement Company in New York began producing puzzolan cement in the spring of 1906, and ran continuously during the rest of the year, except for such small shut-down periods as are incidental to initial runs. This factory is in Buffalo, and has a capacity of 1,000 barrels of slag cement a day. It is the first plant built in the State of New York for producing this variety of cement.

Ohio.—There were two plants for the manufacture of puzzolan cement in Ohio in 1906. Both of them were in operation, one running slightly ahead and one slightly behind the production for 1905. Each of these plants was shut down for a few months, and in one of them extensive improvements were made. Although one other State besides Ohio has two puzzolan plants, yet Ohio in 1906 produced more than twice as much of this kind of cement as any other State, and more than the combined product of any two other States.

Pennsylvania.—The plant which produces puzzolan cement in Pennsylvania is at Sharon, and its production in 1906 was more than a third larger than in 1905. It was idle during a part of the winter on account of the dullness of business incident to that season.

IMPORTS AND EXPORTS.

IMPORTS.

Hydraulic cement is recorded in the custom-houses in pounds when brought into this country from foreign places. Reduced to barrels, the total quantity imported in 1906 was 2,205,710, valued at $2,950,268. The total quantity withdrawn for consumption in 1906 was 2,274,677 barrels.

The following table shows imports of all hydraulic cements into the United States, by countries, from 1903 to 1906:

Imports, in barrels, of hydraulic cements into the United States in 1903–1906, by countries.

	1903.	1904.	1905.	1906.
United Kingdom	146,994	16,365	33,978	464,940
Belgium	737,576	394,368	335,154	563,590
France	14,866	34,912	18,864	64,227
Germany	1,377,414	585,563	456,325	871,579
Other European countries	27,415	7,538	602	49,770
British North America	4,421	566	417	9,589
Other countries	9,265	7,091	1,237	182,015
Total	2,317,951	1,046,403	846,577	2,205,710

RELATION OF DOMESTIC PRODUCTION AND CONSUMPTION TO IMPORTS.

The following table is designed to show the yearly increase in the production of Portland cement in the United States, the fluctuations in natural cement, and the variations in imports for consumption of hydraulic cements into this country since 1901:

Comparison of production of Portland and natural-rock cement, in barrels, in the United States with imports for consumption of hydraulic cement, 1901–1906.

Year.	Natural cement.	Portland cement.	Total of natural and Portland cement.	Imports.
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
1906	4,055,797	46,463,424	50,519,221	2,274,677

The puzzolan-cement production, which is not included in this table, and which has been recorded in these reports only since 1901, is as follows: 1901, 272,689 barrels; 1902, 478,555 barrels; 1903, 525,896 barrels; 1904, 303,045 barrels; 1905, 382,447 barrels; 1906, 481,224 barrels.

In the following table it is impossible to make comparison between domestic Portland cement and imported Portland cement, for the reason that the figures showing the imports or exports of cement to or from this country are not divided into classes, such as Portland, natural, or puzzolan cements, but are received at the Bureau of Statistics grouped under the general head of "hydraulic cements." Hence the table shows a comparative statement of the production of Portland cement in the United States with the entire quantity of hydraulic cement imported into and consumed in the United States, in 1891, 1904, 1905, and 1906.

Comparison of domestic production of Portland cement with consumption of Portland and all imported hydraulic cements, 1891, 1904, 1905, and 1906, in barrels.

	1891.	1904.	1905.	1906.
Production of Portland in the United States	454,813	26,505,881	35,246,812	46,463,424
Imports (entered for consumption)	2,988,313	968,409	896,845	2,274,677
Total	3,443,126	27,474,290	36,143,657	48,738,101
Exports (domestic)		774,940	897,686	583,299
Consumption	3,443,126	26,699,350	35,245,971	48,154,802
Percentage of production of Portland to consumption in the United States	13.2	99.2	100	96.49

The apparent decrease in the percentage of production to consumption in the United States in 1906 is explained by the fact that notwithstanding the greatly increased output of Portland cement, the demand exceeded the supply. On the western coast this deficit was most sharply felt, but it was a factor in nearly every State in the Union in 1906, and in many places during the early part of the year building operations involving the use of large quantities of cement had to be suspended pending the arrival of that material from some other than the local market.

The result of this shortage was an unusual and pronounced increase in the quantity of cement sent to this country from abroad during the latter portion of 1906.

This increase is very clearly shown in the figures sent to this Bureau by the Bureau of Statistics.

EXPORTS.

The fact that in 1906 the quantity of cement exported from this country amounted to but little more than 500,000 barrels, or but a trifle over half as much as was exported during the preceding year, marks the fact already stated, namely, that the supply of cement in the United States in 1906 was not equal to the demand.

The total quantity of hydraulic cement exported from the United States in 1906 was 583,299 barrels, valued at $944,886; decidedly less than the quantity exported in 1904 or 1905.

The following table shows exports of hydraulic cements since 1900:

Exports of hydraulic cement, 1900–1906, in barrels.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1900	100,400	$225,306	1904	774,940	$1,104,086
1901	373,934	679,296	1905	897,686	1,387,906
1902	340,821	526,471	1906	583,299	944,886
1903	285,463	433,984			

The following table shows the apparent total consumption in the United States of all hydraulic cements in 1906:

Total consumption of hydraulic cements in 1906, in barrels.

Total production in United States	51,000,445
Imports withdrawn for consumption	2,274,677
Total	53,275,122
Exports	583,299
Total consumption	52,691,823

The importance of cement as an item of export from America is not sufficiently considered in this country, though it receives some attention in the foreign markets.

In 1906 it was impossible to give this matter serious consideration, because of the shortage at home. But, as before suggested, with the rapid increase in the number of cement factories and the possibility of dull years in construction requiring cement, it seems only wise to seek to build up the export trade in American cement before the strain arrives.

The falling off during the last few years of the exports of Portland cements from other countries into the United States is being seriously considered in the foreign markets. Germany, from 1893 to 1896, sent us $1,261,000 worth of cement, which was almost half of the entire quantity exported, while in 1901 she could get orders for only $904,400 worth from this country, and in 1904 this amount declined to $616,300.

In other words, whereas in the years from 1900 to 1903 the United States took about 38 per cent of Germany's export trade in cement, in 1904 less than 15 per cent was taken. Exports from Great Britain and from Belgium to the United States have experienced a similar decline. In fifteen years the total imports of cement into this country from abroad have been reduced about 66 per cent, and in Great Britain the exports of cement to America have fallen from 50 per cent to 5 per cent of the quantity sent out of that country.

CEMENT IN FOREIGN COUNTRIES.

Canada.—A summary of the mineral production of Canada for 1906, issued in advance of the Annual Report of the Geological Survey of Canada, states that the total quantity of Portland cement made in Canada in 1906 was 2,152,562 barrels, as compared with 1,541,568 barrels in 1905, an increase of 610,994 barrels, or 39.6 per cent. The total sales of Portland cement were 2,119,764 barrels as compared with 1,346,548 barrels in 1905, an increase of 773,216 barrels, or 57.4 per cent.

Fifteen companies were operating plants in Canada during 1906, with a total daily capacity of about 10,500 barrels, viz, one in Nova Scotia, two in Quebec, eleven in Ontario, and one in British Columbia. At least four plants were under construction during the year, of which the total initial daily capacity will be about 4,700 barrels.

Detailed statistics of production in 1905 and 1906 are as follows:

Production, in barrels, and value of cement in Canada in 1905 and 1906.

	Portland cement.		Value of cement sold.
	Manufactured.	Sold.	
1905	1,541,568	1,346,548	$1,913,740
1906	2,152,562	2,119,764	3,164,807

The average price per barrel at the works in 1906 was $1.49 as compared with $1.42 in 1905.

The imports of Portland cement into Canada in 1906 were 694,503 barrels, valued at $778,706, an average of $1.12 per barrel. The duty is 12½ cents per hundred pounds, and the barrels of cement are reckoned at 350 pounds each.

Very little cement is exported from Canada, so that the consumption is practically represented by the Canadian sales and the imports. The total consumption of Portland cement in Canada for the past six years is as follows:

Portland cement consumed in Canada, 1901–1906, in barrels.

1901	872,966	1904	1,694,988
1902	1,139,548	1905	2,264,106
1903	1,401,419	1906	2,814,267

The quantity of natural cement marketed in 1906 was 8,610 barrels, valued at $6,052. The decrease in the value of natural-rock cement in 1906 as compared with 1905 was $4,222. The increase in the value of Portland cement for that period was $1,251,067, or 58.86 per cent in quantity and 65.37 per cent increase in value. This increase in quantity and value of Portland cement is taken from a table prepared to show the mineral products which have had the greatest growth in output in 1906, and in the text preceding this table Portland cement is mentioned as showing a greater growth than any other product during that year. The relative importance of Portland cement in the various industries contributing to the total mineral output of Canada is shown by the fact that it contributed 2.75 per cent in 1905 and 3.96 per cent in 1906.[a]

Germany.—The cement industry in Germany was very profitable in 1906 in comparison with its condition for the last four or five years. Eight years ago companies engaged in the manufacture of cement in Germany were paying 14 per cent dividends. Four years ago these dividends had fallen to 4½ per cent. In 1906 they rose to 11 per cent again.

This increase was due, first, to the building activity throughout the country; second, to steadiness in prices; and third, to the increase in exports of cement to the United States by reason of the demand for cement on the western coast. The San Francisco and the Valparaiso earthquakes were important factors in creating a foreign market for German cements.

There are in all 320 cement mills in Germany, of which 117 manufacture Portland cement. In 1906 a number of new mills were put into operation, though the business is already overcrowded, and the margin of profit very small. In Berlin cement is often sold at a profit of only 50 pfennigs (11.9 cents) per barrel to the manufacturer. In 1906 prices in that city averaged about $1.35 per barrel of 170 kilograms or 375 pounds, including packing.

Germany has pushed her export trade into far-off markets, and now has direct communication with many of them in steamers flying her own flag. British and Dutch South Africa, Portuguese East Africa, British Molucca, Dutch India, China, France, Norway, Sweden, Russia, Mexico and both coasts of South America, British India, Hongkong, Kamerun, Australia, and the Philippines are all countries wherein German cement is marketed.

Any attempt on the part of the United States to compete in these markets should be made with a distinct knowledge of the excellent quality of the German product. Inferior cements, or badly packed barrels carrying superior cement, can not successfully compete with them. A letter from the American consul at Port Limon, in answer to the inquiry of an American cement company regarding shipments of cement to Costa Rica, says:

> The only reason why German and Belgian cements are preferred to the American article is the way they protect theirs, by using an iron drum instead of a wooden barrel, for all shipments to this coast. The reason for this is the climate. During a great part of the year it is so moist that clothing hung for a week in a wardrobe will mildew. Barrels of cement sometimes become broken and often have to stand on open cars or an uncovered dock for days. The cement becomes moist, hardens, and is worthless. Our largest importers claim that their sole reason for buying German instead of American cement is that the former stands the climate better, and not that it is cheaper; they prefer the American article.

The combination between German and Belgian cement makers made late in 1905 is framed in terms to include the French and English cement trade in Holland in its regulations. The general syndicate

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[a] Summary of the mineral production of Canada for 1906: Geol. Survey Canada, 1907.

which now includes the whole German territory has succeeded in strengthening, to some extent, the confidence of the manufacturers in the maintenance of fair prices. This agreement of the cement association has, however, excluded the middlemen, in consequence of which there is much complaint, so that the union of German dealers in building materials, including 700 firms, which handle 1,300,000 tons of cement annually, planned a buying syndicate and demanded an extra rebate of from 6 to 10 per cent from manufacturers for its members. This being refused, further conflict threatens the cement industry in Germany, and the union dealers are discussing the erection of their own factories.[a]

Holland.—In the Netherlands tnere is only one very small cement mill, which produces not more than 2,000 tons (11,200 barrels) a year, and therefore plays but a small part in the cement trade of the Netherlands. The official statistics of the Government do not specify the quantity of cement annually imported into the Netherlands, but its use in concrete construction as applied to bridges, buildings, and tunnels is increasing from year to year.

Cement sells in Holland at about $1.45 per barrel, and the bags in which it is packed, if returned, are credited to the purchaser at 5 cents each. A reduction of 32 cents per 1,000 kilograms (2,204.6 pounds) is made to buyers of large quantities, and an additional reduction of 8 cents per 1,000 kilograms to those buyers who act in conformity with the rules of the German trust. This makes the actual cost of cement delivered at Rotterdam or Amsterdam about $5.80 per 1,000 kilograms, or a few cents more than $1 per barrel.

American cement of good quality could no doubt find a market in the Netherlands, provided the Dutch consumer could be induced to drop connection with the German trust by a guarantee of lower prices and of a supply in the quantities needed at stipulated times.[b]

England.—The many inquiries for cement to be used in rebuilding San Francisco have led the United States consul at Hull to give the following facts:

About 4,000 tons of limestone are brought to Hull each week, and the production of cement is about 5,000 tons per week. The supply could be increased under pressure. The cost of the barrels is larger than in America and adds materially to the price of the cement. Bags cost 25 cents extra each, but on the return of the empty bag most of this is refunded. Since the San Francisco earthquake the demand for cement has been exceptionally large, and it is difficult to fill orders now, as the supply is running short. The demand for British cement on the Pacific coast for the past five years has been light, and the British consul at San Francisco states that the cement trade there has during recent years been largely captured by Belgium and Germany.[c]

South Africa.—This country has presented, since the British occupation, one of the best markets in the world for cement, because of new activity in the public works department. During the past few years importations of cement have not fallen much short of $1,000,000, and in 1903 the records show $2,500,000 worth of cement imported into South Africa. America has had a very minor part in supplying this demand, shipping to the Transvaal less than $400 worth in 1903,

[a] Daily Cons. Repts. Nos. 2804 and 2818, February 27 and March 15, 1907.
[b] Daily Cons. Repts. No. 2545, April 23, 1906.
[c] Daily Cons. Repts. No. 2591, June 16, 1906.

and about double that in 1904, while Germany and England each supplied from $250,000 to $500,000 worth of cement in those years.

Before 1898 the United Kingdom furnished the bulk of all cement to Africa; but with the subsidizing of steamship lines, and cheap rates to seaports in Germany, that country began to supply cement and acquired about 16 per cent of the South African trade. In 1902 Belgium and Denmark began to compete, and the list was as follows: United Kingdom, 43.4 per cent; Germany, 37.2 per cent; Belgium, 18 per cent, and the remaining 1.4 per cent was divided between Denmark and other European countries, the United States not competing at all. In 1903 Austria, France, Italy, Holland, and Sweden were competitors, and acquired a part of the trade before held by Germany. Great Britain increased to 51.4 per cent and Germany fell to 23 per cent. From that time the United Kingdom has gradually increased its trade and advanced from 70 per cent in 1904 to about 90 per cent in 1905. In Great Britain the claim is made that this result is due to the firm and united action of the British manufacturers, to the uniform quality of their product, and to the customs preference, though it is also claimed that the subsidies paid to the steamship lines of the Germans offset this last item.

The one cement factory in South Africa is situated just outside Pretoria, and was a failure up to a year ago, when an American was placed in charge of it. An American kiln was immediately substituted for the one formerly used, and other American ideas were adopted. The result in 1905 was a production of 75,000 barrels of cement, which was marketed in Pretoria at $6.08 per barrel, and many times that quantity could have been sold in Johannesburg alone. The capacity of this factory is to be trebled, and other mills are being planned for location in the Orange River colony near Johannesburg.[a]

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[a] Daily Cons. Repts. No. 2772, January 19, 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 manufactured and not the production of clay.

The clay-working industries have long been recognized as of the highest importance in the commercial development of the country, and it can hardly be denied that the building and structural industries are a correct index of the prosperity of the nation. This being the case the year 1906 was a most prosperous one, as both of the great divisions of the industries enjoyed, on the whole, unexampled prosperity. The pottery industry, which fell behind in 1904 and made a gain of $2,760,624, or 10.97 per cent, in 1905, surpassed even this in 1906, and showed a gain of $3,521,990, or 12.62 per cent, while the brick and tile industry, which increased in value $15,913,316 in 1905, reported a gain of $7,813,544, or 6.42 per cent, in 1906. In spite of this general prosperity the value of the clay products was not so great in spots as in 1905, eleven States showing losses.

As the brick and tile products are largely consumed in structural projects, they rise and fall in volume with the building industry. The cities are the principal consumers of clay products, and, as pointed out elsewhere in this report, in some of the leading cities, notably New York and Brooklyn, building declined, and the clay-working industries suffered correspondingly.

The field for the clay worker is an ever-widening one, and although structural materials of many kinds may come and go, the use of clay products continues, and the present seems to indicate that the place of burnt clay in the building industry will never be supplanted entirely, or even to any great extent. As a paving material its use will continue to increase, especially if the combination of brick and asphalt, the former as foundation and the latter as filler and top, proves to be a success.

The labor situation in the building trades and clay-working industries was good in 1906, no general strikes being inaugurated, though of course there is always more or less disturbance of local character. The low cost of brick, from the widespread character of the industry, will ever be a factor in its favor, but the high cost of putting brick into the wall threatens to be a serious menace to its use. One of the chief features of the brick industry in 1906 was the fall in the price of brick in New York and Chicago, and the cause was the same—competition. In New York the price had been high enough to attract competition from neighboring States; in Chicago the competition was purely local.

The only important branch of the clay-working industries to show a decline in value of product was common brick, and the loss here was so slight, $93,687, or 0.15 of 1 per cent, that it might be considered nil. While the total value declined, the total number of common brick increased 209,684,000, or 2.14 per cent. Had the prices of 1905 been maintained this product would have gained over $1,000,000. The average value of common brick decreased from $6.25 per thousand in 1905 to $6.11 in 1906, and front brick declined from $13.12 in 1905 to $12.79 in 1906; vitrified paving brick increased from $10.07 to $10.45, its maximum.

The total value of all clay products marketed in 1906 was $161,032,722, compared with $149,697,188, a gain of $11,335,534, or 7.57 per cent. The increase in 1905 over 1904 was $18,673,940, or 14.25 per cent. The prospects for 1907 are that the value of the clay products will be even greater than in 1906 and that the figures will reach nearly $175,000,000.

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 be impossible. Thanks are also extended to the officials who have supplied the information concerning the building operations of the various cities of the country, and to the clay-working press for its support and appreciation.

As in previous years, the State geological surveys of Illinois, Iowa, Maryland, and North Carolina have cooperated in the collection of the statistics of their States, the complete returns being due largely to the efforts of the officers of these State surveys. For 1906, in addition to the foregoing, the State geological survey of South Carolina cooperated in that State, with most satisfactory results.

BUILDING OPERATIONS.

The following tables show the number of permits and the cost of buildings erected thereunder in the leading cities of the country in 1905 and 1906, the increase or decrease in the cost of the buildings erected in each city in 1906, and the total increase, together with the percentage of increase or decrease in each case, and the percentage of the total increase; also the number and value of the fireproof buildings, with their cost, and the number of wooden buildings, with their cost. In some instances more than one building is erected under the same permit; the cost given is that of the building or buildings erected.

From this table it will be seen that, in the 49 cities considered, the number of permits issued decreased from 185,806 in 1905 to 180,574 in 1906, a loss of 5,232, or 2.81 per cent, while the cost of the buildings erected under these permits increased $34,090,096, or 5.29 per cent. This is a large increase in the cost of the buildings, but it is nevertheless very much smaller than the increase of 1905 over 1904, which was $175,960,866.

Of these cities 17 show a decrease in the value of the buildings erected, namely: Allegheny, Baltimore, Brooklyn, Cambridge, Chicago, Cincinnati, Columbus, Indianapolis, Kansas City, Mo., Milwaukee, New York, Omaha, Pittsburg, Providence, Reading, Scranton, and Washington. The smallest decrease shown was at Scranton, $38,854, or 1.75 per cent, while the largest was at New York, $23,067,872 or 12.95 per cent. There appears to be no general reason for the decline in the cost of buildings in these cities, some of the causes being local strikes, high cost of labor and material, high rates for money, and overproduction of buildings in 1905. The largest increase would naturally be looked for in San Francisco in view of the great destruction wrought in that city by the earthquake and fire of April 18–20, 1906. The figures for this city from May 19 to December 31 show that permits were issued to erect buildings to cost $34,927,396, an increase of $16,658,643 over 1905. Although unavoidable delays retarded building operations so that comparatively little progress was made until the fall, this is a remarkable showing and is a great credit to the city.

Where normal conditions prevailed, Boston showed the largest actual increase, $10,699,994, while Kansas City, Kans., showed the largest proportional gain, 209.07 per cent, and Seattle, Richmond, Va., Atlanta, St. Joseph, Mo., Toledo, Syracuse, New Haven, Worcester, Mass., Cleveland, Jersey City, St. Louis, Detroit, and New Orleans also showed large gains, ranging in the order named from 77 per cent to 25 per cent.

New York, notwithstanding its big loss, is still by a large margin the foremost city in cost of building operations, reporting more than twice as much as the next city, Brooklyn. The cost of the buildings in these two cities constitutes more than one-third of the total value reported for the 49 cities.

On the basis of one building to a permit, which is generally the case, the average cost for each building in 1906 was $3,758; in 1905 it was $3,469; in 1904, $3,337, and in 1903, $3,066. The average cost per permit in the leading cities was as follows: New York, $18,076; Brooklyn, $3,951; Chicago, $6,081; Philadelphia, $2,278; San Francisco, $6,143; St. Louis, $3,331; Boston, $6,931; Los Angeles, $1,977; Pittsburg, $4,112; and Detroit, $3,234.

The relative rank of the various cities in cost of buildings varies but little. The first four were the same in 1905 and 1906, as given above. St. Louis was fifth in 1905 and sixth in 1906, changing places with San Francisco, which nearly doubled the cost of its buildings on account of abnormal conditions; Boston was tenth in 1905 and seventh in 1906; Los Angeles was ninth in 1905 and eighth in 1906; Pittsburg was seventh in 1905 and ninth in 1906; Detroit was twelfth in 1905 and tenth in 1906; Baltimore, which was abnormal in 1904 and 1905 on account of the fire of 1904, was eighth in 1905 and twelfth in 1906.

Building operations in the leading cities of the United States in 1905 and 1906.

City.	1905.		1906.			
	Number of permits or buildings.	Cost of buildings.	Number of permits or buildings.	Cost of buildings.	Gain (+) or loss (−) in 1906.	Percentage of gain or loss in 1906.
Allegheny, Pa	816	$2,412,570	713	$2,080,634	− $331,936	− 15.95
Atlanta, Ga	3,499	3,312,931	3,741	5,156,149	+ 1,843,218	+ 55.63
Baltimore, Md	2,976	16,638,200	2,826	12,619,970	− 4,018,230	− 24.15
Boston, Mass	2,249	12,364,747	3,328	23,064,741	+10,699,994	+ 86.53
Brooklyn, N. Y	19,679	73,017,706	18,083	71,442,148	− 1,575,558	− 2.15
Buffalo, N. Y	2,886	7,401,006	2,867	8,686,030	+ 1,285,024	+ 17.36
Cambridge, Mass	470	1,659,875	457	1,458,105	− 201,770	− 12.15
Chicago, Ill	16,150	65,000,000	10,641	64,709,325	− 290,675	− .44
Cincinnati, Ohio	3,307	9,709,450	2,130	7,065,746	− 2,643,704	− 27.22
Cleveland, Ohio	4,976	9,777,145	7,553	12,972,974	+ 3,195,829	+ 32.68
Columbus, Ohio	2,133	5,107,400	2,025	4,006,175	− 1,101,225	− 21.56
Dayton, Ohio	1,176	2,350,000	1,223	2,898,380	+ 548,380	+ 23.33
Denver, Colo	2,455	6,374,537	2,461	7,000,996	+ 626,459	+ 9.82
Detroit, Mich	4,021	10,462,100	4,105	13,275,250	+ 2,813,150	+ 26.88
Fall River, Mass	291	885,625	275	939,325	+ 53,700	+ 6.06
Grand Rapids, Mich	1,486	2,145,265	1,250	2,181,307	+ 36,042	+ 1.68
Hartford, Conn	664	3,076,092	652	3,732,915	+ 656,823	+ 21.35
Indianapolis, Ind	4,041	7,225,325	3,825	5,530,998	− 1,694,327	− 23.44
Jersey City, N. J	1,352	3,330,522	1,503	4,334,244	+ 1,003,722	+ 30.13
Kansas City, Kans	818	1,172,093	541	3,622,670	+ 2,450,577	+209.07
Kansas City, Mo	4,437	10,917,024	3,993	10,765,480	− 151,544	− 1.38
Los Angeles, Cal	9,543	15,382,057	9,358	18,502,446	+ 3,120,389	+ 20.28
Louisville, Ky	2,255	4,506,382	2,916	5,116,917	+ 610,535	+ 13.54
Lowell, Mass	251	878,090	353	901,745	+ 23,655	+ 2.69
Memphis, Tenn	2,882	3,554,883	2,549	4,346,767	+ 791,884	+ 22.27
Milwaukee, Wis	4,166	9,806,729	3,782	9,713,284	− 93,445	− .95
Minneapolis, Minn	4,825	8,905,205	4,724	9,466,150	+ 560,945	+ 6.29
Nashville, Tenn	5,636	2,609,889	5,124	2,840,212	+ 230,323	+ 8.82
Newark, N. J	2,379	10,214,615	1,946	10,411,328	+ 196,713	+ 1.92
New Haven, Conn	467	2,143,240	687	3,018,890	+ 875,650	+ 40.85
New Orleans, La	1,970	4,070,077	....	5,098,773	+ 1,028,696	+ 25.27
New York, N. Y	10,043	178,032,527	8,573	154,964,655	−23,067,872	− 12.95
Omaha, Nebr	885	4,387,464	1,093	4,273,050	− 114,414	− 2.60
Philadelphia, Pa	15,933	34,416,745	17,872	40,711,510	+ 6,294,765	+ 18.28
Pittsburg, Pa	4,273	17,159,443	3,738	15,370,047	− 1,789,396	− 10.42
Providence, R. I	1,358	4,562,950	1,350	3,983,300	− 579,650	− 12.70
Reading, Pa	1,548	2,791,065	1,347	1,645,135	− 1,145,930	− 41.05
Richmond, Va	451	1,501,000	740	2,504,895	+ 1,003,895	+ 66.88
Rochester, N. Y	1,707	5,676,624	1,373	6,175,478	+ 498,854	+ 8.78
St. Joseph, Mo	877	670,195	898	1,052,746	+ 382,551	+ 57.08
St. Louis, Mo	8,285	23,434,734	8,988	29,938,693	+ 6,503,959	+ 27.74
St. Paul, Minn	1,657	8,536,345	2,813	9,537,449	+ 1,001,104	+ 11.72
San Francisco, Cal	5,420	18,268,753	5,686	34,927,396	+16,658,643	+ 91.18
Scranton, Pa	1,144	2,212,929	1,097	2,174,075	− 38,854	− 1.75
Seattle, Wash	7,677	6,704,784	7,194	11,875,397	+ 5,170,613	+ 77.11
Syracuse, N. Y	837	2,275,610	1,057	3,313,261	+ 1,037,651	+ 45.59
Toledo, Ohio	1,139	3,087,142	1,759	4,696,058	+ 1,608,916	+ 52.12
Washington, D. C	7,577	12,308,943	8,453	11,668,347	− 640,596	− 5.20
Worcester, Mass	739	2,182,840	912	2,939,403	+ 756,563	+ 34.65
Total	185,806	644,620,873	180,574	678,710,969	+34,090,096	+ 5.29

The attempt was made for the first time to obtain the statistics of the brick and stone or fireproof buildings as compared with those of wood. Of the 49 cities reporting, 35 were able to give figures showing these classes of buildings, and the results are given in the following table:

Character of buildings erected in the leading cities of the United States in 1906.

	Brick and stone.		Wood.	
	Number of permits.	Value.	Number of permits.	Value.
Atlanta, Ga	134	$2,189,327	1,336	$2,167,921
Boston, Mass	479	14,255,431	1,156	5,855,231
Brooklyn, N. Y	5,802	55,586,860	2,782	9,479,465
Chicago, Ill	5,967	58,238,393	4,674	6,470,932
Cincinnati, Ohio	503	4,691,400	748	1,617,290
Cleveland, Ohio	694	6,694,580	3,582	4,953,193
Columbus, Ohio	594	2,193,075	1,125	1,687,300
Dayton, Ohio	126	1,319,080	910	1,411,870
Grand Rapids, Mich	73	698,681	763	1,175,424
Hartford, Conn	127	2,748,900	136	637,800
Indianapolis, Ind	721	1,954,594	1,903	3,030,592
Kansas City, Mo	413	5,544,000	1,621	3,783,710
Los Angeles, Cal	273	6,489,367	6,564	10,536,473
Louisville, Ky	201	2,877,015	1,415	1,566,530
Lowell, Mass	12	304,109	164	421,155
Memphis, Tenn	154	2,193,458	1,373	1,782,214
Milwaukee, Wis	179	3,532,328	1,633	4,433,820
Nashville, Tenn	259	2,056,750	458	484,579
Newark, N. J	155	5,067,445	1,791	4,740,929
New Haven, Conn	87	1,571,600	257	1,183,100
New York, N. Y	2,588	129,927,135	1,279	5,673,110
Omaha, Nebr	157	2,614,400	712	1,493,560
Philadelphia, Pa	10,987	33,034,770	67	123,450
Providence, R. I	53	1,187,400	719	1,979,400
Reading, Pa	884	1,631,245	....	....
Richmond, Va	293	1,549,576	337	333,207
Rochester, N. Y	159	2,414,739	779	3,031,702
St. Louis, Mo	2,640	27,223,734	3,956	993,332
San Francisco, Cal	599	16,374,092	3,258	14,458,894
Scranton, Pa	60	538,015	518	1,197,800
Seattle, Wash	81	5,001,150	3,170	4,751,329
Syracuse, N. Y	81	1,564,959	511	1,360,737
Toledo, Ohio	110	1,629,997	1,542	2,525,960
Washington, D. C	1,349	9,405,200	1,181	1,089,177
Worcester, Mass	72	1,135,295	394	1,067,105
Total	37,066	415,438,100	52,814	107,498,291

Of the total number of permits or buildings, 37,066, or 41.24 per cent, were brick or stone buildings, and 52,814, or 58.76 per cent, were wooden buildings. The total value of the new buildings in these cities was $522,936,391. Of this, $415,438,100, or 79.44 per cent, represented buildings of stone, brick, or other so-called fireproof material, and $107,498,291, or 20.56 per cent, represented wooden buildings. The number of wooden buildings even in these large cities is considerably greater (42.49 per cent) than the number of fireproof buildings, but the value of the wooden buildings was only a little more than one-fourth of that of the fireproof buildings. The average value of each of the fireproof buildings was $11,208, while the wooden buildings averaged only $2,035.

New York leads in the value of its fireproof buildings, though the number erected was not very large. The average value per building was $50,204. There were no wooden buildings erected in the borough of Manhattan, but in the Bronx 1,279 were erected in 1906, with an average value of $4,436. Chicago was second in value of fireproof buildings, though the average value per building was but $9,760, and Brooklyn was third, with an average value of $9,581. Philadelphia reported the largest number of brick buildings, 10,987, of an average value of $3,007. In St. Louis the average value of fireproof buildings was $10,312.

In wooden buildings San Francisco reported the largest outlay, $14,458,894, an average of $4,438 per building, while Los Angeles reported the largest number of wooden buildings, 6,564, an average of $1,605 per building. Brooklyn's wooden buildings erected in 1906 were valued at $9,479,465, an average of $3,407 each; and Chicago erected wooden buildings at a cost of $6,470,932, an average of $1,384. Reading, Pa., is the only city reporting no wooden buildings erected during the year, there being a city ordinance prohibiting the erection of wooden buildings, while in 10 other cities—Dayton, Grand Rapids, Indianapolis, Los Angeles, Lowell, Milwaukee, Providence, Rochester, Scranton, and Toledo—the cost of the wooden buildings exceeded the cost of the fireproof buildings erected within the year.

PRODUCTION.

In the following table will be found a statement of the value of the clay products of the United States in 1905 and 1906:

Value of the products of clay in the United States in 1905 and 1906, by States and Territories.

State or Territory.	1905.			1906.		
	Brick and tile.	Pottery.	Total.	Brick and tile.	Pottery.	Total.
Alabama	$1,358,626	$34,245	$1,392,871	$1,650,903	$37,996	$1,688,899
Arizona	90,436	....	90,436	93,694	....	93,694
Arkansas	623,871	20,088	643,959	512,694	19,500	532,194
California	3,769,934	95,213	3,865,147	4,265,633	98,597	4,364,230
Colorado	1,548,236	48,995	1,633,231	1,784,005	47,083	1,831,088
Connecticut and Rhode Island	1,503,478	[a] 105,100	1,608,578	1,613,761	[a] 133,444	1,747,205
Delaware	227,064	....	227,064	237,768	....	237,768
District of Columbia	307,109	9,912	317,021	335,139	([b])	335,139
Florida	329,738	([b])	329,738	289,644	([b])	289,644
Georgia	2,097,356	22,390	2,119,746	2,380,367	20,257	2,400,624
Idaho and Nevada	230,780	....	230,780	282,889	....	282,889
Illinois	11,418,779	943,007	12,361,786	11,651,278	982,903	12,634,181
Indiana	5,567,426	932,147	6,499,573	6,224,541	933,693	7,158,234
Indian Territory	374,235	....	374,235	299,790	....	299,790
Iowa	3,321,763	70,359	3,392,122	3,411,027	58,000	3,469,027
Kansas	1,906,360	([b])	1,906,360	2,432,371	([b])	2,432,371
Kentucky	2,249,267	157,083	2,406,350	2,425,214	167,209	2,592,423
Louisiana	821,109	([b])	821,109	894,277	6,420	900,697
Maine	619,294	([b])	619,294	680,370	([b])	680,370
Maryland	1,885,009	364,358	2,249,367	1,763,040	373,499	2,136,539
Massachusetts	1,751,616	298,841	2,050,457	1,895,199	277,534	2,172,733
Michigan	1,719,746	45,961	1,765,707	1,793,367	51,110	1,844,477
Minnesota	1,499,386	([b])	1,499,386	1,603,279	([b])	1,603,279
Mississippi	803,317	15,580	818,897	831,769	19,311	851,080
Missouri	6,160,043	43,368	6,203,411	6,626,775	69,500	6,696,275
Montana	313,006	([b])	313,006	297,299	([b])	297,299
Nebraska	1,006,743	....	1,006,743	990,708	....	990,708
New Hampshire	554,734	([b])	554,734	726,051	([b])	726,051
New Jersey	10,044,191	6,655,334	16,699,525	10,079,611	7,282,658	17,362,269
New Mexico	141,722	....	141,722	152,599	....	152,599
New York	12,858,617	1,627,730	14,486,347	12,008,260	1,868,347	13,876,607
North Carolina	1,006,842	13,319	1,020,161	1,170,568	11,770	1,182 338
North Dakota	232,432	....	232,432	269,873	....	269,873
Ohio	15,278,968	13,024,071	28,303,039	17,023,806	13,990,359	31,014,165
Oklahoma	222,064	....	222,064	241,111	....	241,111
Oregon	380,575	([b])	380,575	506,192	([b])	506,192
Pennsylvania	17,778,122	1,346,431	19,124,553	19,363,794	2,410,817	21,774,611
South Carolina	720,997	28,838	749,835	805,212	25,269	830,481
South Dakota	58,271	....	58,271	58,175	....	58,175
Tennessee	1,329,609	163,670	1,493,279	1,405,458	214,768	1,620,226
Texas	1,618,157	100,788	1,718,945	1,860,963	108,635	1,969,598
Utah	544,578	([b])	544,578	632,344	2,100	634,444
Vermont	112,967	....	112,967	112,368	....	112,368
Virginia	1,994,578	([b])	1,994,578	1,966,078	([b])	1,966,078
Washington	1,133,932	41,100	1,175,032	1,458,324	41,560	1,499,884
West Virginia	822,990	1,195,805	2,018,795	1,194,757	1,588,555	2,783,312
Wisconsin	1,369,665	12,450	1,382,115	1,215,172	12,170	1,227,342
Wyoming	34,556	....	34,556	74,321	....	74,321
Other States	....	502,711	502,711	....	587,820	587,820
Total	121,778,294	27,918,894	149,697,188	129,591,838	31,440,884	161,032,722
Per cent of total	81.35	18.65	100.00	80.48	19.52	100.00

[a] Produced by Connecticut alone. [b] Included in other States.

This table shows that the marketed clay products of the United States in 1906 were valued at $161,032,722, as against $149,697,188 in 1905, a gain of $11,335,534, or 7.57 per cent.

Of the output for 1906, the brick and tile of this classification, the materials which enter most largely into structural and engineering arts, were valued at $129,591,838, or 80.48 per cent of the total, and the pottery, or finer grades of goods, was valued at $31,440,884, or 19.52 per cent of the total. In 1905 these percentages were 81.35 and 18.65, respectively. In fact about these relative proportions have been maintained for quite a number of years. In 1905 the value of the brick and tile reported was $121,778,294 and pottery $27,918,894, and in 1904 they were $105,864,978 and $25,158,270, respectively.

Every State and Territory contributes to the nation's wealth in the production of clay goods, though in Rhode Island and Nevada there were not in 1906 a sufficient number of producers to permit the publication of State totals without disclosing individual statements, so that these States are combined with contiguous ones.

Value of the clay products of the United States, by States, in 1905 and 1906, showing increase or decrease, with percentage of increase or decrease.

State.	1905.	1906.	Increase (+) and decrease (−) in 1906.	Percentage of increase (+) and decrease (−) in 1906.
Alabama	$1,392,871	$1,688,899	+ $296,028	+ 21.25
Arizona	90,436	93,694	+ 3,258	+ 3.60
Arkansas	643,959	532,194	− 111,765	− 17.36
California	3,865,147	4,364,230	+ 499,083	+ 12.91
Colorado	1,633,231	1,831,088	+ 197,857	+ 12.11
Connecticut and Rhode Island	1,608,578	1,747,205	+ 138,627	+ 8.62
Delaware	227,064	237,768	+ 10,704	+ 4.71
District of Columbia	317,021	335,139	+ 18,118	+ 5.72
Florida	329,738	289,644	− 40,094	− 12.16
Georgia	2,119,746	2,400,624	+ 280,878	+ 13.25
Idaho and Nevada	230,780	282,889	+ 52,109	+ 22.58
Illinois	12,361,786	12,634,181	+ 272,395	+ 2.20
Indiana	6,499,573	7,158,234	+ 658,661	+ 10.13
Indian Territory	374,235	299,790	− 74,445	− 19.89
Iowa	3,392,122	3,469,027	+ 76,905	+ 2.27
Kansas	1,906,360	2,432,371	+ 526,011	+ 27.59
Kentucky	2,406,350	2,592,423	+ 186,073	+ 7.73
Louisiana	821,109	900,697	+ 79,588	+ 9.69
Maine	619,294	680,370	+ 61,076	+ 9.86
Maryland	2,249,367	2,136,539	− 112,828	− 5.02
Massachusetts	2,050,457	2,172,733	+ 122,276	+ 5.96
Michigan	1,765,707	1,844,477	+ 78,770	+ 4.46
Minnesota	1,499,386	1,603,279	+ 103,893	+ 6.93
Mississippi	818,897	851,080	+ 32,183	+ 3.93
Missouri	6,203,411	6,696,275	+ 492,864	+ 7.95
Montana	313,006	297,299	− 15,707	− 5.02
Nebraska	1,006,743	990,708	− 16,035	− 1.59
New Hampshire	554,734	726,051	+ 171,317	+ 30.88
New Jersey	16,699,525	17,362,269	+ 662,744	+ 3.97
New Mexico	141,722	152,599	+ 10,877	+ 7.67
New York	14,486,347	13,876,607	− 609,740	− 4.21
North Carolina	1,020,161	1,182,338	+ 162,177	+ 15.90
North Dakota	232,432	269,873	+ 37,441	+ 16.11
Ohio	28,303,039	31,014,165	+2,711,126	+ 9.58
Oklahoma	222,064	241,111	+ 19,047	+ 8.58
Oregon	380,575	506,192	+ 125,617	+ 33.01
Pennsylvania	19,124,553	21,774,611	+2,650,058	+ 13.86
South Carolina	749,835	830,481	+ 80,646	+ 10.76
South Dakota	58,271	58,175	− 96	− .16
Tennessee	1,493,279	1,620,226	+ 126,947	+ 8.50
Texas	1,718,945	1,969,598	+ 250,653	+ 14.58
Utah	544,578	634,444	+ 89,866	+ 16.50
Vermont	112,967	112,368	− 599	− .53
Virginia	1,994,578	1,966,078	− 28,500	− 1.43
Washington	1,175,032	1,499,884	+ 324,852	+ 27.65
West Virginia	2,018,795	2,783,312	+ 764,517	+ 37.87
Wisconsin	1,382,115	1,227,342	− 154,773	− 11.20
Wyoming	34,556	74,321	+ 39,765	+115.07
Other States	[a] 502,711	[a] 587,820	+ 85,109	+ 16.93
Total	149,697,188	161,032,722	+11,335,534	+ 7.57

[a] Includes pottery products which could not be separately classified without disclosing individual figures.

Of the States and Territories represented by the 48 totals 37 show gains and 11 losses in 1906. By a coincidence, in 1905 the same number of totals showed increases and decreases, though the States are not the same. In 1904, 23 States showed a decrease from the preceding year. The States showing a loss in 1906 were: Arkansas, Florida, Indian Territory, Maryland, Montana, Nebraska, New York, South Dakota, Vermont, Virginia, and Wisconsin. The only States to show losses in both years were Arkansas, South Dakota, and Wisconsin. None of those showing losses, except New York, are among the leading clay-working States. The losses are, with the exception of New York, comparatively small, ranging from $96 in South Dakota, or 0.16 of 1 per cent, to $609,740, or 4.21 per cent. Notwithstanding New York's loss, the total for the State in 1906 is far greater than that for 1904, when it was $10,543,070, or a gain in 1906 over 1904 of $3,333,537, or 31.62 per cent, thus corroborating what was already believed—that 1905 was an unusual year in the clay-working industries of New York. Of the States showing gains Ohio was first, Pennsylvania next, and West Virginia third in the size of their increase. Other States showing large gains were California, Indiana, Kansas, Missouri, and New Jersey.

In the following table will be found a comparison of the several varieties of clay products marketed in 1905 and 1906, showing the actual gain or loss in each variety and the percentage of gain or loss in each variety:

Value of the products of clay in the United States in 1905 and 1906, with increase or decrease.

Product.	1905.	1906.	Increase in 1906.	Percentage of increase in 1906.
Common brick	$61,394,383	$61,300,696	[a] $93,687	[a] 0.15
Vitrified paving brick or block	6,703,710	7,857,768	1,154,058	17.22
Front brick	7,108,092	7,895,323	787,231	11.08
Fancy or ornamental brick	293,907	207,119	[a] 86,788	[a] 29.53
Enameled brick	636,279	773,104	136,825	21.50
Drain tile	5,850,210	6,543,289	693,079	11.85
Sewer pipe	10,097,089	11,114,967	1,017,878	10.08
Architectural terra cotta	5,003,158	5,739,460	736,302	14.72
Fireproofing and terra-cotta lumber	3,004,526	3,652,181	647,655	21.56
Hollow building tile or blocks	1,094,267	934,357	[a] 159,910	[a] 14.61
Tile (not drain)	3,647,726	4,634,898	987,172	27.06
Stove lining	645,432	743,414	97,982	15.18
Fire brick	12,735,404	14,206,868	1,471,464	11.55
Miscellaneous	3,564,111	3,988,394	424,283	11.90
Total brick and tile	121,778,294	129,591,838	7,813,544	6.42
Total pottery	27,918,894	31,440,884	3,521,990	12.62
Grand total	149,697,188	161,032,722	11,335,534	7.57

[a] Decrease.

This table, more than any other, exhibits the industry in 1906 as compared with 1905 and is interesting as giving the status of the various branches. It will be observed that only three products showed a decrease from 1905, and in the only important one, common brick, the loss was so small as to be negligible. All other important branches showed large gains in 1906.

The product showing the largest actual gain was fire brick, which increased $1,471,464, or 11.55 per cent. Next to common brick this is the product of largest value, reporting $14,206,868, as against $12,735,404 in 1905.

The next largest actual gain was in vitrified paving, $1,154,058, or 17.22 per cent. The year 1905 was unquestionably below the normal in this industry, owing to local conditions, and in 1906 the industry was where it should normally have been. The undoubted merit of vitrified brick when properly laid as a paving material is becoming realized more and more, partly as a result of the educational campaign carried on by the makers of this product, and its future increased use seems assured. The use of this variety of brick in buildings also is increasing, as its advantages for this character of work become known.

The product showing the largest proportional gain was tile (not drain) including wall, floor, and roofing tile; this product showed a gain of 27.06 per cent and is likely to continue to show large proportional gains, though the actual gain was but $987,172. This product is the fourth in actual gain, being exceeded only by fire brick, vitrified brick, and sewer pipe.

The front-brick industry continues to prosper, the product reported in 1906 being valued at three-quarters of a million dollars more than in 1905. This seems to indicate that fine buildings in increasing numbers are being erected of brick.

The use of fancy or ornamental (shape) brick continues to decline. This product is evidently being displaced by other forms of ornamentation, probably by terra cotta. The decrease in 1906 was quite marked—$86,788, or 29.53 per cent.

The enameled-brick industry is one that shows a large relative increase—from $636,279 in 1905 to $773,104 in 1906, or 21.50 per cent. The increased use of this product will probably soon bring the value of the domestic enameled brick up to the million dollar mark.

The use of drain tile in the middle Western States is on the increase, as indicated by the figures here given, which show that the product rose in value from $5,850,210 in 1905 to $6,543,289 in 1906, a gain of 11.85 per cent.

Sewer pipe is one of the growing branches of the clay-working industries, as shown by the gain recorded here, $1,017,878, or 10.08 per cent, which brings the total value of the product up to $11,114,967.

The pottery industry increased from $27,918,894 in 1905 to $31,440,884 in 1906, a gain of $3,521,990, or 12.62 per cent.

The total gain of the brick and tile products was $7,813,544, or 6.42 per cent, and the total gain for both brick and tile and pottery was $11,335,534, or 7.57 per cent.

The following table shows the products of clay in the United States from 1897 to 1906, 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, 1897–1906, by varieties.

Year.	Number of operating firms reporting.	Common brick.			Vitrified paving brick.		
		Quantity (thousands).	Value.	Average price per thousand.	Quantity (thousands).	Value.	Average price per thousand.
1897	5,424	5,292,532	$26,430,207	$4.99	435,851	$3,582,037	$8.22
1898	5,971	5,867,415	30,980,704	5.28	474,419	4,016,822	8.47
1899	6,962	7,695,305	39,887,522	5.18	580,751	4,750,424	8.18
1900	6,475	7,140,622	38,621,514	5.41	546,679	4,764,124	8.71
1901	6,421	8,038,579	45,503,076	5.66	605,077	5,484,134	9.06
1902	6,046	8,475,067	48,885,869	5.77	617,192	5,744,530	9.31
1903	6,034	8,463,683	50,532,075	5.97	654,499	6,453,849	9.86
1904	6,108	8,665,171	51,768,558	5.97	735,489	7,557,425	10.28
1905	5,925	9,817,355	61,394,383	6.25	665,879	6,703,710	10.07
1906	5,857	10,027,039	61,300,696	6.11	751,974	7,857,768	10.45

Year.	Front brick.			Fancy or ornamental brick (value).	Enameled brick (value).	Fire brick (value).	Stove lining (value).	Drain tile (value).
	Quantity (thousands).	Value.	Average price per thousand.					
1897	310,918	$3,855,033	$12.40	$685,048	(a)	$4,094,704	(b)	$2,623,305
1898	295,833	3,572,385	12.08	358,372	$279,993	6,093,071	(b)	3,115,318
1899	438,817	4,767,343	10.86	476,191	329,969	8,641,882	$416,235	3,682,394
1900	344,516	3,864,670	11.09	289,698	323,630	9,830,517	462,541	2,976,281
1901	415,343	4,709,737	11.34	372,131	463,709	9,870,421	423,371	3,143,001
1902	458,391	5,318,008	11.60	335,290	471,163	11,970,511	630,924	3,506,787
1903	433,016	5,402,861	12.48	328,387	569,689	[b]14,062,369	(b)	4,639,214
1904	434,351	5,560,131	12.80	300,233	545,397	11,167,972	(b)	5,348,555
1905	541,590	7,108,092	13.12	293,907	636,279	12,735,404	645,432	5,850,210
1906	617,469	7,895,323	12.79	207,119	773,104	14,206,868	743,414	6,543,289

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.
1897	$4,069,534	$1,841,422	$1,979,259	(c)	$1,476,638	$10,309,209	$1,413,595	$62,359,991
1898	3,791,057	2,043,325	1,900,642	(c)	1,746,024	14,589,224	2,000,743	74,487,680
1899	4,560,334	2,027,532	1,665,066	(c)	1,276,300	17,250,250	6,065,928	95,797,370
1900	5,842,562	2,372,568	1,820,214	(c)	2,349,420	19,798,570	2,896,036	96,212,345
1901	6,736,969	3,367,982	1,860,269	(c)	2,867,659	22,463,860	2,945,268	110,211,587
1902	7,174,892	3,526,906	3,175,593	(c)	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
1906	11,114,967	5,739,460	3,652,181	934,357	4,634,898	31,440,884	3,988,394	161,032,722

a Enameled brick not separately classified prior to 1898.
b Stove lining not separately classified prior to 1899 is included in fire brick in 1903; in miscellaneous in 1904.
c Hollow building tile or blocks included in fireproofing prior to 1903.

This table shows the wonderful growth of this industry and its great importance. In these ten years the value of clay products has increased nearly $100,000,000, or 158.23 per cent, the exact figures being from $62,359,991 in 1897 to $161,032,722 in 1906.

Only three products failed to reach their maximum value in 1906, namely: common brick, fancy or ornamental brick, and hollow building tile or block, and in the value of these products the decrease from the maximum was very slight. In fact, although the value of the common brick did not equal the maximum of 1905, the quantity reached a maximum of 10,027,039,000. Fancy or ornamental brick and hollow building brick or tile have for some years been decreasing almost steadily. Common brick increased from the minimum, 5,292,532,000 in 1897, to 10,027,039,000 in 1906, an increase of 4,734,507,000, or 89.45 per cent, in ten years; the value ranged from

$26,430,207 in 1897 to the maximum, $61,394,383 in 1905, a gain of $34,964,176, or 132 per cent. The price per thousand varied from $4.99 in 1897 to $6.25 in 1905.

Vitrified paving brick has ranged in quantity in the ten-year period from 435,851,000 in 1897 to 751,974,000 in 1906, an increase of 72.53 per cent, and in value from $3,582,037 in 1897 to $7,857,768 in 1906, a gain of $4,275,731, or 119.37 per cent. The average value per thousand ranged from $8.18 in 1899 to $10.45 in 1906.

Front brick has made an almost steady gain since 1897, though its minimum quantity and value were in 1898, when the former was 295,833,000 and the latter $3,572,385. In 1906 the maxima were reached in 617,469,000 brick, valued at $7,895,323, a gain of 321,636,000 brick, or 108.72 per cent, and of $4,322,938, or 121.01 per cent. The average value per thousand ranged from $10.86 in 1899 to $13.12 in 1905.

The enameled-brick product continues to increase in value, the minimum being $279,993 in 1898, when it was first separately classified, and the maximun $773,104 in 1906, a gain of $493,111, or 176.12 per cent.

The fire-brick product has gained in value steadily since 1897, except in 1904, and it has run from $4,094,704 in the former year to $14,206,868 in 1906, a gain of $10,112,164, or 246.96 per cent.

In draintile 1897 and 1906 represent the minimum and maximum of this branch of the industry, the product of the former year being valued at $2,623,305 and of the latter at $6,543,289, a gain in ten years of $3,919,984, or 149.43 per cent.

In the sewer-pipe industry the minimum value of product in the period covered was in 1898, when it was $3,791,057. From that year it has steadily increased until 1906, when the maximum was reached—$11,114,967—a gain since 1898 of $7,323,910, or 193.19 per cent.

The use of architectural terra cotta has steadily grown with the years, the value of this article increasing from $1,841,422 in 1897 to $5,739,460 in 1906, a gain of $3,898,038, or 211 per cent.

Fireproofing is another clay product, the use of which has been increasing for several years, the year 1906 showing the highest product yet reported. The minimum was in 1899, when it was valued at $1,665,066, and the maximum was $3,652,181, in 1906, an increase of nearly 120 per cent.

The pottery branch of the industry, with the exception of one year, has steadily gained in value from $10,309,209 in 1897 to $31,440,884 in 1906, an increase of $21,131,675, or 204.98 per cent—a most creditable showing.

The brick and tile total value has increased during the same period from $52,050,782 to $129,591,838, a gain of $77,541,056, or 148.97 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 total value produced by each State in 1905 and 1906:

Rank of States, value of output, and percentage of total value of clay products in 1905 and 1906.

State.	1905. Rank.	1905. Number of operating firms reporting.	1905. Value.	1905. Percentage of total product.	1906. Rank.	1906. Number of operating firms reporting.	1906. Value.	1906. Percentage of total product.
Ohio	1	792	$28,303,039	18.91	1	784	$31,014,165	19.26
Pennsylvania	2	516	19,124,553	12.78	2	514	21,774,611	13.52
New Jersey	3	163	16,699,525	11.16	3	175	17,362,269	10.78
New York	4	249	14,486,347	9.68	4	253	13,876,607	8.62
Illinois	5	469	12,361,786	8.26	5	466	12,634,181	7.85
Indiana	6	441	6,499,573	4.34	6	419	7,158,234	4.44
Missouri	7	224	6,203,411	4.14	7	190	6,696,275	4.16
California	8	122	3,865,147	2.58	8	113	4,364,230	2.71
Iowa	9	306	3,392,122	2.27	9	304	3,469,027	2.15
West Virginia	14	62	2,018,795	1.35	10	65	2,783,312	1.73
Kentucky	10	121	2,406,350	1.61	11	117	2,592,423	1.61
Kansas	16	68	1,906,360	1.27	12	66	2,432,371	1.51
Georgia	12	95	2,119,746	1.42	13	99	2,400,624	1.49
Massachusetts	13	78	2,050,457	1.37	14	82	2,172,733	1.35
Maryland	11	68	2,249,367	1.50	15	70	2,136,539	1.33
Texas	18	129	1,718,945	1.15	16	139	1,969,598	1.22
Virginia	15	94	1,994,578	1.33	17	91	1,966,078	1.22
Michigan	17	154	1,765,707	1.18	18	142	1,844,477	1.14
Colorado	19	94	1,633,231	1.09	19	94	1,831,088	1.14
Connecticut and Rhode Island	20	42	1,608,578	1.08	20	42	1,747,205	1.08
Alabama	23	111	1,392,871	.93	21	112	1,688,899	1.05
Tennessee	22	121	1,493,279	1.00	22	116	1,620,226	1.01
Minnesota	21	111	1,499,386	1.00	23	109	1,603,279	1.00
Washington	25	72	1,175,032	.78	24	61	1,499,884	.93
Wisconsin	24	157	1,382,115	.92	25	147	1,227,342	.76
North Carolina	26	177	1,020,161	.68	26	214	1,182,338	.73
Nebraska	27	102	1,006,743	.67	27	98	990,708	.62
Louisiana	28	67	821,109	.55	28	67	900,697	.56
Mississippi	29	98	818,897	.55	29	102	851,080	.53
South Carolina	30	67	749,835	.50	30	63	830,481	.52
New Hampshire	33	33	554,734	.37	31	33	726,051	.45
Maine	32	64	619,294	.41	32	59	680,370	.42
Utah	34	54	544,578	.36	33	52	634,444	.39
Arkansas	31	65	643,959	.43	34	62	532,194	.33
Oregon	35	63	380,575	.25	35	63	506,192	.31
District of Columbia	38	14	317,021	.21	36	13	335,139	.21
Indian Territory	36	28	374,235	.25	37	25	299,790	.19
Montana	39	29	313,006	.21	38	25	297,299	.18
Florida	37	22	329,738	.22	39	20	289,644	.18
Idaho and Nevada	41	49	230,780	.15	40	57	282,889	.18
North Dakota	40	19	232,432	.16	41	19	269,873	.17
Oklahoma	43	27	222,064	.15	42	22	241,111	.15
Delaware	42	25	227,064	.15	43	23	237,768	.15
New Mexico	44	18	141,722	.09	44	21	152,599	.09
Vermont	45	11	112,967	.08	45	11	112,368	.07
Arizona	46	16	90,436	.06	46	18	93,694	.06
Wyoming	48	7	34,556	.02	47	11	74,321	.05
South Dakota	47	11	58,271	.04	48	9	58,175	.04
Other States			[a] 502,711	.34			[a] 587,820	.36
Total		5,925	149,697,188	100.00		5,857	161,032,722	100.00

[a] Undistributed pottery products.

This table shows that every State and Territory was a producer of clay products in 1906, ranging in value from $58,175 in South Dakota, or 0.04 of 1 per cent of the total, to $31,014,165, or 19.26 per cent in Ohio.

Ohio continues to be the leading clay-working State, reporting products valued at $31,014,165 in 1906. The prestige of this State in this industry is not likely to be wrested from her, as in 1906 its products were valued at $9,239,554 more than the second in rank—Pennsylvania. In 1905 Ohio's clay products were valued at $28,303,039, or 18.91 per cent of the total. Pennsylvania was second in both years, reporting products valued at $21,774,611, or 13.52

per cent of the total, in 1906, as compared with $19,124,553, or 12.78 per cent of the total, in 1905. There was no change in the relative rank of the first 9 States, though West Virginia, which was fourteenth in 1905, reporting products valued at $2,018,795, rose to tenth in 1906, with products valued at $2,783,312, and Kentucky, which was tenth in 1905, was eleventh in 1906.

The first 10 States marketed wares in 1906 valued at $121,132,911; these same States in 1905 reported wares valued at $112,954,298, a gain in these States of $8,178,613. This was 72.15 per cent of the entire gain of 1906 over 1905. The first 5 States reported wares valued at $96,661,833, or 60.03 per cent of the total; in 1905 they reported $90,975,250, or 60.77 per cent of the total.

Of the remaining States, 13 maintained the same rank as in 1905; 11 advanced in relative rank and 13 fell back in rank. Of these the most striking instances were Kansas, which rose from sixteenth to twelfth, and Maryland, which fell from eleventh to fifteenth.

The number of operating firms reporting continues to decrease, notwithstanding the large number of plants started each year, and is to be accounted for both by the temporary character of many of the brickyards which are abandoned at the close of one season, some to be opened up elsewhere, and by the fact that consolidations are still going on which reduce the number of firms reporting but not the number of yards. No attempt is made to show the number of yards nor the plants from which no sales of products were made in 1906—a considerable number, notwithstanding the prosperity of the year. Ohio has the greatest number of operating firms—784 in 1906 and 792 in 1905. New Jersey and New York are the only States of importance which show an increase in the number of firms reporting, the former having reports from 12 more firms than in 1905, and the latter from 4 more firms. West Virginia, Georgia, Massachusetts, Maryland, North Carolina, and Texas also report an increased number of operating firms, North Carolina reporting the largest increase—37.

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 works, the rank of States, and the percentage of total value of each State in 1905 and 1906:

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.	Percentage 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 1906.

Rank.	State	Common brick. Quantity.	Common brick. Value.	Common brick. Average price per thousand.	Vitrified paving brick or block. Quantity.	Vitrified paving brick or block. Value.	Vitrified paving brick or block. Average price per thousand.
		Thousands.			*Thousands.*		
19	Alabama	166,225	$1,046,986	$6.30	(a)	(a)	$11.62
46	Arizona	10,953	93,014	8.49			
34	Arkansas	72,305	489,633	6.77	(a)	(a)	12.00
8	California	278,780	1,962,866	7.05	(a)	(a)	18.49
17	Colorado	120,944	787,084	6.51	6,239	$74,460	11.93
20	Connecticut and Rhode Island	212,648	1,503,929	7.07	(a)	(a)	16.36
43	Delaware	28,004	222,628	7.95			
36	District of Columbia	32,597	242,085	7.43			
39	Florida	42,635	285,224	6.69			
12	Georgia	303,286	1,783,988	5.88	(a)	(a)	13.99
40	Idaho and Nevada	32,757	272,174	8.31	(a)	(a)	26.50
4	Illinois	1,195,210	5,719,906	4.79	122,227	1,306,476	10.69
7	Indiana	307,076	1,778,270	5.79	45,725	502,509	10.99
37	Indian Territory	41,913	252,608	6.03	2,169	20,231	9.33
9	Iowa	168,871	1,118,709	6.62	16,930	185,990	10.99
10	Kansas	314,371	1,376,552	4.38	78,199	658,392	8.42
11	Kentucky	142,185	881,879	6.20	(a)	(a)	14.13
28	Louisiana	116,073	811,185	6.99	(a)	(a)	10.00
32	Maine	58,344	383,011	6.56	(a)	(a)	15.04
18	Maryland	204,238	1,267,771	6.21	(a)	(a)	15.60
14	Massachusetts	204,282	1,415,864	6.93			
16	Michigan	206,583	1,178,202	5.70	6,229	81,814	13.13
21	Minnesota	165,598	986,982	5.96	(a)	(a)	10.68
29	Mississippi	121,107	801,420	6.62			
6	Missouri	257,292	1,810,304	7.04	57,414	539,700	9.40
38	Montana	24,488	203,365	8.30	(a)	(a)	15.95
27	Nebraska	119,501	835,702	6.99	(a)	(a)	8.00
31	New Hampshire	95,770	716,051	7.48			
5	New Jersey	413,258	2,610,686	6.32	(a)	(a)	14.98
44	New Mexico	16,416	115,131	7.01	(a)	(a)	10.00
3	New York	1,535,579	9,205,981	6.00	10,787	163,969	15.20
26	North Carolina	166,338	1,041,078	6.26	(a)	(a)	10.00
41	North Dakota	25,972	204,188	7.86			
2	Ohio	550,422	3,243,157	5.89	202,978	1,955,360	9.63
42	Oklahoma	33,918	234,162	6.90	(a)	(a)	8.00
35	Oregon	45,007	341,127	7.58			
1	Pennsylvania	1,027,541	6,586,374	6.41	93,417	996,347	10.67
30	South Carolina	128,009	748,648	5.85			
48	South Dakota	6,064	54,175	8.93			
23	Tennessee	169,371	1,038,266	6.13	(a)	(a)	13.00
15	Texas	211,842	1,307,199	6.17	(a)	(a)	10.00
33	Utah	54,903	368,151	6.71			
45	Vermont	13,836	85,755	6.20			
13	Virginia	232,697	1,536,312	6.60			
22	Washington	99,788	708,968	7.10	9,609	156,476	16.28
25	West Virginia	74,833	469,527	6.27	47,902	578,164	12.07
24	Wisconsin	170,496	1,109,386	6.51			
47	Wyoming	6,713	65,033	9.69			
	Other States [b]				52,149	637,880	12.23
	Total	10,027,039	61,300,696	6.11	751,974	7,857,768	10.45
	Per cent of brick and tile products		47.30			6.06	
	Per cent of total of clay products		38.07			4.88	

[a] Included in "Other States."
[b] Includes all products made by less than 3 producers in 1 State.

Brick and tile products of the United States in 1906—Continued.

Rank.	State.	Front brick.			Fancy or ornamental brick (value).	Drain tile (value).	Sewer pipe (value).	Architectural terra cotta (value).	Fireproofing (value).
		Quantity.	Value.	Average price per thousand.					
		Thousands.							
19	Alabama	(a)	(a)	$11.35		$2,285	(a)		(a)
46	Arizona	(a)	(a)	20.00					
34	Arkansas	539	$6,046	11.22		3,795			
8	California	18,421	501,746	27.24	(a)	30,545	$827,477	$254,932	$98,968
17	Colorado	24,147	256,770	10.63	$2,806	6,126	(a)	(a)	(a)
20	Connecticut and Rhode Island	(a)	(a)	16.51					
43	Delaware	(a)	(a)	18.97		(a)			
36	District of Columbia	(a)	(a)	13.05		(a)	30,004		(a)
39	Florida					(a)			
12	Georgia	2,094	20,747	9.91		12,000	221,000	(a)	(a)
40	Idaho and Nevada	425	10,095	23.75					
4	Illinois	30,022	341,298	11.37	11,635	1,052,588	587,805	(a)	409,171
7	Indiana	35,090	395,368	11.27	4,700	1,373,441	486,897	(a)	323,015
37	Indian Territory	733	8,413	11.48	(a)				
9	Iowa	8,871	101,795	11.48		1,721,614	(a)		
10	Kansas	19,875	187,577	9.44	(a)	19,694	(a)		
11	Kentucky	11,893	109,771	9.23		27,359	(a)		
28	Louisiana	(a)	(a)	12.67		(a)			
32	Maine	(a)	(a)	10.53		(a)	(a)		
18	Maryland	2,266	31,968	14.11	(a)	3,315		(a)	
14	Massachusetts	(a)	(a)	22.17	(a)			(a)	(a)
16	Michigan	1,474	14,162	9.61	(a)	314,098	(a)		
21	Minnesota	7,510	98,170	13.07		41,779	(a)		(a)
29	Mississippi	1,051	12,549	11.94		9,600			
6	Missouri	29,019	394,563	13.59	30,689	64,063	1,208,236	(a)	(a)
38	Montana	(a)	(a)	20.00	(a)	(a)	(a)		(a)
27	Nebraska	(a)	(a)	13.96	(a)	(a)			
31	New Hampshire								
5	New Jersey	62,138	896,887	14.43	1,951	23,209	(a)	1,682,022	1,399,233
44	New Mexico	(a)	(a)	12.46	(a)				
3	New York	23,625	351,824	14.89		153,237	(a)	967,987	75,631
26	North Carolina	385	4,410	11.45		(a)	(a)		(a)
41	North Dakota	2,732	51,100	18.70					
2	Ohio	90,310	1,025,590	11.36	38,218	1,520,748	3,987,360	(a)	793,179
42	Oklahoma	559	6,149	11.00					
35	Oregon	1,247	33,837	27.13	(a)	23,424	(a)		(a)
1	Pennsylvania	151,138	1,761,991	11.66	40,880	9,113	985,635	367,353	191,489
30	South Carolina	(a)	(a)	13.74					
48	South Dakota	(a)	(a)	20.00					
23	Tennessee	12,077	124,031	10.27	3,663	19,719	(a)		
15	Texas	8,492	110,189	12.98	(a)	3,652	(a)		
33	Utah	9,917	107,255	10.82	(a)	(a)	(a)		
45	Vermont					(a)			
13	Virginia	25,385	392,130	15.45	(a)	4,805			
22	Washington	4,439	122,770	27.66		13,057	313,880	(a)	14,792
25	West Virginia	(a)	(a)	15.00		(a)	(a)		
24	Wisconsin	5,384	52,038	9.67	(a)	51,143			
47	Wyoming	533	8,788	16.49					
	Other States [b]	25,678	355,296	13.84	72,577	38,880	2,466,673	2,467,166	346,703
	Total	617,469	7,895,323	12.79	[c]980,223	6,543,289	11,114,967	5,739,460	3,652,181
	Per cent of brick and tile products		6.09		.76	5.05	8.58	4.43	2.82
	Per cent of total of clay products		4.90		.61	4.07	6.90	3.57	2.27

a Included in "Other States."
b Includes all products made by less than 3 producers in 1 State.
c Including enameled brick valued at $773,104, made in the following States: California, Colorado, Illinois, Maryland, Missouri, New Jersey, New York, Ohio, and Pensylvania.

Brick and tile products of the United States in 1906—Continued.

Rank.	State.	Hollow building tile or blocks (value).	Tile, not drain (value).	Stove lining (value).	Fire brick. Quantity (thousands).	Fire brick. Value.	Fire brick. Average price per thousand.	Miscellaneous (value).[a]	Total value.	Percentage of total value.
19	Alabama	([b])			9,094	$157,147	$17.28	$23,602	$1,650,903	1.27
46	Arizona							180	93,694	.07
34	Arkansas	([b])			([b])	([b])	12.12	700	512,694	.40
8	California	$31,600	$69,023	([b])	14,272	347,806	24.37	68,055	4,265,633	3.29
17	Colorado	([b])	40,640		14,280	278,407	19.50	75,258	1,784,005	1.38
20	Connecticut and Rhode Island	([b])		([b])	([b])	([b])	22.00		1,613,761	1.25
43	Delaware				([b])	([b])	20.00		237,768	.18
36	District of Columbia							30,366	335,139	.26
39	Florida				([b])	([b])	20.00		289,644	.22
12	Georgia	([b])	([b])		3,555	51,310	14.43	7,000	2,380,367	1.84
40	Idaho and Nevada				([b])	([b])	30.00		282,889	.22
4	Illinois	7,757	([b])	([b])	14,646	236,032	16.12	34,330	11,651,278	8.99
7	Indiana	99,404	([b])	([b])	14,074	149,351	10.61	442,145	6,224,541	4.80
37	Indian Territory				([b])	([b])	17.10	17,100	299,790	.23
9	Iowa	162,664			57	930	16.32	5,084	3,411,027	2.63
10	Kansas	([b])	([b])		([b])	([b])	24.73	443	2,432,371	1.88
11	Kentucky	([b])	296,391		50,022	898,527	17.96		2,425,214	1.87
28	Louisiana							29,721	894,277	.69
32	Maine				([b])	([b])	14.99	80	680,370	.52
18	Maryland		([b])	$32,200	14,278	266,980	18.70	10,000	1,763,040	1.36
14	Massachusetts		91,394	186,815	1,435	57,940	40.38	2,456	1,895,199	1.46
16	Michigan	4,290		([b])	([b])	([b])	10.05		1,793,367	1.38
21	Minnesota	5,991			([b])	([b])	17.50	13,080	1,603,279	1.24
29	Mississippi	([b])						1,200	831,769	.64
6	Missouri	27,717	([b])	([b])	70,201	1,324,895	18.87	470,688	6,626,775	5.11
38	Montana				1,008	45,034	44.68	6,000	297,299	.23
27	Nebraska	([b])			([b])	([b])	30.00		990,708	.76
31	New Hampshire				([b])	([b])	25.00		726,051	.56
5	New Jersey	85,962	1,163,401	([b])	39,415	954,081	24.21	858,722	10,079,611	7.78
44	New Mexico	([b])							152,599	.12
3	New York	32,428	101,319	131,908	13,605	451,783	33.21	233,411	12,008,260	9.27
26	North Carolina				([b])	([b])	17.91		1,170,568	.90
41	North Dakota	([b])			([b])	([b])	21.62		269,873	.21
2	Ohio	365,842	1,523,410	110,800	109,675	1,670,630	15.23	754,712	17,023,806	13.14
42	Oklahoma								241,111	.19
35	Oregon	([b])	([b])		183	5,524	30.19	20,000	506,192	.39
1	Pennsylvania	51,179	389,013	203,674	374,857	6,854,640	18.29	839,295	19,363,794	14.94
30	South Carolina				2,169	30,564	14.09		805,212	.62
48	South Dakota				([b])	([b])	40.00		58,175	.04
23	Tennessee	([b])			3,473	45,379	13.07	5,000	1,405,458	1.08
15	Texas		([b])		2,484	45,557	18.34	18,137	1,860,963	1.44
33	Utah		([b])		1,654	40,512	24.49	9,680	632,344	.49
45	Vermont			([b])					112,368	.09
13	Virginia				1,284	21,110	16.44		1,966,078	1.52
22	Washington	([b])	([b])		1,670	46,525	27.86	7,999	1,458,324	1.13
25	West Virginia		([b])		4,428	59,757	13.50	2,450	1,194,757	.92
24	Wisconsin	810						1,500	1,215,172	.94
47	Wyoming	([b])							74,321	.06
	Other States [c]	58,713	960,307	78,017	9,020	166,447	18.45		([d])	
	Total	934,357	4,634,898	743,414	770,839	14,206,868	18.43	3,988,394	129,591,838	100.00
	Per cent of brick and tile products	.72	3.58	.57		10.96		3.08	100.00	
	Per cent of total of clay products	.58	2.88	.46		8.82		2.47	80.48	

[a] Including adobes, aquarium ornaments, art terra cotta, assayers' supplies, boiler and locomotive tile and tank blocks, brick and tile for chemical purposes, burnt clay ballast, chimney pipe, flues and tops, charcoal furnaces, conduits, crucibles, flue and furnace lining, gas logs, glass-house supplies, grave markers, insulators, muffles, oven tile, radial chimney brick and blocks, retorts and settings, rustic stumps, saggers, scorifiers, sewer brick and blocks, sleeves and nozzles, stone pumps, tunnel blocks, vitrified curbing, wall coping, and well brick and tile.

[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.

These tables show the details, by States, of the production of the coarser clay products in 1905 and 1906. The total value of these products in 1906 was $129,591,838, as compared with $121,778,294 in 1905, a gain of $7,813,544, or 6.42 per cent. The gain of these products in 1905 over 1904 was $15,913,316, or 15.03 per cent.

The common building brick is still and perhaps always will be the clay product of greatest value. In 1906 10,027,039,000 of this variety were reported, valued at $61,300,696. This product increased from 9,817,355,000 brick in 1905 to 10,027,039,000 in 1906, an increase of 209,684,000, or 2.13 per cent. In 1904 the common brick reported numbered 8,665,171,000, valued at $51,768,558.

New York continues to be the largest producer of common brick, reporting 1,535,579,000 in 1906, valued at $9,205,981, or $6 per thousand. In 1905 New York reported 1,518,196,000 common brick, valued at $10,297,214, or $6.78 per thousand. The quantity for 1906 is 15.31 per cent of the production of the entire United States, and the value is 15.02 per cent of the total. In 1904 New York's product of common brick was 1,169,233,000, valued at $6,783,528, or $5.80 per thousand. The larger part of this product, as shown elsewhere, comes from the Hudson River region. Illinois was the next largest producer of common brick, reporting for 1906 1,195,210,000 brick, valued at $5,719,906, or $4.79 per thousand. In 1905 this State reported 1,125,024,000 brick, valued at $6,259,232, or $5.56 per thousand. As in New York the Hudson River region is the great common-brick producing territory, so in Illinois the great common-brick producing region is Cook County, and the decline in price there brought the average for the whole State to $4.79, the lowest for several years. The only other State to report more than a billion common brick was Pennsylvania, which marketed 1,027,541,000 brick, valued at $6,586,374 or $6.41 per thousand. As in 1905, while this State was third in quantity, it was second in value of common brick, and the average value per thousand was greater than that for either New York or Illinois. The value of common brick in Pennsylvania exceeded that of Illinois by $866,468, although the quantity in the latter State was greater than that of Pennsylvania by 167,669,000. In 1905 Pennsylvania reported 1,036,777,000 brick, valued at $6,532,814, or $6.30 per thousand. Ohio was fourth in quantity and value in 1906, reporting 550,422,000 common brick, valued at $3,243,157, or $5.89 per thousand, and New Jersey was fifth, reporting 413,258,000 brick, valued at $2,610,686, or $6.32 per thousand. The other States range from Kansas, with 314,371,000 brick, valued at $1,376,552, or $4.38 per thousand, to South Dakota, with 6,064,000 brick, valued at $54,175, or $8.93 per thousand, though California's 278,780,000 common brick were valued at $1,962,866, or $7.05 per thousand.

The average price per thousand for common brick ranged from $9.69 in Wyoming to $4.38 in Kansas, the average for the whole country being $6.11 per thousand. The State whose average per thousand most nearly approaches the general average was Tennessee, with an average of $6.13 per thousand. In value common brick constituted 47.30 per cent of the brick and tile products and 38.07 of all clay products; in 1905 these percentages were, respectively, 50.42 and 41.01.

The vitrified paving brick in 1906 numbered 751,974,000, valued at $7,857,768, or $10.45 per thousand. In 1905 the number was 665,879,000, and the value $6,703,710, an increase in 1906 of 86,095,000 in number, or 12.93 per cent, and an increase of 17.22 per cent in value. In 1905 this industry, because of local conditions, showed a loss of nearly a million dollars in value, but the gain of 1906, $1,154,058, indicates that the industry has recovered from the setback and is in its normal condition—one of activity and growth. The value of the product in 1904 was $7,557,425, so that the value of the product in 1906 was $300,343, or 3.97 per cent, more than that for 1904. Ohio, owing to natural advantages, continues to be the largest producer, reporting, in 1906, 202,978,000 vitrified brick, valued at $1,955,360. This is nearly 27 per cent of the total product of the country and 24.88 per cent of the total value. In 1905 this State produced slightly more than one-third of the total output and a little less than one-third of the total value. Illinois and Pennsylvania were next in order of production and value. Illinois, where probably the largest plants are located, reported 122,227,000 brick, valued at $1,306,476, or $10.69 per thousand, and Pennsylvania 93,417,000 brick, valued at $996,347, or $10.67 per thousand. Kansas ranked fourth, reporting 78,199,000 brick, valued at $658,392, or $8.42 per thousand. In 1905 Ohio reported 224,086,000 vitrified brick, valued at $2,055,120, or $9.17 per thousand; thus, while the quantity and value in this State decreased, the average value per thousand increased from $9.17 in 1905 to $9.63 in 1906. The average price per thousand ranged from $8 in Nebraska and Oklahoma, to $26.50 in Idaho and Nevada. As, however, none of these are important producing States a better idea of the actual range of the average would be obtained by taking $8.42 in Kansas as one extreme and $16.26 in Washington as the other, with the general average for the country at $10.45. In 1905 the average value per thousand for the whole country was $10.07. Vitrified brick in 1906 was 6.06 per cent of the brick and tile products, and 4.88 per cent of all clay products; in 1905 these percentages were, respectively, 5.50 and 4.48.

Front brick reported in 1906 numbered 617,469,000, valued at $7,895,323, or $12.79 per thousand; in 1905, 541,590,000 were reported, valued at $7,108,092, or $13.12 per thousand. The number in 1906 gained 75,879,000, or 14.01 per cent, and the value 11.08 per cent. Pennsylvania, Ohio, and New Jersey were the leading States, in the order named, in the production of front brick in 1906 as in 1905, the first reporting, in 1906, 151,138,000, valued at $1,761,991, or $11.66 per thousand, the second 90,310,000, valued at $1,025,590, or $11.36 per thousand, and the third 62,138,000, valued at $896,887, or $14.43 per thousand. In 1905 these States reported front brick valued, respectively, at $1,683,031, $1,074,007, and $852,744. The average value per thousand for front brick in these States in 1905 was: Pennsylvania, $12.81; Ohio, $12.01; New Jersey, $15.86. In 1905 Missouri was fourth, with a product valued at $362,996; in 1906 California was fourth, reporting a product valued at $501,746. The average value per thousand ranged from $27.66 in Washington to $9.23 in Kentucky, with an average for the whole country of $12.79; in 1905 the general average was $13.12 per thousand. In 1906 this product was 6.09 per cent of the value of the brick and tile products and 4.90 per cent of all clay products; in 1905 these percentages were, respectively, 5.84 and 4.75.

The drain-tile industry is one of growing importance, the total value in 1906 being $6,543,289. Of this total the States of Indiana, Illinois, Iowa, Michigan, and Ohio reported tile marketed to the value of $5,982,489, or 91.43 per cent of the total. Drain tile was 5.05 per cent of the brick and tile products and 4.07 per cent of all clay products in 1906; in 1905 these percentages were, respectively, 4.80 and 3.91.

Sewer pipe is growing steadily in importance. In 1905 its value was $10,097,089, which in 1906 had increased to $11,114,967, a gain of $1,017,878, or 10.08 per cent. It is produced in 26 States, but in only 9 of these did a sufficient number of producers report to enable State totals to be published without divulging individual statements. Of these 9 States, Ohio is the leading one, reporting sewer pipe marketed to a net value of $3,987,360, as compared with $3,550,160 in 1905. Missouri was the second largest producer, with an output valued at $1,208,236, and Pennsylvania was third, reporting $985,635. These States maintained the same rank in the production of sewer pipe in 1905 and 1904, and in each year they produced more than one-half of the entire product. Sewer pipe was 8.58 per cent of the brick and tile products in 1906 and 8.29 per cent in 1905, and it was 6.90 per cent of all clay products in 1906 and 6.74 per cent in 1905.

Architectural terra cotta may be considered one of the wares of the highest grade in the brick and tile classification, and its production would, therefore, naturally be looked for in few States. It is reported from only 13 States, and of these in only 4 can the totals be given without disclosing individual statements, and nearly one-half of the product must be concealed under "other States." Of the States for which totals may be given in 1906 New Jersey is the largest producer; and in fact it will be violating no confidence to say that were totals for all States to be given, New Jersey would still be the leading State, reporting a product valued at $1,682,022, or 29.31 per cent of the total for the country; in 1905 also New Jersey was first, with a product valued at $1,614,263. New York was second in both 1905 and 1906, the value of its product being $874,722 in 1905, and $967,987, or 16.87 per cent of the total, in 1906. This product constituted 4.43 per cent of the brick and tile products and 3.57 per cent of all clay products in 1906, and 4.11 per cent and 3.34 per cent, respectively, in 1905.

Fireproofing is of a lower grade than architectural terra cotta and is reported from 18 States, the totals for only 8 of which can be published. Of these eight, New Jersey was first in 1906, reporting a product valued at $1,399,233, or 38.31 per cent of the total; in 1905 this State's product was valued at $1,017,774, or 37.48 per cent of the total. Ohio was second in both years. Illinois, which was fourth in 1905, with a product valued at $323,550, was third in 1906, with a product valued at $409,171, displacing Indiana, which reported a value of $323,015. The value of fireproofing was less than 3 per cent of the value of the total brick and tile products in 1906, and only 2.27 per cent of that of all clay products; in 1905 these percentages were, respectively, 2.47 and 2.01.

The use of hollow building tile or block appears to be spreading geographically, as it was reported from 27 States in 1906 as against 21 States in 1905 and 20 in 1904. The value of the product declined from $1,094,267 in 1905, to $934,357 in 1906. Ohio is the largest producer of this ware, reporting $365,842, or 39.15 per cent of the total, in 1906, and $317,516, or 29.02 per cent of the total, in 1905. In

1905 New Jersey was second and Indiana third; in 1906 Iowa was second and Indiana third.

Tile, not drain, embraces some of the most interesting of the clay products, such as roofing tile, floor, wall, and art tile. All of these products are used in the higher class of buildings, and as the structures erected in this country are continually improving, these products may be expected to show steady gains. Tile, not drain, was made in 19 States in 1906, but in only 8 are there a sufficient number of producers to permit of the publication of totals without disclosing confidential returns. Ohio was the leading producer, reporting $1,523,410, or 32.87 per cent, out of a total value of $4,634,898 in 1906. New Jersey was second in value of product and Pennsylvania third. These relative standings were the same in 1905.

The stove-lining industry is more widespread than would be supposed, this product being reported from 13 States in 1906, though the principal production is in the Eastern States. Pennsylvania was the leading State, reporting a product worth $203,674 in 1906, with Massachusetts second with $186,815, and New York third with $131,908. These relative positions were maintained in 1905.

Fire brick is one of the most important branches of the clay-working industries. Fire clay suitable for the manufacture of fire brick is found in many States, and into some States, where it does not occur in suitable quality, it is imported for the manufacture of refractory wares. The following figures for quantity represent the product reduced to the equivalent of the standard 9-inch brick. Fire brick was reported from 39 States in 1906. Pennsylvania was the largest producer, reporting 374,857,000 fire brick, valued at $6,854,640, or $18.29 per thousand; for 1905 this State reported 312,470,000 fire brick, valued at $5,771,795, or $18.47 per thousand, a gain in 1906 of 62,387,000 brick, or about 20 per cent, and of $1,082,845, or about 19 per cent. Pennsylvania alone produced in 1906 48.63 per cent of the fire brick of the United States and 48.25 per cent of the value. Ohio was second in both years, producing 109,675,000 fire brick in 1906, valued at $1,675,630, or $15.23 per thousand, against 94,742,000 brick, valued at $1,427,919, or $15.07 per thousand, in 1905. Missouri was third in both years in quantity, reporting 70,201,000 fire brick in 1906 and 62,239,000 in 1905, and third in 1906 in value, with a total of $1,324,895, or $18.87 per thousand. In 1905, however, Missouri was passed by New Jersey, whose fire-brick product was valued at $1,393,448, as compared with Missouri's value of $1,117,209, though the quantity reported by New Jersey was but 52,149,000 brick. In 1906 New Jersey was fourth in value of product, $954,081, but fifth in quantity, with 39,415,000 fire brick, the fourth State being Kentucky, with 50,022,000 brick. The latter State was fifth in value, $898,527. The other States are comparatively small producers, New York being the largest, reporting for 1906 13,605,000 brick, valued at $451,783, or $33.21 per thousand. The average value per thousand ranged from $10.05 in Michigan to $44.68 in Montana, with an average of $18.43 for the whole country. As in other varieties of brick, these extremes are in States of small production. Fire brick composed 10.96 per cent of the brick and tile products and 8.82 per cent of all clay products in 1906; in 1905 these percentages were 10.46 and 8.51, respectively.

Ohio is the leading State in the clay industry as a whole, but when the coarser products are considered—brick and tile of this classification—Pennsylvania is the leading State, its output being valued in 1906 at $19,363,794, or 14.94 per cent of the total; and in 1905 at $17,778,122, or 14.60 per cent, a gain in 1906 of $1,585,672, or 8.92 per cent. Ohio ranks second, with products valued at $17,023,806, or 13.14 per cent of the total, a gain in 1906 over 1905 of $1,744,838, or 11.42 per cent. New York, with its large common-brick industry, was third in both years, notwithstanding the decrease in the value of its product. In 1906 the value of New York's brick and tile production was $12,008,260, or 9.27 per cent of the total; in 1905 it was $12,858,617, a loss in 1906 of $850,357, or 6.61 per cent. Illinois was fourth in both years and New Jersey fifth. In fact, there was no change in the relative rank of the first 9 States. Kansas was thirteenth in 1905 and tenth in 1906, displacing Kentucky, which became eleventh in 1906. There were no changes of importance in the relative ranks of the States; Maryland showed the greatest change, dropping from fourteenth place in 1905, with products valued at $1,885,009, to eighteenth place in 1906, with products valued at $1,763,040, a loss of $121,969, or 6.47 per cent.

The first 7 States—Pennsylvania, Ohio, New York, Illinois, New Jersey, Missouri, and Indiana—each contributing over $5,000,000, reported products in 1906 valued at $82,978,065, or 64.03 per cent of the total; these States in 1905 contributed brick and tile products valued at $79,106,146, or 64.96 per cent.

HUDSON RIVER REGION.

One of the most interesting centers of the clay-working industries is the region along the Hudson River from Cohoes, N. Y., to New York City, on the east, and Jersey City, N. J., on the west. Ten counties are included in this region, 9 in New York and 1 in New Jersey. This region for many years has been almost the exclusive source of supply for New York City for common building brick. As 1905 was such a phenomenal year in the history of the industry along the Hudson, the product increasing 31.36 per cent in quantity and 56 per cent in value over 1904, the year 1906 was naturally looked forward to with much interest. As a natural reaction from the high prices of 1905 a break was almost sure to come. The season opened with prices high—from $9 to $11 per thousand for common brick—but by midsummer such prices had attracted producers in adjacent States, the market broke, and prices fell to $5.50 and $6 per thousand.

The total number of brick marketed from these 10 counties by 135 firms in 1906 was 1,274,372,000, valued at $7,672,639, or $6.02 per thousand, as compared with 1,297,389,000 brick, valued at $9,063,753, or $6.99 per thousand, in 1905, a decrease of 23,017,000 brick, or only 1.77 per cent, but a decrease in value of $1,391,114, or 15.35 per cent. Compared with 1904, however, 1906 showed a large increase in both quantity and value—286,728,000 brick and $1,862,525—thus emphasizing the fact that 1905 was a most extraordinary year in this region. The unusual activity in 1905 served to stimulate the industry, and as a consequence yards that had been idle or producing but small quantities of brick, or that were about to be abandoned, were put into operation and the number of firms reporting increased from 129 in 1905 to 135 in 1906.

New York's portion of this region, contributing about 94 per cent of the total, showed the entire loss in quantity, New Jersey's portion gaining in quantity, but losing slightly in value. The loss in quantity in New York was 31,266,000 brick, or 2.54 per cent, and the loss in value was $1,385,107, or 16.08 per cent. New York also showed a gain of 6 in firms reporting.

This product, 1,198,400,000 common brick, composes 78.04 per cent of New York's total output of common brick, and was greater than the common-brick product in any other State of the Union, Illinois nearly approaching it with 1,195,210,000 brick. The value of New York's portion of this region, $7,228,041, was greater by $641,667 than the value of the common brick reported from Pennsylvania, that State reporting the largest value next to New York, and the value of the common brick marketed by this district in 1906 was exceeded by the value of all the clay products of only 5 States, namely, Ohio, Pennsylvania, New Jersey, New York, and Illinois. Of the counties included in this region, Rockland, in which Haverstraw is located, reports the largest product, 287,538,000 brick, valued at $1,823,371, with Ulster second, reporting 261,970,000 brick, valued at $1,391,013. These two counties were also the first and second in 1905. Rockland's production of common brick in 1906 was exceeded by only 7 States outside of New York, namely, Georgia, Illinois, Indiana, Kansas, New Jersey, Ohio, and Pennsylvania; and Ulster's product was exceeded by only the foregoing States and California. In 1905 Dutchess was the third county in production, reporting 182,807,000 brick; but in 1906 Orange produced 182,103,000 brick, while Dutchess fell to fourth place, with 154,456,000 brick. The average value per thousand in 1906 ranged from $5.31 in Ulster County to $6.79 in Columbia County. In 1905 the prices ranged from $6.49 in Ulster to $7.59 in Greene County. The average for the whole New York region was $6.03 in 1906 and $7 in 1905.

The product reported from Bergen County, N. J., increased from 67,723,000 brick in 1905 to 75,972,000 brick in 1906, though the value decreased from $450,605 to $444,598, and the average value per thousand decreased from $6.65 in 1905 to $5.85 in 1906.

Production of common brick in the Hudson River district from Cohoes to New York City in 1905 and 1906, by counties.

County.	1905.				1906.			
	Number of firms reporting.	Quantity (thousands).	Value.	Average price per thousand.	Number of firms reporting.	Quantity (thousands).	Value.	Average price per thousand.
Albany	10	71,992	$496,029	$6.89	12	72,936	$454,392	$6.23
Columbia	6	82,260	596,663	7.25	6	79,500	539,850	6.79
Dutchess	16	182,807	1,237,597	6.77	16	154,456	883,607	5.72
Greene	6	49,338	374,720	7.59	6	61,467	370,131	6.02
Orange	8	141,930	1,015,776	7.16	10	182,103	1,130,683	6.21
Rensselaer	5	17,200	89,900	5.23	7	24,900	143,550	5.77
Rockland	34	324,583	2,407,500	7.42	32	287,538	1,823,371	6.34
Ulster	23	278,556	1,806,691	6.49	24	261,970	1,391,013	5.31
Westchester	9	81,000	588,272	7.26	10	73,530	491,444	6.68
Total for New York	117	1,229,666	8,613,148	7.00	123	1,198,400	7,228,041	6.03
Bergen County, N. J.	12	67,723	450,605	6.65	12	75,972	444,598	5.85
Total	129	1,297,389	9,063,753	6.99	135	1,274,372	7,672.639	6.02

POTTERY.

INTRODUCTION.

The pottery industry, which ten or twelve years ago was only of minor importance, reached in the year 1906 a stage in its history which may be regarded as one of considerable magnitude, the value of its products reaching $31,440,884. The industry has reached a distinctive position, not only in the commercial world but in the artistic world as well. This position has been won only by the earnest desire and effort on the part of the potters of the United States to improve their products. It is safe to say that some of our potters are now turning out ware the equal in every way of that imported, and it is hoped that it will be only a question of a little time when the United States will be producing large quantities of pottery equal to the best European product, and when the lovers of fine pottery will not find it necessary to go abroad to satisfy their demands. At present the domestic production is nearly three-fourths of the consumption, and it is steadily gaining. The demand for fine pottery is increasing at such a rate, however, that imports are almost keeping pace with domestic production, the former increasing at the present time at the rate of 10.48 per cent and the latter at the rate of 12.62 per cent per annum.

The total value of the pottery products rose from $27,918,894 in 1905 to $31,440,884 in 1906, a gain of $3,521,990, or 12.62 per cent. The gain in 1905 over 1904 was $2,760,624, or 10.97 per cent. While this gain in the value of the pottery products should be very satisfactory to the potters of the country, the evident improvement in the quality of the ware is of much greater moment and gives promise of a still greater development in the future.

In collecting the figures for 1906 the schedule of inquiry was so changed as to combine the production of yellow and Rockingham ware with that of stoneware, since there was only one State in 1905 in which there were sufficient producers reported to permit the publication of State totals for any of these wares without disclosing individual returns. C. C. ware was combined with white granite, semiporcelain, etc., for the same reason, and bone china, delft, and belleek ware were combined with china. In all of these instances the products were so nearly related in body that it was thought that they could be combined without sacrificing the accuracy of the information furnished.

PRODUCTION.

The following tables show the statistics of the production of the pottery industry in the United States in 1905 and 1906:

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	51,175		(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	Washington	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
	Number of firms reporting each variety		187	263		83	

[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 centage 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	
	Number of firms reporting each variety.	12		32	31			

[a] Including art and chemical pottery, bread toasters, chicken fountains, craquelle porcelain, faïence, filter stones, Flemish ware, Hampshire pottery, jardinières, 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 washboards.

[b] Sanitary ware for California included in California miscellaneous.

[c] Included in Other States.

[d] Included in [f] ($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 1906, by varieties of products, by States.

Rank of State.	State.	Number of active firms.	Red earthenware.	Stoneware and yellow and Rockingham ware.	C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware.	China, bone china, Delft and Belleek ware.
20	Alabama	25	$2,620	$35,376		
23	Arkansas	3	(a)	(a)		
14	California	15	37,781	25,199		
18	Colorado	6	9,077	26,266		
12	Connecticut	4	41,544	(a)		
	District of Columbia		(a)			
	Florida		(a)	(a)		
22	Georgia	17	5,345	14,912		
6	Illinois	23	37,543	897,650	(a)	
7	Indiana	18	6,550	66,774	(a)	
16	Iowa	6	10,100	(a)		
	Kansas			(a)		
11	Kentucky	11	26,637	140,572		
27	Louisiana	3	(a)			
	Maine			(a)		
8	Maryland	10	12,733	(a)	$352,000	
9	Massachusetts	14	171,160	18,210	(a)	
17	Michigan	6	43,510			
	Minnesota			(a)		
24	Mississippi	8	2,004	17,307		
15	Missouri	11	4,429	65,071		
	Montana		(a)	(a)		
	New Hampshire					
2	New Jersey	57	22,068	54,725	1,436,246	$1,065,986
4	New York	25	34,034	70,131	(a)	657,817
26	North Carolina	28	713	11,057		
1	Ohio	126	206,258	1,581,732	9,735,072	(a)
	Oregon		(a)	(a)		
3	Pennsylvania	46	165,073	312,150	845,366	(a)
21	South Carolina	8	11,701	13,568		
10	Tennessee	11	(a)	163,900		
13	Texas	21	10,045	98,590		
28	Utah	3	2,100			
	Virginia					
19	Washington	4	5,500	36,060		
5	West Virginia	13		23,200	1,047,770	
25	Wisconsin	4	11,470			
	Other States [b]		29,267	521,434	736,049	63,973
	Total	[c] 540	909,262	4,193,884	14,152,503	1,787,776
	Per cent of pottery products		2.89	13.34	45.01	5.69
	Per cent of total clay products		.56	2.60	8.79	1.11
	Number of firms reporting each variety		186	255	77	14

[a] Included in "Other States."
[b] 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.
[c] Includes fourteen firms not distributed.

Value of pottery products in 1906, by varieties of products, by States—Continued.

Rank of State.	State.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Percentage of total
20	Alabama				$37,996	0.12
23	Arkansas			$1,500	19,500	.06
14	California	([b])		18,447	98,597	.31
18	Colorado			11,740	47,083	.15
12	Connecticut		([b])	20,000	133,444	.42
	District of Columbia				([c])	
	Florida				([c])	
22	Georgia				20,257	.07
6	Illinois		([b])	36,876	982,903	3.13
7	Indiana	$435,000	([b])		933,693	2,97
16	Iowa			3,400	58,000	.19
	Kansas				([c])	
11	Kentucky				167,209	.53
27	Louisiana			5,920	6,420	.02
	Maine				([c])	
8	Maryland			4,000	373,499	1.19
9	Massachusetts		([b])	24,033	277,534	.88
17	Michigan			7,600	51,110	.16
	Minnesota				([c])	
24	Mississippi				19,311	.06
15	Missouri				69,500	.22
	Montana				([c])	
	New Hampshire			([b])	([c])	
2	New Jersey	3,742,045	$783,549	178,039	7,282,658	23.16
4	New York	([b])	663,886	46,944	1,868,347	5.94
26	North Carolina				11,770	.04
1	Ohio	285,000	1,100,979	1,021,020	13,990,359	44.50
	Oregon				([c])	
3	Pennsylvania	186,560		897,993	2,410,817	7.67
21	South Carolina				25,269	.08
10	Tennessee			50,000	214,768	.68
13	Texas				108,635	.35
28	Utah				2,100	.01
	Virginia		([b])	([b])	([c])	
19	Washington				41,560	.13
5	West Virginia	387,000	([b])	85,000	1,588,555	5.05
25	Wisconsin			700	12,170	.04
	Other States[d]	62,705	289,870	47,653	[e] 587,820	1.87
	Total	5,098,310	2,838,284	2,460,865	31,440,884	100.00
	Per cent of pottery products	16.21	9.03	7.83	100.00	
	Per cent of total clay products	3.17	1.76	1.53	19.52	
	Number of firms reporting each variety	35	35			

[a] Including art and chemical pottery, bread toasters, craquelle porcelain, faïence, Hampshire pottery, handmade tile, hanging baskets, jardinières and pedestals, Pewabic pottery, pins, stilts, and spurs for potters' use; porcelain doorknobs, shuttle eyes, thread guides and filter tubes, porcelain hardware trimmings, porcelain-lined cooking ware, porcelain teeth, stems, and mouth rings; stove crocks, Teco pottery, tobacco pipes, toy marbles, turpentine cups, umbrella stands, and vases.
[b] Included in "Other States."
[c] Included in [e] ($587,820).
[d] 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.
[e] Made up of State totals of District of Columbia, Florida, Kansas, Minnesota, Montana, New Hampshire, Oregon, and Virginia.

As in former years, pottery products, except earthenware and stoneware, are reported from but few States. White ware, or what is known as "general ware," is produced in but 9 States, sanitary ware in but 7 States, and porcelain electrical supplies in but 9. Where, however, there are less than 3 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 a few States, the others being grouped under "Other States."

Red earthenware was reported from 31 States, Ohio being first with a product valued at $206,258, compared with $137,705 in 1905, which gave Ohio the third rank as a producer of this ware. Massachusetts, which was first in 1905 with a product valued at $185,074, was second in 1906, with a product valued at $171,160. Pennsylvania was third in both years. The total value of this product in 1906 was $909,262, as compared with $780,637 in 1905, a gain of $128,625, or 16.48 per cent. This product was reported by 187 operators in 1905, and by 186 in 1906. It constituted 2.89 per cent of the value of pottery products in 1906 and 2.80 in 1905.

Stoneware and yellow and Rockingham ware were reported from 30 States, Ohio being the leading one with a product valued at $1,581,732; Illinois was second, and Pennsylvania third. The total value of these products in 1906 was $4,193,884, and $3,969,016 in 1905, a gain of $224,868, or 5.67 per cent. Two hundred and sixty-three operators reported in 1905 and 255 in 1906. These wares were 13.34 per cent of the pottery products in 1906 and 14.21 per cent in 1905.

C. C. ware, white granite, semiporcelain, and semivitreous ware were reported for 1906 to the value of $14,152,503, as compared with $13,196,614 in 1905, a gain in 1906 of $955,889, or 7.24 per cent. The wares represented by this column, which are the general household wares, compose the bulk of what is known as pottery, and Ohio is the leading producer, reporting wares valued at $9,735,072, or 68.79 per cent of the total. New Jersey is second with products valued at $1,436,246, or 10.15 per cent of the total. West Virginia is third. These products made up 45.01 per cent of the total clay products in 1906, and 47.26 per cent in 1905.

China, including bone china, delft, and belleek ware increased in value from $1,558,730 in 1905 to $1,787,776 in 1906, a gain of $229,046, or 14.69 per cent. These products are reported from 4 States, for only 2 of which are totals given. New Jersey is the leading State, with products valued at $1,065,986, and New York second with $657,817. These products constituted 5.69 per cent of the pottery products in 1906, and 5.58 per cent in 1905.

Sanitary ware was reported from 7 States in 1906, and the product increased in value from $4,597,145 in 1905 to $5,098,310 in 1906, a gain of $501,165, or 10.9 per cent. New Jersey is the leading State in the production of this ware, reporting a value of $3,742,045, or 73.4 per cent of the total. Indiana was second, though the product fell off somewhat in this State, and West Virginia was third. In 1905 it was possible to give totals for only 2 States, but the number of firms reporting this ware so increased that in 1906 it was necessary to conceal the totals for only 2 States.

The porcelain electrical supply branch of pottery appears to have been in a flourishing condition. The product increased in value from $2,253,061 in 1905 to $2,838,284 in 1906, a gain of $585,223, or 25.97 per cent. This product was reported from 7 States in 1905 and 9 States in 1906, and composed 9.03 per cent of the pottery total in 1906 and 8.07 per cent of the total in 1905.

Ohio was the leading pottery-producing State in 1906, with wares valued at $13,990,359, or 44.50 per cent of the total; in 1905 this State's pottery products were valued at $13,024,071, or 46.65 per cent of the total. New Jersey was second in rank of production, reporting $7,282,658, or 23.16 per cent of the total of 1906, and $6,655,334, or 23.84 per cent of the total of 1905. New York was third in 1905, her pottery products being valued at $1,627,730, or 5.83 per cent of the total; but in 1906 Pennsylvania passed New York, the former reporting wares valued at $2,410,817, or 7.67 per cent of the total as compared with $1,868,347, or 5.94 per cent of the total for the latter, New York taking fourth place. West Virginia was fifth in both years, but with the large new plant at Newell in full operation this State will probably exceed Pennsylvania in value of output. As it is, this State is making steady gains in the value of its pottery products, having increased from $1,195,805 in 1905 to $1,588,555 in 1906, a gain of $392,750, or 32.84 per cent. There are practically no other changes in relative rank. Iowa fell from fifteenth to sixteenth; Missouri, which was eighteenth in 1905, rose to fifteenth in 1906, and Colorado fell from sixteenth to eighteenth, the remaining States were, with two exceptions, the same.

The number of firms reporting pottery sales increased from 533 in 1905 to 540 in 1906, notwithstanding the numerous combinations and idle plants. Ohio has the largest number of firms, 123 in 1905 and 126 in 1906, New Jersey and Pennsylvania each reported 49 in 1905, but in 1906 the former reported 57 and the latter 46, New York had 23 reporting in 1905 and 25 in 1906, West Virginia 12 in 1905 and 13 in 1906, Illinois 24 and 23, and Indiana 17 and 18.

The value of the white ware, exclusive of sanitary ware and porcelain electrical supplies, was $15,940,279, as compared with $14,755,344 in 1905, a gain of $1,184,935, or 8.03 per cent. The gain of this ware in 1905 over 1904 was $977,400, or 7.09 per cent. These products composed 50.70 per cent of the pottery products in 1906 and 52.85 in 1905, while if sanitary ware be added, most of which is made with a high-grade body, the total value of high-grade ware in 1906, would be $21,038,589, or 66.91 per cent of all pottery products.

TRENTON, N. J., AND EAST LIVERPOOL, OHIO.

While pottery products are reported from 37 States, in only 6 is high-grade, general ware made, namely, New York, New Jersey, Pennsylvania, Maryland, West Virginia, and Ohio. Of these, two, New Jersey and Ohio, are considered the great pottery-producing States. In the former almost the entire product, 93.25 per cent, comes from one city—Trenton—while the great pottery center of Ohio is East Liverpool. This city is not to the State what Trenton is to New Jersey, but produces 43.98 per cent of the pottery products of the State. Nevertheless Trenton and East Liverpool are considered the leading pottery centers of the country, and for this reason a table has been prepared showing the pottery products of these centers.

Value of pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1905 and 1906, by varieties.

Variety.	1905.			1906.		
	Trenton.	East Liverpool.	Total.	Trenton.	East Liverpool.	Total.
Stoneware and yellow and Rockingham ware	....	$83,060	$83,060	....	$72,492	$72,492
White ware, C.C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware	$1,610,926	5,227,037	6,837,963	$1,436,246	5,317,016	6,753,262
China, bone china, delft and belleek ware	945,917	....	945,917	1,065,986	....	1,065,986
Sanitary ware	3,042,147	....	3,042,147	3,372,054	....	3,372,054
Porcelain electrical supplies	535,206	525,247	1,060,453	778,549	604,906	1,383,455
Miscellaneous [a]	35,637	151,257	186,894	138,593	158,303	296,896
Total	6,169,833	5,986,601	12,156,434	6,791,428	6,152,717	12,944,145
Per cent of total pottery product	22.10	21.44	43.54	21.60	19.57	41.17

[a] Including art and chemical pottery, stilts, pins, and spurs for potters' use; porcelain door and shutter knobs, stems and mantel rings, etc.

This table shows that these 2 cities continue remarkably close together in the total value of their products, though Trenton's increase over East Liverpool in 1906 is considerably more than it has been since figures have been prepared by this office, being $638,711, or 10.38 per cent, more than East Liverpool's product. The next greatest difference was in 1903, when it was $417,989 in favor of Trenton; and the smallest difference was in 1901, when it was only $13,036. The difference in 1905, in Trenton's favor, was $183,222, while in 1904 the difference was $264,088. Trenton produces no yellow or Rockingham ware and East Liverpool reports no china or sanitary ware. In Trenton there was a decrease in the value of the white ware of $174,680, while East Liverpool reported a gain of $89,979 in this variety of ware. The largest gain in any one item was in sanitary ware reported from Trenton—$329,907. Each of these cities reported several times more pottery than any other State, except, of course, the two in which they are located. The two cities together produced 41.17 per cent of the pottery products of the whole country in 1906, Trenton reporting 21.60 per cent and East Liverpool 19.57 per cent.

CONSUMPTION.

The pottery imports into the United States in 1906 were valued at $13,231,102 and the production at $31,440,884, a total of $44,671,986. After deducting the exports, domestic, $1,118,450, and foreign, $41,151, there appears to have been a net consumption of $43,512,385, of which the domestic production was 72.26 per cent, the highest percentage reached except in 1902. In 1905 the domestic production was 71.81 per cent of the consumption, and it was 70.66 per cent in 1904. 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 shows the value of imports of clay products from 1902 to 1906, inclusive. It will be seen that the total value has increased every year. The total for 1906 is the largest ever recorded, having risen from $12,148,141 in 1905 to $13,406,899 in 1906, an increase of $1,258,758, or 10.03 per cent. In 1905 the increase was 5.74 per cent, and in 1904 it was only 0.28 of 1 per cent.

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1902–1906.

Year.	Pottery.				Brick, fire brick, tile, etc.	Grand total.
	Brown earthen and common stone ware.[a]	China and porcelain, not decorated.	China and porcelain, decorated.	Total.		
1902	$58,926	$1,016,010	$8,495,598	$9,570,534	$235,737	$9,806,271
1903	95,890	1,234,223	9,897,588	11,227,701	228,589	11,456,290
1904	81,951	1,329,146	9,859,144	11,270,241	218,170	11,488,411
1905	100,618	1,157,573	10,717,871	11,976,062	172,079	12,148,141
1906	96,400	1,312,326	11,822,376	13,231,102	175,797	13,406,899

[a] Including Rockingham ware.

As will be noted, practically all of the imports are pottery. In 1906 pottery constituted 98.69 per cent and brick and tile 1.31 per cent of the imports, and in 1905 the percentages were 98.58 and 1.42, respectively. Of these pottery imports, 99.27 per cent was general ware and only 0.73 of 1 per cent was of the lower grade wares in 1906, and in 1905, 99.16 per cent was general ware and 0.84 of 1 per cent was common wares.

The following table shows the exports of clay products of domestic manufacture from the United States from 1902 to 1906, inclusive:

Exports of clay wares of domestic manufacture from the United States, 1902–1906.

Year.	Brick.				Pottery.			Grand total (value).
	Building.		Fire (value).	Total (value).	Earthen and stone ware (value).	China (value).	Total (value).	
	Quantity (thousands).	Value.						
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
1906	27,758	247,625	637,441	885,066	1,003,969	114,481	1,118,450	2,003,516

From this table it will be seen that the value of the exports of clay products increased from $1,783,432 in 1905 to $2,003,516 in 1906, the largest ever recorded, and a gain of $220,084, or 12.34 per cent. The increase in 1905 over 1904 was $404,308, or 29.32 per cent.

The gain in the exports of brick and tile was $85,188, or 10.65 per cent, and the pottery exports increased $134,896, or 13.72 per cent. Of these exports, the earthenware, etc., was 89.76 per cent and the china 10.24 per cent. For the first time the pottery exports exceeded $1,000,000 in value. Building brick showed a decrease of 6,484,000 brick and of $16,251, making the gain in the value of fire brick exported $101,439. The average value per thousand for building brick exported was $8.92 in 1906 and $7.71 in 1905.

CLAY PRODUCTS IN VARIOUS STATES.

The following table gives the statistics of clay products from 1902 to 1906, 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 solely the values of the products named, though the classification as given in the tables is the nearest that can be made without reconstructing them entirely. The item "Miscellaneous" under each State includes all products not otherwise classified, and those which could not be published separately without disclosing individual returns.

Clay products of the United States, by States, from 1902 to 1906.

CALIFORNIA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	181,040,000	217,715,000	256,898,000	284,205,000	278,780,000
Value	$1,291,941	$1,600,882	$1,843,936	$1,961,909	$1,962,866
Average per M	$7.14	$7.35	$7.18	$6.90	$7.05
Vitrified—					
Quantity	....	(a)	(a)	(a)	(a)
Value	....	(a)	(a)	(a)	(a)
Average per M	....	$15.00	$18.08	$19.23	$18.49
Front—					
Quantity	6,099,000	8,886,000	11,722,000	11,871,000	18,421,000
Value	$119,302	$229,537	$291,813	$302,872	$501,746
Average per M	$19.56	$25.83	$24.89	$25.51	$27.24
Fancy or ornamental . value	(a)	(a)	$27,037	$31,899	(a)
Fire ... do	$96,491	$200,332	$285,718	$290,878	$347,806
Stove lining ... do	$1,250	(b)	(a)	(a)	(a)
Draintile ... do	$10,459	$17,994	$29,440	$27,852	$30,545
Sewer pipe ... do	$381,076	$411,380	$568,626	$663,044	$827,477
Architectural terra cotta ... do	$173,194	$180,488	$221,000	$215,160	$254,932
Fireproofing ... do	$18,645	$61,649	$51,125	$45,551	$98,968
Tile, not drain ... do	(a)	(a)	(a)	$34,679	$69,023
Pottery:					
Earthenware and stoneware, value	$40,012	$37,740	$45,005	$53,359	$62,980
Sanitary ware ... value	(a)	(a)	....	(a)	(a)
Miscellaneous ... do	$120,726	$91,541	$261,034	$237,944	$207,887
Total value	$2,253,096	$2,831,543	$3,624,734	$3,865,147	$4,364,230
Number of operating firms reporting	89	105	121	122	113
Rank of State	11	9	8	8	8

CONNECTICUT AND RHODE ISLAND.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	156,885,000	158,382,000	186,908,000	211,613,000	212,648,000
Value	$896,171	$890,989	$1,039,204	$1,329,220	$1,503,929
Average per M	$5.71	$5.62	$5.56	$6.28	$7.07
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$9.10	$14.03	$14.00	$19.00	$16.36
Front—					
Quantity	(a)	(a)	3,060,000	(a)	(a)
Value	(a)	(a)	$45,730	(a)	(a)
Average per M	$9.09	$15.04	$14.94	$14.01	$16.51
Fancy or ornamental . value	(a)	(a)	(a)	(a)	....
Fire ... do	(a)	$61,500	$43,500	(a)	(a)
Stove lining ... do	$12,750	(b)	(a)	(a)	(a)
Fireproofing ... do	(a)	(a)	....	....	....
Tile, not drain ... do	....	....	(a)	....	....
Pottery: [c]					
Earthenware and stoneware, value	$48,100	$42,250	(a)	(a)	(a)
Miscellaneous ... value	$260,657	$211,330	$87,175	$279,358	$243,276
Total value	$1,217,678	$1,206,069	$1,215,609	$1,608,578	$1,747,205
Number of operating firms reporting	41	41	43	42	42
Rank of Connecticut and Rhode Island	21	23	23	20	20

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Produced by Connecticut alone.

Clay products of the United States, by States, from 1902 to 1906—Continued.

GEORGIA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	223,705,000	257,844,000	269,815,000	275,841,000	303,286,000
Value	$1,114,527	$1,305,896	$1,374,318	$1,444,479	$1,783,988
Average per M	$4.98	$5.06	$5.09	$5.24	$5.88
Vitrified—					
Quantity	....	(a)	(a)	(a)	(a)
Value	....	(a)	(a)	(a)	(a)
Average per M	....	$10.93	$12.00	$14.00	$13.99
Front—					
Quantity	5,150,000	2,915,000	3,924,000	2,667,000	2,094,000
Value	$46,560	$25,748	$42,064	$28,676	$20,747
Average per M	$9.04	$8.83	$10.72	$10.75	$9.91
Fancy or ornamental.value	(a)	$2,100	(a)	....	....
Fire.....do	(a)	$73,600	$28,100	$73,050	$51,310
Stove lining.....do	....	(b)	(a)	....	....
Draintile.....do	(a)	(a)	$8,099	$13,500	$12,000
Sewer pipe.....do	$174,008	$162,068	$165,068	$218,000	$221,000
Architectural terra cotta..do	$91,000	$85,500	(a)	(a)	(a)
Fireproofing.....do	$21,650	(a)	(a)	(a)	(a)
Tile, not drain.....do	....	....	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware, value	$16,464	$21,942	$22,057	$21,890	$20,257
Yellow and Rockingham ware.....value	(a)	....	....	....	
Miscellaneous.....do	$44,460	$54,168	$281,230	$320,151	$291,322
Total value	$1,508,669	$1,731,022	$1,920,936	$2,119,746	$2,400,624
Number of operating firms reporting	103	99	103	95	99
Rank of State	19	15	12	12	13

ILLINOIS.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	1,023,681,000	1,015,541,000	999,310,000	1,125,024,000	1,195,210,000
Value	$5,131,621	$5,388,589	$5,167,165	$6,259,232	$5,719,906
Average per M	$5.01	$5.31	$5.17	$5.56	$4.79
Vitrified—					
Quantity	91,116,000	96,568,000	121,073,000	90,563,000	122,227,000
Value	$839,784	$1,015,710	$1,234,703	$973,247	$1,306,476
Average per M	$9.22	$10.52	$10.20	$10.75	$10.69
Front—					
Quantity	20,943,000	25,122,000	21,299,000	30,447,000	30,022,000
Value	$240,466	$274,723	$251,762	$348,354	$341,298
Average per M	$11.48	$10.93	$11.82	$11.44	$11.37
Fancy or ornamental.value	$11,893	$12,927	$11,733	$13,567	$11,635
Fire.....do	$199,048	$233,106	$217,008	$176,692	$236,032
Draintile.....do	$693,783	$892,807	$1,002,463	$1,051,852	$1,052,588
Sewer pipe.....do	$360,149	$532,858	$550,344	$580,538	$587,805
Architectural terra cotta..do	$1,000,765	$1,198,477	(a)	(a)	(a)
Fireproofing.....do	$358,015	$335,838	$324,264	$323,550	$409,171
Tile, not drain.....do	$257,049	$283,426	$194,471	(a)	(a)
Pottery:					
Earthenware and stoneware, value	$602,708	$694,770	$801,946	$889,857	$935,193
Yellow and Rockingham ware.....value	(a)	(a)	(a)	(a)	
C. C. and white granite ware, value	$56,256	$168,363	....	....	(a)
Semivitreous porcelain ware, value	(c)	(c)	....	....	
Miscellaneous.....value	$130,303	$159,203	$1,021,588	$1,744,897	$2,034,077
Total value	$9,881,840	$11,190,797	$10,777,447	$12,361,786	$12,634,181
Number of operating firms reporting	515	502	492	469	466
Rank of State	4	4	4	5	5

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Included in C. C. and white granite ware.

Clay products of the United States, by States, from 1902 to 1906—Continued.

INDIANA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	305,233,000	294,890,000	283,707,000	279,073,000	307,076,000
Value	$1,710,385	$1,697,190	$1,677,714	$1,630,072	$1,778,270
Average per M	$5.60	$5.76	$5.91	$5.84	$5.79
Vitrified—					
Quantity	45,933,000	47,864,000	51,859,000	43,573,000	45,725,000
Value	$441,494	$482,967	$513,209	$474,600	$502,509
Average per M	$9.61	$10.09	$9.90	$10.89	$10.99
Front—					
Quantity	24,866,000	24,742,000	19,890,000	22,212,000	35,090,000
Value	$215,202	$232,487	$197,890	$231,353	$395,368
Average per M	$8.65	$9.36	$9.95	$10.42	$11.27
Fancy or ornamental. value	$10,398	(a)	(a)	$15,520	$4,700
Fire ... do	$66,725	$115,526	$130,216	$163,728	$149,351
Stove lining ... do	....	(b)	(a)	(a)	(a)
Draintile ... do	$807,516	$1,014,706	$1,205,717	$1,267,691	$1,373,441
Sewer pipe ... do	$311,223	$363,212	$294,000	$430,680	$486,897
Architectural terra cotta .. do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	$342,854	(a)	$210,800	$393,985	$323,015
Tile, not drain ... do	$579,896	$463,082	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware ... value	$28,780	$73,160	$65,390	$74,462	$73,324
C. C. ware, white granite, semiporcelain and semivitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
Sanitary ware ... value	(a)	(a)	$425,000	$496,000	$435,000
Miscellaneous ... do	$769,260	$1,252,295	$1,182,653	$1,321,482	$1,636,359
Total value	$5,283,733	$5,694,625	$5,902,589	$6,499,573	$7,158,234
Number of operating firms reporting	512	490	465	441	419
Rank of State	6	6	6	6	6

IOWA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	228,142,000	191,323,000	207,041,000	193,259,000	168,871,000
Value	$1,575,959	$1,355,129	$1,440,758	$1,366,653	$1,118,709
Average per M	$6.91	$7.08	$6.96	$7.07	$6.62
Vitrified—					
Quantity	23,905,000	21,888,000	19,231,000	13,253,000	16,930,000
Value	$232,056	$232,510	$199,528	$134,802	$185,990
Average per M	$9.71	$10.62	$10.38	$10.17	$10.99
Front—					
Quantity	7,504,000	12,815,000	7,994,000	5,676,000	8,871,000
Value	$80,711	$135,849	$91,269	$60,669	$101,795
Average per M	$10.76	$10.60	$11.42	$10.69	$11.48
Fancy or ornamental. value	$1,690	(a)	(a)	....	....
Fire ... do	$850	$975	(a)	$869	$930
Stove lining ... do	....	(b)	(a)	....	....
Draintile ... do	$672,212	$1,028,383	$1,294,134	$1,509,226	$1,721,614
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta .. do	(a)	....	....	....	....
Fireproofing, terra-cotta lumber, and hollow building block or tile ... value	$103,824	$131,191	$161,658	$137,554	$162,664
Tile, not drain ... do	$2,590	(a)	$4,300	(a)	....
Pottery:					
Earthenware and stoneware ... value	$43,387	$52,922	$66,050	$68,859	$54,600
Miscellaneous ... do	$130,057	$156,444	$203,156	$113,490	$122,725
Total value	$2,843,336	$3,093,403	$3,460,853	$3,392,122	$3,469,027
Number of operating firms reporting	325	304	327	306	304
Rank of State	8	8	9	9	9

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

KENTUCKY.

Product.	1902.	1903.	1904.	1905.	1906
Brick:					
Common—					
Quantity	112,728,000	123,309,000	138,677,000	147,702,000	142,185,000
Value	$659,612	$689,403	$796,074	$862,330	$881,879
Average per M	$5.85	$5.59	$5.74	$5.84	$6.20
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$13.80	$15.20	$14.91	$14.27	$14.13
Front—					
Quantity	6,172,000	6,869,000	2,178,000	11,558,000	11,893,000
Value	$47,027	$53,769	$20,571	$128,777	$109,771
Average per M	$7.62	$7.83	$9.44	$11.14	$9.23
Fire ... value	$605,448	$873,294	$680,084	$739,059	$898,527
Stove lining ... do	(a)	(b)	(a)	...	...
Draintile ... do	$26,039	$20,621	$26,564	$28,865	$27,359
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta ... do	...	...	...	(a)	...
Fireproofing ... do	...	(a)	(a)	...	...
Tile, not drain ... do	$237,469	$222,420	(a)	$296,949	$296,391
Pottery:					
Earthenware and stoneware ... value	$137,043	$139,827	$157,613	$157,083	$167,209
Miscellaneous ... do	$160,405	$191,625	$406,371	$193,287	$211,287
Total value	$1,873,043	$2,190,959	$2,087,277	$2,406,350	$2,592,423
Number of operating firms reporting	111	113	120	121	117
Rank of State	15	11	10	10	11

MARYLAND.

Product.	1902.	1903.	1904.	1905.	1906
Brick:					
Common—					
Quantity	141,235,000	147,663,000	160,279,000	210,446,000	204,238,000
Value	$879,995	$976,969	$1,048,850	$1,423,663	$1,267,771
Average per M	$6.23	$6.62	$6.54	$6.76	$6.21
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$15.51	$9.46	$10.08	$17.96	$15.60
Front—					
Quantity	3,457,000	2,728,000	2,245,000	1,426,000	2,266,000
Value	$45,375	$40,479	$37,537	$24,118	$31,968
Average per M	$13.13	$14.84	$16.72	$16.91	$14.11
Fancy or ornamental ... value	(a)	(a)	(a)	(a)	(a)
Fire ... do	$277,290	$272,295	$235,136	$224,667	$266,980
Stove lining ... do	$21,540	(b)	(a)	$32,890	$32,200
Draintile ... do	$2,105	$1,355	$2,848	$4,703	$3,315
Sewer pipe ... do	(a)	...	...	...	...
Architectural terra cotta ... do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware ... value	$13,651	$16,428	$13,440	$13,325	$17,499
Yellow and Rockingham ware ... value	(a)	(a)	(a)	(a)	
C. C. and white granite semiporcelain and semivitreous porcelain ware, value	$505,722	$450,000	$382,500	(a)	$352,000
Miscellaneous ... value	$159,684	$151,295	$151,746	$526,001	$164,806
Total value	$1,905,362	$1,908,821	$1,872,057	$2,249,367	$2,136,539
Number of operating firms reporting	68	59	63	68	70
Rank of State	13	14	13	11	15

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

MASSACHUSETTS.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	241,376,000	190,812,000	165,435,000	194,504,000	204,282,000
Value	$1,529,671	$1,236,103	$1,012,226	$1,264,787	$1,415,864
Average per M	$6.34	$6.48	$6.12	$6.50	$6.93
Vitrified—					
Quantity	...	...	(a)	...	...
Value	...	...	(a)	...	...
Average per M	...	...	$14.00	...	...
Front—					
Quantity	3,631,000	2,625,000	(a)	2,080,000	(a)
Value	$69,230	$52,450	(a)	$33,971	(a)
Average per M	$19.07	$19.98	$21.67	$16.33	$22.17
Fancy or ornamental . value	(a)	(a)	(a)	(a)	(a)
Fire . do	$54,342	$200,225	(a)	$68,180	$57,940
Stove lining . do	$133,752	(b)	(a)	$173,151	$186,815
Architectural terra cotta . do	(a)	(a)	(a)	(a)	(a)
Fireproofing . do	(a)	(a)	(a)	(a)	(a)
Tile, not drain . do	$67,418	(a)	$72,000	$82,000	$91,394
Pottery:					
Earthenware and stoneware, value	$206,808	$198,382	$193,633	$208,950	$189,370
C. C. and white granite ware, value	(a)	(a)	(a)	(a)	(a)
Miscellaneous . value	$314,446	$421,525	$451,199	$219,418	$231,350
Total value	$2,375,667	$2,108,685	$1,729,058	$2,050,457	$2,172,733
Number of operating firms reporting	90	86	87	78	82
Rank of State	10	12	16	13	14

MICHIGAN.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	237,254,000	215,791,000	205,196,000	211,558,000	206,583,000
Value	$1,331,752	$1,251,572	$1,116,714	$1,152,505	$1,178,202
Average per M	$5.61	$5.80	$5.44	$5.45	$5.70
Vitrified—					
Quantity	(a)	(a)	(a)	6,112,000	6,229,000
Value	(a)	(a)	(a)	$81,706	$81,814
Average per M	$12.26	$13.27	$13.28	$13.37	$13.13
Front—					
Quantity	5,684,000	2,225,000	1,080,000	693,000	1,474,000
Value	$42,792	$19,000	$7,500	$5,995	$14,162
Average per M	$7.53	$8.54	$6.94	$8.65	$9.61
Fancy or ornamental . value	(a)	(a)	(a)	...	(a)
Fire . do	...	(a)	(a)	(a)	(a)
Stove lining . do	...	(b)	(a)	(a)	(a)
Draintile . do	$96,645	$129,028	$208,088	$205,445	$314,098
Sewer pipe . do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta . do	...	(a)	...	...	...
Fireproofing, terra cotta lumber, and hollow building tile or blocks . value	$3,290	$19,138	$8,080	(a)	$4,290
Tile, not drain . do	(a)	...	...	...	...
Pottery:					
Earthenware and stoneware, value	$44,098	$42,007	$40,621	(a)	$43,510
Miscellaneous . value	$225,463	$249,676	$333,510	$320,056	$208,401
Total value	$1,744,040	$1,710,421	$1,714,513	$1,765,707	$1,844,477
Number of operating firms reporting	182	178	168	154	142
Rank of State	16	16	17	17	18

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

MINNESOTA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	192,674,000	161,911,000	164,154,000	166,233,000	165,598,000
Value	$1,103,515	$982,728	$970,247	$977,837	$986,982
Average per M	$5.72	$6.07	$5.91	$5.88	$5.96
Vitrified—					
Quantity		195,000	(a)	(a)	(a)
Value		$1,875	(a)	(a)	(a)
Average per M		$9.62	$10.00	$14.54	$10.68
Front—					
Quantity	6,280,000	6,922,000	6,566,000	6,636,000	7,510,000
Value	$75,850	$78,930	$113,260	$85,300	$98,170
Average per M	$12.08	$11.40	$17.25	$12.85	$13.07
Fancy or ornamental.value	(a)	(a)	(a)		
Fire.....do	(a)			(a)	(a)
Draintile.....do	$2,219	$10,087	$11,100	$15,770	$41,779
Sewer pipe.....do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta..do	(a)				
Fireproofing.....do	$41,000	(a)	(a)	(a)	(a)
Tile, not drain.....do	(a)				
Pottery:					
Earthenware and stoneware, value	(a)	(b)	(b)	(b)	(b)
Miscellaneous.....value	$679,147	$453,388	$225,300	$420,479	$476,348
Total value	$1,901,731	$1,527,008	$1,319,907	$1,499,386	$1,603,279
Number of operating firms reporting	111	116	114	111	109
Rank of State	15	18	21	21	23

MISSOURI.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	292,134,000	274,755,000	271,370,000	316,002,000	257,292,000
Value	$1,832,118	$1,725,253	$1,690,460	$2,028,957	$1,810,304
Average per M	$6.27	$6.28	$6.23	$6.42	$7.04
Vitrified—					
Quantity	22,288,000	31,496,000	47,235,000	43,375,000	57,414,000
Value	$194,250	$307,237	$480,671	$470,935	$539,700
Average per M	$8.72	$9.75	$10.17	$10.86	$9.40
Front—					
Quantity	30,744,000	26,153,000	25,599,000	28,224,000	29,019,000
Value	$358,089	$333,965	$322,445	$362,996	$394,563
Average per M	$11.65	$12.77	$12.60	$12.86	$13.59
Fancy or ornamental.value	$49,411	$39,756	$32,967	$44,632	$30,689
Fire.....do	$739,385	$925,915	$925,520	$1,117,209	$1,324,895
Stove lining.....do	(a)	(c)	(a)	(a)	(a)
Draintile.....do	$35,887	$45,363	$80,479	$59,858	$64,063
Sewer pipe.....do	$903,279	$1,050,794	$1,176,679	$1,101,938	$1,208,236
Architectural terra cotta..do	(a)	$371,006	(a)	(a)	(a)
Fireproofing, terra cotta lumber, and hollow building tile or blocks.....value	$99,690	$98,888	(a)	(a)	(a)
Tile, not drain.....do	$103,356	$235,091	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware, value	$48,913	$50,001	$69,327	$43,368	$69,500
Miscellaneous, value	$802,036	$478,338	$702,956	$973,518	$1,254,325
Total.....value	$5,166,414	$5,661,607	$5,481,504	$6,203,411	$6,696,275
Number of operating firms reporting	235	242	232	224	190
Rank of State	7	7	7	7	7

[a] Included in miscellaneous.
[b] The value of pottery products for Minnesota for 1903, 1904, 1905, and 1906 could not be included in the State totals without disclosing the operations of individual establishments.
[c] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

NEW JERSEY.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	300,583,000	272,178,000	319,975,000	465,040,000	413,258,000
Value	$1,506,224	$1,500,295	$1,842,075	$3,090,809	$2,610,686
Average per M	$5.01	$5.51	$5.76	$6.65	$6.32
Vitrified—					
Quantity	1,014,000	1,402,000	4,953,000	991,000	(a)
Value	$10,437	$22,195	$66,813	$13,803	(a)
Average per M	$10.29	$15.83	$13.49	$13.93	$14.98
Front—					
Quantity	42,926,000	41,075,000	47,058,000	53,770,000	62,138,000
Value	$552,000	$548,553	$687,469	$852,744	$896,887
Average per M	$12.86	$13.35	$14.61	$15.86	$14.43
Fancy or ornamental. value	$11,407	$14,970	(a)	$1,975	$1,951
Enameled do	(a)	(a)	(a)	(a)	(a)
Fire do	$819,580	$949,392	$908,882	$1,393,448	$954,081
Stove lining do	$8,477	(b)	(a)	(a)	(a)
Draintile do	$33,020	$20,825	$24,842	$24,315	$23,209
Sewer pipe do	(a)	(a)	$23,299	$56,576	(a)
Architectural terra cotta do	$861,730	$1,364,094	$1,412,023	$1,614,263	$1,682,022
Fireproofing, terra-cotta lumber, and hollow building tile or blocks value	$965,047	$1,325,654	$1,211,646	$1,308,075	$1,485,195
Tile, not drain do	$795,153	$734,159	$548,097	$585,130	$1,163,401
Pottery:					
Earthenware and stoneware value	$59,820	$65,004	$70,819	$70,825	$76,793 (Earthenware and stoneware; Yellow and Rockingham ware)
Yellow and Rockingham ware value	(a)	(a)	....	....	
C. C. ware do	$581,267	$454,029	$325,959	(a)	$1,436,246 (C. C. ware; White granite ware; Semivitreous porcelain ware)
White granite ware do; Semivitreous porcelain ware value	$1,431,270	$1,575,892	$1,284,199	$1,288,926	
China do	$680,368	$805,691	$816,374	$816,917	$1,065,986 (China; Bone china, delft, and belleek ware)
Bone china, delft, and belleek ware value	$90,840	$106,000	$162,500	$129,000	
Sanitary ware do	$2,807,322	$2,794,984	$2,878,621	$3,426,291	$3,742,045
Porcelain electrical supplies value	$358,496	$385,398	$302,293	$540,206	$783,549
Miscellaneous do	$1,040,805	$749,804	$738,136	$1,486,222	$1,440,218
Total value	$12,613,263	$13,416,939	$13,304,047	$16,699,525	$17,362,269
Number of operating firms reporting	154	159	161	163	175
Rank of State	3	3	3	3	3

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

NEW YORK.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	1,061,712,000	1,068,464,000	1,169,233,000	1,518,196,000	1,535,579,000
Value	$5,021,132	$5,305,522	$6,783,528	$10,297,214	$9,205,981
Average per M	$4.73	$4.96	$5.80	$6.78	$6.09
Vitrified—					
Quantity	27,009,000	16,797,000	14,490,000	12,076,000	10,787,000
Value	$322,250	$220,296	$189,281	$149,391	$163,969
Average per M	$11.93	$13.11	$13.06	$12.37	$15.20
Front—					
Quantity	18,963,000	18,383,000	19,104,000	12,610,000	23,625,000
Value	$249,573	$248,760	$263,150	$237,305	$351,824
Average per M	$13.16	$13.53	$13.77	$18.82	$14.89
Fancy or ornamental. value		(a)	(a)	(a)	
Enameled do					(a)
Fire do	$402,006	$629,245	$381,784	$427,873	$451,783
Stove lining do	$132,832	(b)	(a)	$133,383	$131,908
Draintile do	$110,301	$140,181	$139,876	$153,598	$153,237
Sewer pipe do	$209,105	$134,360	$125,510	(a)	(a)
Architectural terra cotta do	(a)	$947,153	$785,978	$874,722	$967,987
Fireproofing do	$123,497	(a)	$132,034	$117,577	$75,631
Tile, not drain do	$125,680	$150,504	$154,417	$164,445	$101,319
Pottery:					
Earthenware and stoneware value	$86,708	$82,310	$74,781	$83,780	$104,165 (with Yellow and Rockingham ware)
Yellow and Rockingham ware value		(a)	(a)		
C. C. and white granite ware value	(a)	(a)	(a)	(a)	(a)
China do	(a)	(a)	(a)	(a)	$657,817
Sanitary ware do	(a)	(a)	(a)	(a)	(a)
Porcelain electrical supplies value	$391,319	$474,842	$438,792	$617,663	$663,886
Miscellaneous do	$1,239,710	$875,079	$1,073,939	$1,229,396	$847,100
Total value	$8,414,113	$9,208,252	$10,543,070	$14,486,347	$13,876,607
Number of operating firms reporting	262	242	240	249	253
Rank of State	5	5	5	4	4

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

OHIO.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	538,552,000	497,071,000	455,936,000	514,419,000	550,422,000
Value	$3,091,847	$3,002,506	$2,708,456	$3,033,435	$3,243,157
Average per M	$5.74	$6.04	$5.94	$5.90	$5.89
Vitrified—					
Quantity	186,786,000	202,649,000	218,791,000	224,086,000	202,978,000
Value	$1,643,532	$1,860,071	$2,222,931	$2,055,120	$1,955,360
Average per M	$8.80	$9.17	$10.16	$9.17	$9.63
Front—					
Quantity	63,815,000	50,997,000	65,645,000	89,390,000	90,310,000
Value	$674,822	$633,101	$755,870	$1,074,007	$1,025,590
Average per M	$10.57	$12.41	$11.51	$12.01	$11.36
Fancy or ornamental . value	[a] $47,376	$42,522	$64,514	$18,153	$38,218
Fire . do	$1,327,982	$1,561,936	$1,186,966	$1,427,919	$1,670,630
Stove lining . do	$192,460	([c])	([b])	$49,538	$110,800
Draintile . do	$894,713	$1,149,990	$1,143,957	$1,291,323	$1,520,748
Sewer pipe . do	$2,646,134	$3,295,635	$3,495,917	$3,550,160	$3,987,360
Architectural terra cotta . do	$18,289	([b])	....	....	([b])
Fireproofing, terra-cotta lumber, and hollow building tile or blocks . value	$757,613	$865,649	$788,825	$923,762	$1,159,021
Tile, not drain . do	$1,156,371	$1,072,103	$1,005,611	$1,188,460	$1,523,410
Pottery:					
Earthenware and stoneware . value	$1,311,686	$1,225,735	$1,226,973	$1,448,007	$1,787,990 (Earthenware and stoneware; Yellow and Rockingham ware)
Yellow and Rockingham ware . value	$129,591	$222,904	$231,994	$177,143	
C. C. ware . do	$729,526	$762,475	$503,945	$609,478	$9,735,072 (C. C. ware; White granite ware; Semivitreous porcelain ware)
White granite ware . do; Semivitreous porcelain ware . value	$6,757,661	$6,681,080	$7,422,196	$8,521,944	
China . do	([b])	$265,300	$280,614	([b])	([b])
Sanitary ware . do	([b])	([b])	([b])	([b])	$285,000
Porcelain electrical supplies . value	$415,874	$486,740	$557,027	$879,207	$1,100,979
Miscellaneous . do	$2,454,271	[a] $2,080,381	[a] $2,051,987	[a] $2,055,383	[a] $1,870,830
Total value	$24,249,748	$25,208,128	$25,647,783	$28,303,039	$31,014,165
Number of operating firms reporting	801	815	819	792	784
Rank of State	1	1	1	1	1

[a] Enameled brick is included in fancy brick in 1902; in miscellaneous in 1903, 1904, 1905, and 1906.
[b] Included in miscellaneous.
[c] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

PENNSYLVANIA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	949,718,000	927,212,000	856,963,000	1,036,777,000	1,027,541,000
Value	$6,074,352	$6,174,437	$5,439,116	$6,532,814	$6,586,374
Average per M	$6.40	$6.66	$6.35	$6.30	$6.41
Vitrified—					
Quantity	76,024,000	72,039,000	71,522,000	71,888,000	93,417,000
Value	$716,887	$685,274	$766,638	$750,389	$996,347
Average per M	$9.43	$9.51	$10.72	$10.44	$10.67
Front—					
Quantity	77,746,000	80,177,000	75,407,000	131,368,000	151,138,000
Value	$966,530	$1,050,805	$962,765	$1,683,031	$1,761,991
Average per M	$12.43	$13.11	$12.77	$12.81	$11.66
Fancy or ornamental . value	$20,972	$32,602	$23,317	$37,966	$40,880
Enameled do	(a)	(a)	(a)	(a)	(a)
Fire do	$6,080,213	$6,537,076	$5,477,475	$5,771,795	$6,854,640
Stove lining do	$116,653	(b)	(a)	$180,353	$203,674
Draintile do	$9,317	$11,451	$8,646	$13,509	$9,113
Sewer pipe do	$550,481	$727,465	$834,646	$886,979	$985,635
Architectural terra cotta do	$243,800	$329,004	$349,317	$405,015	$367,353
Fireproofing, terra-cotta lumber, hollow building tile or blocks value	$138,839	$278,621	$193,190	$352,107	$242,668
Tile, not drain do	$232,431	$207,608	$215,107	$310,931	$389,013
Pottery:					
Earthenware and stoneware value	$499,227	$533,535	$504,221	$459,111	$477,223
Yellow and Rockingham ware value	(a)	(a)	(a)	(a)	
C. C. ware do	(a)	....	(a)	....	$845,366
White granite ware do	$1,099,011	$1,036,194	$707,809	$716,245	
Sanitary ware do	$146,000	$144,414	(a)	(a)	$186,560
Miscellaneous do	$938,712	$1,098,838	$1,339,616	$1,024,308	$1,827,774
Total value	$17,833,425	$18,847,324	$16,821,863	$19,124,553	$21,774,611
Number of operating firms reporting	511	523	529	516	514
Rank of State	2	2	2	2	2

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.

Clay products of the United States, by States, from 1902 to 1906—Continued.

TEXAS.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	217,461,000	178,134,000	197,033,000	202,070,000	211,842,000
Value	$1,353,489	$1,074,051	$1,157,130	$1,209,898	$1,307,199
Average per M	$6.22	$6.03	$5.87	$5.99	$6.17
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$9.23	$9.53	$8.81	$10.47	$10.00
Front—					
Quantity	6,844,000	5,462,000	5,645,000	8,001,000	8,492,000
Value	$73,619	$65,628	$58,734	$102,054	$110,189
Average per M	$10.76	$12.02	$10.40	$12.76	$12.98
Fancy or ornamental, value	$4,557	$11,240	$2,544	$18,127	(a)
Fire, do	$17,781	$22,333	$30,208	$14,724	$45,557
Draintile, do	$2,766	(a)	(a)	....	$3,652
Sewer pipe, do	(a)	(a)	(a)	(a)	(a)
Tile, not drain, do	(a)	(a)	(a)	....	(a)
Pottery:					
Earthenware and stoneware, value	$96,402	$96,136	$106,471	$100,788	$108,635
Miscellaneous, value	$145,200	$203,192	$181,010	$273,354	$394,366
Total value	$1,693,814	$1,472,580	$1,536,097	$1,718,945	$1,969,598
Number of operating firms reporting	172	168	152	129	139
Rank of State	17	20	18	18	16

VIRGINIA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	192,337,000	189,891,000	203,484,000	237,161,000	232,697,000
Value	$1,185,362	$1,245,861	$1,292,558	$1,572,442	$1,536,312
Average per M	$6.16	$6.56	$6.35	$6.63	$6.60
Vitrified—					
Quantity	....	(a)	(a)	(a)	....
Value	....	(a)	(a)	(a)	....
Average per M	....	$8.92	$10.46	$10.80	....
Front—					
Quantity	20,433,000	18,866,000	21,077,000	22,155,000	25,385,000
Value	$344,139	$303,431	$344,891	$352,297	$392,130
Average per M	$16.84	$16.08	$16.36	$15.90	$15.45
Fancy or ornamental, value	(a)	$27,330	$28,576	$20,363	(a)
Fire, do	(a)	(a)	(a)	(a)	$21,110
Draintile, do	$4,240	$4,750	$5,673	$4,500	$4,805
Pottery:					
Earthenware and stoneware, value	(a)	(a)	(a)	....	....
Porcelain electrical supplies, value	....	....	(a)	(b)	(b)
Miscellaneous, value	$44,092	$91,974	$64,694	$44,976	$11,721
Total value	$1,577,833	$1,673,346	$1,736,392	$1,994,578	$1,966,078
Number of operating firms reporting	98	100	99	94	91
Rank of State	18	17	15	15	17

[a] Included in miscellaneous.
[b] The value of pottery products for Virginia for 1905 and 1906 could not be included in the State total without disclosing individual figures.

Clay products of the United States, by States, from 1902 to 1906—Continued.

WEST VIRGINIA.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	81,166,000	88,060,000	68,133,000	69,228,000	74,833,000
Value	$527,661	$576,404	$469,501	$476,630	$469,527
Average per M	$6.50	$6.55	$6.89	$6.88	$6.27
Vitrified—					
Quantity	60,549,000	51,762,000	39,620,000	24,692,000	47,902,000
Value	$578,777	$576,258	$470,339	$263,449	$578,164
Average per M	$9.56	$11.13	$11.87	$10.67	$12.07
Front—					
Quantity	(a)	269,000	388,000	(a)	(a)
Value	(a)	$3,356	$5,380	(a)	(a)
Average per M	$14.33	$12.48	$13.87	$16.67	$15.00
Fire value	$23,633	$70,802	$11,814	$26,868	$59,757
Stove lining	....	(b)	(a)	....	....
Draintile value	$1,226	$1,499	$1,398	(a)	(a)
Sewer pipe do	(a)	(a)	(a)	(a)	(a)
Tile, not drain do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware, value	$15,018	$16,600	$18,923	$19,110	$23,200
C. C. and white granite ware, value	$1,026,446	$1,099,900	$912,935	(a)	$1,047,770
Semivitreous porcelain ware, value	(c)				
Sanitary ware value	(a)	(a)	(a)	(a)	$387,000
Miscellaneous do	$345,783	$213,741	$184,259	$1,232,738	$217,894
Total value	$2,518,544	$2,558,560	$2,074,549	$2,018,795	$2,783,312
Number of operating firms reporting	53	56	64	62	65
Rank of State	9	10	11	14	10

WISCONSIN.

Product.	1902.	1903.	1904.	1905.	1906.
Brick:					
Common—					
Quantity	152,127,000	181,722,000	186,292,000	186,531,000	170,496,000
Value	$919,883	$1,193,360	$1,230,620	$1,260,066	$1,109,386
Average per M	$6.05	$6.57	$6.61	$6.76	$6.51
Vitrified—					
Quantity	....	(a)	....	....	....
Value	....	(a)	....	....	....
Average per M	....	$12.00	....	....	....
Front—					
Quantity	7,724,000	6,794,000	8,438,000	4,917,000	5,384,000
Value	$70,303	$62,857	$86,688	$49,275	$52,038
Average per M	$9.10	$9.25	$10.27	$10.02	$9.67
Fancy or ornamental value	(a)	(a)	(a)	$1,048	(a)
Fire do	(a)	....	....	....	....
Draintile do	$17,763	$34,556	$54,831	$57,576	$51,143
Tile, not drain do	(a)	....	....	....	....
Pottery:					
Earthenware and stoneware, value	$12,285	$13,586	$13,075	$11,950	$11,470
Miscellaneous value	$6,424	$3,037	$5,780	$2,200	$3,305
Total value	$1,026,658	$1,307,396	$1,390,994	$1,382,115	$1,227,342
Number of operating firms reporting	150	158	159	157	147
Rank of State	22	22	20	24	25

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Included in white granite ware.

CLAY.

INTRODUCTION.

The clay-mining industry continues to grow, as evidenced by the figures given in the following tables. The clay resources of the United States are almost without limit, every variety known being found within its domain. As the country becomes more thickly settled and the value of clay becomes known, more valuable deposits will be discovered. This office is in receipt almost daily of samples of clay from all parts of the country, some of which give promise of commercial value. The value of clay, however, depends largely upon its proximity to centers of transportation and population, as none but the highest grade will stand the cost of transportation.

The clay given in these tables is only such as is sold as clay by the miner, and does not include the clay which is burned into clay products by the miner. This is a small quantity compared with the total quantity of clay consumed, and includes mainly clay used in pottery, paper clay, and fire clay. Potters, especially makers of high-grade ware, usually purchase their clay, and fire-brick makers do so to some extent; the makers of the coarser products generally mine their own clay. The latter is not included.

DEVELOPMENTS.

During the year the most important developments in the clay-mining industry were the discovery of deposits of kaolin-ball clay in Edwards County, Tex., and the discovery of kaolin in Union County, Ill. The white sedimentary clays of South Carolina and Georgia appear to be finding a more extended market, both as paper clay and in the pottery industry. The movement on foot to establish potteries in the South near the sources of supply, if successful, will have a marked effect on the clay-mining industry of that section.

PRODUCTION.

In the following tables will be found statements of the clay mined and shipped by the miner as such in 1905 and 1906:

Clay mined and sold in the United States in 1905, in 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	13,994	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	102,461
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	3,494	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
Average price per ton		7.32		4.02		1.36		2.73		1.24		1.21		.98		1.53

a Including brick clay, cement shale, clay used for plaster and for boiler covering, modeling clay, sewer-pipe 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 1906, in 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									25,871	$16,564			20,000	$4,000	45,871	$20,564
Arizona [b]	(c)	(c)					(c)	(c)	16,966	21,917			4,618	1,975	42,258	126,912
California									44,213	53,918	(c)	(c)			57,413	67,418
Colorado									19,761	27,318	(c)	(c)	50,390	40,272	71,796	70,597
Delaware	(c)	(c)							(c)	(c)	(c)	(c)			29,766	122,661
Georgia			32,552	$141,765					6,070	14,568	(c)	(c)	(c)	(c)	38,979	156,690
Illinois	(c)	(c)			(c)	(c)	(c)	(c)	44,989	50,793	44,950	$37,603	34,060	20,845	139,704	131,272
Indiana									52,474	52,200	(c)	(c)	3,500	1,750	63,279	62,974
Iowa									355	560			1,650	1,350	2,005	1,910
Kentucky							(c)	(c)	31,658	24,912	(c)	(c)	7,250	11,000	45,910	59,780
Maryland	(c)	(c)							13,628	24,234	1,525	1,894	1,260	950	18,413	39,078
Massachusetts									1,585	4,224			2,826	2,218	4,411	6,442
Michigan					1,989	$5,455									1,989	5,455
Missouri	(c)	(c)							158,845	346,437	3,486	2,616	2,617	14,500	165,258	365,793
Montana									1,615	3,598					1,615	3,598
New Jersey			(c)	(c)			1,908	$9,081	360,411	523,835	23,523	41,787	84,302	106,041	470,174	680,999
New York					(c)	(c)			2,962	3,508	(c)	(c)	1,124	806	6,864	9,933
North Carolina	11,803	$90,036							(c)	(c)	140	65	48	72	12,010	90,358
Ohio					1,435	1,625			200,159	210,832	43,175	33,702	4,226	5,142	248,995	251,301
Pennsylvania	19,281	109,040	6,831	38,663					300,386	392,545	1,767	543	57,773	31,540	386,038	572,331
South Carolina			36,550	162,025					(c)	(c)			7,600	10,600	44,665	175,351
Tennessee							25,811	64,522	20,656	23,904	3,188	3,216	9,283	12,755	58,938	104,397
Texas									888	2,570	(c)	(c)	1,929	2,889	3,167	5,984
Utah	(c)	(c)							4,688	11,166					4,713	11,416
Vermont	4,992	36,125							(c)	(c)					5,392	37,325
Virginia	(c)	(c)							(c)	(c)			1,102	659	2,903	24,354
West Virginia									53,457	36,052	(c)	(c)			54,207	36,377
Wyoming													719	3,986	719	3,986
Other States [d]	15,861	134,251	30	255	18,003	24,466	26,454	125,470	18,835	32,356	25,107	29,348	342	342	(e)	(e)
Total	51,937	369,452	75,963	342,708	21,427	31,546	54,173	199,073	1,380,472	1,878,011	146,861	150,774	296,619	273,692	2,027,452	3,245,256
Average value per ton		7.11		4.51		1.47		3.67		1.36		1.03		0.92		1.60

[a] Including bentonite, brick clay, plaster clay, puddled clay, sagger clay, sewer-pipe clay, shale, terra-cotta clay, and wad clay.
[b] Including Connecticut, Florida, Idaho, Indian Territory, New Mexico, North Dakota, Oregon, South Dakota, Washington, and Wisconsin.
[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.

As appears from these tables, the clay mined in the United States in 1906 and sold as such amounted to 2,027,452 short tons, valued at $3,245,256, as compared with 1,806,133 short tons, valued at $2,768,006, in 1905, a gain in 1906 of 221,319 tons, or 12.25 per cent, and of $477,250, or 17.24 per cent.

New Jersey continues to be the leading clay-producing State, both in quantity of clay mined and in value of the product, that State reporting 470,174 tons in 1906, valued at $680,999, or 20.98 per cent of the total value for the entire country. This was a gain of 29,529 tons and of $64,540 in 1906 over 1905. Fire clay is New Jersey's principal clay; small quantities of ball and stoneware clay are reported also.

Pennsylvania was second in quantity and value of clay mined in 1906, reporting 386,038 short tons of clay, valued at $572,331, or 17.64 per cent of the total value. This was a gain in 1906 of 150,528 tons, or 63.92 per cent, and of $165,943, or 40.83 per cent. Missouri was third in value of product in 1906, though its output was exceeded by that of Ohio, the value of its product being $365,793, or 11.27 per cent of the total, a gain of $43,368, or 13.45 per cent. Ohio, the great clay State, was third in output, but fourth in value in 1906, as in 1905, its clay being valued in 1906 at $251,301, a gain of $33,999, or 15.65 per cent.

All the States reporting show an increase in the value of product except Alabama, Indiana, Montana, New York, and West Virginia.

Kaolin is reported as being marketed from 10 States, but totals are given for only 3, and paper clay from 3, of which South Carolina is the leading State. Slip and ball clay are marketed in but few States, while fire and stoneware clays are reported from nearly every State in the list. New Jersey, Pennsylvania, and Missouri, in the order given, are the leading States in value of fire clay reported.

It will be observed that every variety of clay except slip and stoneware clay showed an increase in value in 1906. Kaolin increased in value $42,617, or 13.04 per cent; paper clay, $35,470, or 11.54 per cent; ball clay, $31,861, or 19.05 per cent; fire clay, $348,543, or 22.79 per cent; while slip clay decreased in value from $33,384 in 1905 to $31,546 in 1906, and stoneware clay fell from $219,767 to $150,774, a loss of $68,993, or 31.39 per cent.

IMPORTS.

The following table shows the imports of clay from 1902 to 1906, inclusive:

Classified imports of clay for consumption 1902–1906, in short tons.

Year.	Kaolin or china clay.		All other clays.						Total.	
			Unwrought.		Wrought.		Common blue.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902....	149,029	$883,092	28,931	$138,032	3,002	$47,093	7,815	$86,588	188,777	$1,154,805
1903....	157,088	898,573	32,691	152,018	2,725	36,211	10,165	110,794	202,669	[a]1,198,418
1904....	160,046	891,708	25,402	123,241	1,363	25,026	5,263	50,364	192,074	1,090,339
1905....	187,803	1,019,650	30,661	151,583	1,560	38,036	5,909	54,390	225,933	1,263,659
1906....	223,404	1,208,189	33,267	166,366	1,889	37,549	9,220	84,578	267,780	1,496,682

[a] Includes clay not otherwise provided for, valued at $822, but for which no quantity is reported.

LIME AND SAND-LIME BRICK.[a]

By Edwin C. Eckel.

INTRODUCTION.

Until recently statistics relative to the lime industry were reported in the volume on Mineral Resources in the chapter on stone, while the sand-lime brick production was reported in the chapter on clay products. This practice had grown up quite naturally, as the earlier statistics on lime were gathered merely incidentally to the collection of limestone statistics, while the sand-lime brick industry was new and unimportant. The recent growth of both industries, however, seemed to make it desirable to devote a separate section to lime and its products, and accordingly this was done in 1905. This year the same plan has been followed, but additional material is now presented relative to certain technologic features of the industries reported on. This is possible owing to the complete responses made by individual producers to requests for information as to fuel used, uses of their lime, and other particulars.

LIME.

PRODUCTION.

The lime output increased from 2,984,100 tons, valued at $10,941,,680[b] in 1905 to 3,197,754 tons, valued at $12,480,653, in 1906, an increase of 213,654 tons in quantity and of $1,538,973 in value. The average price per ton was $3.67 in 1905 and $3.90 in 1906, an increase of $0.23 per ton.

There was an increase in value per ton in almost every State, the cause given in almost all cases being increase in cost of fuel and supplies and increase in cost of labor. The figures given represent the net value of the lime.

The number of lime burners reporting a production in 1906 was 1,012; the number giving complete record of fuel burned was 951.

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[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.

[b] Does not include value ($408,548) of limestone burned at sugar refineries and alkali plants, but not included in the tonnage for 1905.

Detailed statistics of lime production during 1905 and 1906, by States, are given in the following table:

Quantity and value of lime burned in the United States in 1905 and 1906, by States, in short tons.

State.	1905.			1906.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Alabama	79,973	$292,162	$3.65	92,403	$341,627	$3.70
Arizona	5,298	32,557	6.15	14,084	96,470	6.85
Arkansas	29,424	114,846	3.90	30,348	121,953	4.02
California	67,476	535,157	7.93	73,941	601,557	8.19
Colorado	10,115	48,459	4.79	6,595	32,020	4.86
Connecticut	70,558	261,509	3.71	90,457	411,853	4.55
Florida	10,719	63,950	5.97	18,362	71,382	3.89
Georgia	16,200	49,580	3.06	18,903	72,840	3.85
Idaho	6,694	44,733	6.68	5,932	39,840	6.72
Illinois	98,907	421,589	4.26	121,546	534,118	4.39
Indiana	106,408	366,866	3.45	114,819	353,648	3.08
Indian Territory	100	650	6.50	510	3,350	6.57
Iowa	19,360	76,904	3.97	17,497	78,366	4.48
Kansas	2,795	17,242	6.17	1,560	10,217	6.55
Kentucky	9,556	28,393	2.97	9,784	28,081	2.87
Maine	220,927	971,305	4.40	228,208	1,066,275	4.67
Maryland	134,431	360,247	2.68	127,863	350,460	2.74
Massachusetts	84,380	395,326	4.69	119,267	563,100	4.72
Michigan	48,089	192,844	4.01	68,133	281,465	4.13
Minnesota	18,977	81,093	4.27	19,920	93,555	4.70
Missouri	186,173	787,069	4.23	207,334	916,693	4.42
Montana	4,073	22,436	5.51	4,745	30,098	6.34
Nevada	....	....	....	150	2,400	16.00
New Jersey	40,659	168,775	4.15	42,714	187,978	4.40
New Mexico	400	2,625	6.56	1,790	9,975	5.57
New York	114,876	490,845	4.27	114,620	519,855	4.54
North Carolina	1,792	7,980	4.45	5,896	41,468	7.03
Ohio	327,373	1,056,721	3.23	331,972	1,100,133	3.31
Oklahoma	400	4,000	10.00	120	1,500	12.50
Oregon	7,886	74,745	9.48	3,934	32,388	8.23
Pennsylvania	620,018	1,672,267	2.70	624,060	1,857,754	2.98
Rhode Island	6,461	42,743	6.62	7,003	54,569	7.79
South Carolina	7,955	34,440	4.33	7,134	34,719	4.87
South Dakota	4,165	26,308	6.32	3,666	23,930	6.53
Tennessee	75,667	252,908	3.34	83,047	307,165	3.70
Texas	31,984	142,470	4.45	41,183	192,527	4.67
Utah	12,765	69,089	5.41	17,461	86,518	4.95
Vermont	39,620	188,921	4.77	32,755	167,393	5.11
Virginia	114,221	396,434	3.47	104,468	382,083	3.66
Washington	27,935	160,985	5.76	59,094	347,924	5.89
West Virginia	104,156	255,337	2.45	98,447	257,333	2.61
Wisconsin	214,872	726,071	3.38	225,633	769,808	3.41
Wyoming	262	3,099	11.83	396	4,265	10.77
Total	2,984,100	[a]10,941,680	3.67	3,197,754	12,480,653	3.90

[a] Not including value ($408,548) of limestone burned for lime at sugar refineries and alkali plants.

The following table gives the value of the total lime production in the United States for the years 1896 to 1906, inclusive:

Value of total production of lime in the United States, 1896–1906.

1896	$6,327,900	1902	$9,335,618
1897	6,390,487	1903	9,255,882
1898	6,886,549	1904	9,951,456
1899	6,983,067	1905	10,941,680
1900	6,797,496	1906	12,480,653
1901	8,204,054		

USES OF THE LIME PRODUCED IN 1906.

In the following table the total lime production for 1906 is classified according to the uses for which it was sold, as reported by the lime manufacturers. This table, though complete, is in far from satisfactory shape, but at present it does not seem possible to correct it. The desirable improvements are two: (1) A closer classification of the uses to which lime is put, for it will be seen that the table includes obviously conflicting and duplicate uses, and (2) an allowance for the limestone sold direct to users who burn it into lime and apply it in some of the industries covered by the table. At present this last item is partly included in the present chapter, under lime, and partly in the chapter on stone, under limestone. It is hoped that in future reports it will be possible to make a more satisfactory grouping.

Though defective to the extent above noted, the table is of interest as giving the first approximate data for determining the relative importance of the structural and the chemical uses of lime. It will be seen that the lime sold for structural uses as building lime, hydrated lime, for sand-lime brick manufacture, for slag cement, and for quick-lime brick, amounted to 2,647,724 tons out of the total lime production of 3,197,754 tons, leaving 550,030 tons for the various chemical industries.

Production of lime in the United States in 1906, by uses, in short tons.

Use.	Quantity.	Value.
Building lime	2,506,452	$10,247,579
Hydrated lime	120,357	479,079
Sand-lime brick	19,737	85,845
Slag cement	175	500
Quick-lime brick	1,003	4,391
Sugar factories	28,678	128,547
Fertilizer	300,024	713,336
Steel works	11,517	46,100
Paper mills	53,266	197,277
Glass works	20,558	62,216
Ammonia works	2,049	5,643
Water purification	2,965	10,950
Glue factories	1,050	3,000
Chemical works	79,932	282,400
Acetate lime	2,400	12,000
Lead smelters	10,750	55,375
Sheep dipping	70	525
Tanneries	7,472	37,780
Alkali works	2,450	9,000
Ground lime	18,627	58,220
Cyaniding plants	2,222	13,890
Soap	6,000	27,000
Total	3,197,754	12,480,653

FUELS USED IN LIME BURNING.

The total lime output of 1906 was 3,197,754 tons, made by 1,012 producers. Of these, 951 makers, producing 2,808,986 tons, replied to the questions as to character and quantity of fuel used. The data presented below cover, therefore, about 90 per cent of the total American lime industry.

Kind and quantity of fuel used in burning lime in 1906.

Kind of fuel used.	Quantity of fuel.	Quantity of lime burned.	Number of firms using.
		Short tons.	
Wood .... cords..	412,359	921,073	285
Shavings .... short tons..	22,945	43,677	3
Coal .... do....	357,735	1,150,220	549
Coke .... do....	2,160	9,889	7
Oil .... barrels..	24,486	16,921	5
Gas .... cubic feet..	236,435,000	60,760	6
Mixed fuels:			
Wood .... cords..	71,282	429,411	76
Coal .... short tons..	95,960		
Wood .... cords..	300	1,120	1
Coke .... short tons..	150		
Wood .... cords..	300	18,286	1
Coal .... short tons..	2,000		
Coke .... do....	500		
Coal and coke .... do....	9,288	28,685	9
Coal .... do....	37,386	128,944	9
Gas .... cubic feet..	193,543,000		
Total	....	2,808,986	951

The total quantity of the various kinds of fuel consumed in the American lime industry during 1906 was, therefore, as follows:

Total fuel consumed in burning lime in 1906.

Wood .... cords..	484,241
Shavings .... short tons..	22,945
Coal .... do....	501,081
Coke .... do....	4,098
Gas .... cubic feet..	429,978,000
Oil .... barrels..	24,486

The "gas" in the above table includes both natural gas and producer gas, as can be determined from its fuel efficiency.

FUEL CONSUMPTION PER TON OF LIME.

The most valuable use to which the above data may be put is, of course, the determination of the average fuel consumption per short ton of lime burned with different kinds of fuel. Disregarding the product from the plants using mixed fuels, these averages are as shown in the following table:

Fuel consumption per short ton of lime burned in 1906.

Wood .... cord..	0.448
Shavings .... short ton..	.525
Coal .... do....	.311
Coke .... do....	.219
Oil .... barrels..	1.447
Gas .... cubic feet..	3,891

HEAT LOSSES IN THE LIMEKILN.

It is of course possible to carry these calculations a step further and to determine the average efficiency—or inefficiency—of all the limekilns in the country. By using average values for the heat units in the various fuels we can determine that in 1906 the heat utilized in all limekilns averaged 7,413,500 B. T. U. per ton of burned lime. In a volume[a] published recently the writer calculated the

[a] Eckel, E. C., Cements, Limes, and Plasters, New York, 1905, p 99.

theoretical heat requirements for lime burning and stated that in burning a pure nonmagnesian limestone they would amount to 2,113,600 B. T. U. per short ton of limestone, which is closely equivalent to 3,774,300 B. T. U. per short ton of burned lime. On comparing this quantity of heat actually required in burning a ton of lime with the quantity used during 1906 it will be seen that the average limekiln wastes almost exactly half of all the fuel put into it. There is evidently still considerable room for improvement in lime-burning methods.

HYDRATED LIME.

In sending out the statistical inquiries for 1906 an attempt was made to secure data relative to the hydrated-lime industry, with the results set forth in the following tables. Though a gratifying number of replies were made to the questions which bore on this industry, there is no doubt that the statistics below are relatively incomplete and do not give a fair idea of the present status of this comparatively recent development in lime manufacture. It is hoped that in future years greater completeness will be attained.

The reports show that in 1906 the total quantity of lime hydrated by the burners and marketed as hydrated lime was 120,357 short tons, valued at $479,079, or $4.15 per ton. It is practically certain, however, that much of the product reported as building lime was in reality hydrated lime.

The number of lime-hydrating plants which reported as having operated in 1906 was as follows:

Number of lime-hydrating plants in operation in 1906, by States.

Alabama	1	Michigan	1
Arizona	1	New York	1
Connecticut	1	Ohio	8
Georgia	2	Pennsylvania	8
Indiana	2	West Virginia	1
Iowa	1	Wisconsin	1
Kansas	1		
Maine	1	Total	30

IMPORTS AND EXPORTS.

The imports of lime for consumption into the United States in 1906 were 20,692 short tons, valued at $91,241, as against 22,247 short tons, valued at $84,564, in 1905, and 22,297 short tons, valued at $82,008, in 1904.

The exports in 1906 were valued at $101,668, as against $76,658 in 1905.

SAND-LIME BRICK.

PRODUCTION.

The year 1906 showed fairly prosperous conditions in the sand-lime brick industry, the product being valued at $1,170,005, an increase of 20 per cent over the value, $972,064, in 1905. During 1906 the value of the common building brick made by this process averaged $6.71 per thousand, as against $6.58 in 1905. The front brick averaged $10.42 per thousand, as against the 1905 average of $11.02. Almost 90 per cent of the entire sand-lime product is marketed as common brick, a result which could hardly have been anticipated when this brick was first introduced into this country.

Detailed statistics for 1905 and 1906 are presented in the following table:

Production of sand-lime brick in the United States in 1905 and 1906, by States.

1905.

State.	Number of operating firms reporting.	Common brick.		Front brick.		Fancy brick.		Blocks, value.	Total value.
		Quantity. (thousands).	Value.	Quantity. (thousands).	Value.	Quantity. (thousands).	Value.		
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		

1906.

State.	Number of operating firms reporting.	Common brick.		Front brick.		Fancy brick.		Blocks, value.	Total value.
		Quantity. (thousands).	Value.	Quantity. (thousands).	Value.	Quantity. (thousands).	Value.		
Alabama, Kentucky, Mississippi, and Tennessee	6	6,877	$51,079	1,276	$11,947				$63,026
Arkansas, Kansas, Minnesota, Nebraska, South Dakota, and Texas	8	14,877	96,128	1,897	17,962	(a)	(a)		114,390
California	4	4,837	38,789	1,900	22,400				61,189
Colorado and Idaho	4	569	6,043	2,191	22,743			(a)	31,464
Delaware, Maryland, and Virginia	4	9,403	61,719	(a)	(a)				67,119
Florida	8	11,678	83,306	(a)	(a)				89,306
Georgia	3	5,139	37,701	(a)	(a)				40,701
Illinois and Wisconsin	4	8,150	49,150	690	6,060				55,210
Indiana	6	17,077	84,361	326	2,474	(a)	(a)		86,880
Iowa	3	3,921	28,271	(a)	(a)	(a)	(a)	(a)	38,255
Michigan	11	27,281	162,879	1,796	12,022	(a)	(a)		174,921
New Jersey	3	6,520	49,143					(a)	50,143
New York	9	21,288	169,257	1,910	22,064				191,321
North Carolina	3	3,147	22,225	(a)	(a)				32,975
Ohio	4	1,232	7,049	(a)	(a)				10,184
Pennsylvania	7	6,673	50,211	978	12,710				62,921
Other States [b]				2,718	32,963	121	$3,473	$5,876	(c)
Total	87	148,669	997,311	15,682	163,345	121	3,473	5,876	1,170,005
Average value per M			6.71		10.42		28.70		

[a] Included in Other States.
[b] Includes all products made by less than three producers in one State, to prevent disclosing individual operations.
[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, 1903–1906.

Year.	Number of plants.	Value of product.
1903	16	$155,040
1904	57	463,128
1905	84	972,064
1906	87	1,170,005

THE CONSTITUTION OF SAND-LIME BRICK.

In previous publications on the sand-lime brick industry the writer has stated that conclusive evidence had not yet been produced as to the constitution of the binding medium of sand-lime brick. The advocates of the new product not only claimed that a definite lime silicate was formed during processes of manufacture, but usually made the additional claim, by implication at least, that this silicate was the same as that which exists in Portland cement. The fact was overlooked that purely chemical means could not be relied on to prove these facts, if facts they were. Under these circumstances the writer, admitting his own incompetency to decide the question, believed it advisable to consider the matter unsettled, pending a decisive test by the only means possible—the petrographic microscope, used by one of the very few investigators intimately acquainted with the lime-silicate series.

During the past year evidence has been submitted which seems conclusive. Mr. Frederick E. Wright, at the writer's request, examined several specimens of commercial sand-lime brick in the geophysical laboratory of the Carnegie Institution. Mr. Wright states that the binding material of these specimens is a hydrous lime silicate somewhat akin to the familiar minerals of the zeolite group. The reactions involved in the formation of such a hydrous silicate from lime and sand in the presence of steam are simple and well known. It is to be noted, however, that these reactions are in no way comparable to those which take place during the processes of Portland cement manufacture and that the binding material of sand-lime brick is very different in composition and relationship from Portland cement clinker.

It may safely be assumed, then, that a sand-lime brick as marketed consists of (1) sand grains held together by a network of (2) hydrous lime silicate, with probably (if a magnesian lime were used) some allied magnesian silicate, and (3) lime hydrate or a mixture of lime and magnesia hydrates. These three elements will always be present, and the structural value of the brick will depend in large part on the relative percentages in which the sand, the silicates, and the hydrates occur.

GLASS SAND, SAND, AND GRAVEL.

By Ernest F. Burchard.

GLASS SAND.

DEVELOPMENTS.

Late in December, 1906, certain newly opened deposits were reported to have begun producing glass sand, but their production is not included in the statistics given herein, which are for the calendar year 1906. One of these deposits is on White River, near Guyon, Ark., and others are near Fredonia and Fall River in southern Kansas. Development of sands in these localities will prove of great importance to the glass-making industry in the gas belt of Kansas and Indian Territory. Heretofore manufacturers alike of bottle, flint, and window glass in this region have been obliged to depend on sand supplies from eastern Missouri, which were largely controlled by glass makers in that district. On account of the distance of the eastern Missouri glass sand from the Kansas markets freight rates have brought the cost of the material at those markets up to three or four times the net price at the quarries, while, as a consequence of car famines and of the natural disinclination of some producers to supply raw material promptly to competitors, the Kansas manufacturers and their customers have recently suffered serious inconvenience. Shortage of raw materials has resulted in shut downs, tie ups, cancellation of contracts, increased cost of the manufactured products, and corresponding losses to the trade and to the consumer.

The opening of the northern Arkansas deposits has been made possible by the recent building of the White River branch of the Missouri Pacific Railway, while the increased demands of the local district and the saving in freight rates are responsible for the development of the Kansas deposits. The occurrence and character of these deposits have been described in the fifth and eighth of the series of papers cited below.

CHARACTER.

Glass sand is derived mainly from pure quartz sandstone, of varying degrees of induration, by crushing it into its component grains and then cleaning and drying the product. A high degree of purity (see analyses, page 7) is required for a glass sand, consequently it is not so abundant as, and is more expensive to prepare than, other grades of sand. The cost of preparation of glass sand in proportion to its selling price is higher than that of fire sand, molding sand, furnace sand, etc., which are impure silica sands containing argillaceous material that must be washed out in cleaning a glass sand. The production of fire and other sands is therefore the more profitable, and many firms are producing them in preference to glass sand, although they may have material fairly suitable for the preparation of the latter.

PRICES.

There are such wide local variations in the price of glass sand that no average figures can be given for the country at large. In the Mississippi Valley, in the Illinois-Fox River district, and near the mouth of Missouri River, where extensive deposits of easily quarried sand are close to transportation routes, glass sand is produced on a large scale and comparatively cheaply, so that the cleaned and dried product is sold at from 65 to 75 cents a ton. Eastward and westward from the middle Mississippi Valley, until the coast States are reached, prices are higher, and it appears that they are largely controlled by the prices which the central producers receive for their sand plus the freight charges on that sand to centers of consumption. These considerations bring the prices approximately to the following figures per short ton for the outlying States: Ohio, \$0.998; Pennsylvania, \$1.49; West Virginia, \$1.44; Minnesota, \$1.30; Colorado, \$1.25. Sands in New Jersey, New York, and Virginia approximate, respectively, 60, 80, and 78 cents per ton, while in California 80 cents is an average price. Some of the Massachusetts sand is of exceptional purity and is so carefully prepared for special uses that it brings an extra price, averaging slightly above \$4.50 per ton.

LITERATURE.

Papers published by the United States Geological Survey, in which the character, distribution, relation to markets and fuel supplies, and methods of extraction and preparation of glass sands are discussed, are listed below in the order of their dates:

WEEKS, JOSEPH D., Glass materials: Mineral Resources U. S. for 1883–1884, U. S. Geol. Survey, 1885, pp. 958–973.

———, Glass materials: Mineral Resources U. S. for 1885, U. S. Geol. Survey, 1886, pp. 544–555.

CAMPBELL, M. R., Description of the Brownsville-Connellsville quadrangles, Pennsylvania: Geologic Atlas U. S., folio 94, U. S. Geol. Survey, 1903, p. 49.

COONS, A. T., Glass sand: Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1904, pp. 1007–1015.

BURCHARD, E. F., Requirements of sand and limestone for glass making: Bull. U. S. Geol. Survey No. 285, 1906, pp. 452–458.

———, Glass sand of the middle Mississippi basin: Bull. U. S. Geol. Survey No. 285, 1906, pp. 459–472.

STOSE, G. W., Glass-sand industry in eastern West Virginia: Bull. U. S. Geol. Survey No. 285, 1906, pp. 473–475.

BURCHARD, E. F., Glass-sand industry of Indiana, Kentucky, and Ohio: Bull. U. S. Geol. Survey No. 315, 1907, pp. 361–376.

———, Notes on glass sands from various localities, mainly undeveloped: Bull. U. S. Geol. Survey No. 315, 1907, pp. 377–382.

MOLDING SAND.

USE AND CHARACTER.

The material used in making molds and cores for casting iron, steel, brass, and other molten metals is termed molding sand. It varies from clayey loam to a clean, sharp, coarse sand, according to requirements. Practice is so diverse in various lines and in different foundries that not only is a great variety of so-called sand used in its natural state, but in many instances various other ingredients, such as loam, clay, oil, flour, and molasses, are mixed in definite proportions with the sands to give results desired. Three essential qualities in molding sand are refractoriness, porosity, and bond. The grain of the sand should be such as to meet the requirements. Its size affects directly the porosity of the material and the character of the work for which it is used. In general, the finer and more intricate the design the finer the sand required. The refractory nature of the sand and clay is governed by the presence of a high content of silica and the absence of such fluxing constituents as lime carbonate, alkalies, and iron oxides. The material, including the bond, must possess at the same time plasticity and strength. It must be plastic in order to be molded around the pattern, and it must have sufficient strength to stand when unsupported by the pattern and to resist the impact of the metal when poured into the mold. Too much clay and iron oxide will cause the mold to shrink and crack under the intense heat, yet too little will cause it to dry and crumble, if not to collapse entirely. Under a simple preliminary examination a good sand should show to the unaided eye grains nearly uniform in size, angular rather than round, and when spread on dark paper it should show no dust. To the touch the sand should feel sharp rather than smooth, and when moistened with 10 to 20 per cent of water it must be capable of being formed into balls which will not become pulpy nor be too easily crushed.

COMPOSITION OF SANDS.

It is evident from the foregoing statements that the physical properties of molding sands are of much more importance than their chemical composition. The difference in composition between glass sands and molding sands is shown in the following table. Sands which on analysis fail to reach the required purity of a glass sand may possess still greater intrinsic value as molding or furnace sands.

Analyses of American glass sands and molding sands.

	Silica (SiO_2).	Alumina (Al_2O_3).	Iron oxide (Fe_2O_3).	Lime (CaO).	Magnesia (MgO).	Color.	Grain.
1. Sand for clear flint glass.	99.659	0.310	0.011	0.020		White.	Medium ($\frac{1}{40}$ inch)±.
2. Sand for window glass..	98.87	.21	.08	.24	.12	Gray.	Do.
3. Sand for green bottle glass.	97.50	1.50	.50	....	.50	Pale yellow.	Do.
4. Sand for delicate molding.	81.50	9.88	3.14	1.04	.65	....	Fine.
5. Sand for medium-class molding.	84.86	7.03	2.18	.62	.98	....	Medium.
6. Sand for heavy castings.	82.92	8.21	2.90	.62	....	....	Coarse.

LITERATURE.

The following three papers, arranged chronologically, contain much valuable information concerning molding sands. The last paper is probably the most complete that has yet been published concerning the sands of a particular area, and it embodies tabulated results of considerable experimental work on the physical properties of the material.

MERRILL, G. P., Guide to the study of the collections in the section of applied geology. Nonmetallic minerals: Rept. U. S. Nat. Mus. for 1899, 1901, pp. 474–477.

ECKEL, EDWIN C., Molding sand, its uses, properties, and occurrence: Twenty-first Rept. New York State geologist, 1901, pp. 91–96.

KÜMMEL, H. B., and others, Report upon some molding sands of New Jersey: Ann. Rept. State geologist of New Jersey for 1904, 1905, pp. 189–246.

PRODUCTION.

The sand and gravel production reported to this office in 1906 was 32,932,002 short tons, valued at $12,698,208; in 1905 the production reported was 23,204,967 short tons, valued at $11,223,645; there was, therefore, in 1906, an increase in quantity of 9,727,035 short tons and in value of $1,474,563. This large increase in quantity with a comparatively small increase in value is due to the fact that a large quantity of material, especially gravel having a merely nominal value, was reported as used for filling by contractors, railroads, etc.

Exclusive of gravel, from which a large part of the sand is screened, the total sand reported in 1906 was 24,501,992 short tons, valued at $10,067,668, which, compared with the production of 18,782,111 tons of sand, valued at $9,422,988, in 1905, shows an increase in quantity of 5,719,881 tons and in value of $644,680. A large quantity of the sand classed as "other sand" is used, as is the cheaper gravel, for filling purposes by railroads and contractors, and has a low average price, running as low as 8 and 10 cents per ton, the average value being about 25 cents per ton.

The price of sand and gravel varies, according to the use to which it is put, from 8 or 10 cents per ton to nearly $5 for some of the finest grades of glass sand. This value, as is the case with all the values given for sand and gravel, represents the net value of the material, free on board at point of shipment.

Pennsylvania reports the largest value of production of sand and gravel in the United States, which includes first rank in the production of glass sand, engine sand, and sand for "other uses," the total production for 1906 being 5,232,875 short tons, valued at $2,480,811. New York ranks second in value of output, the total reported for 1906 being 4,097,485 tons, valued at $1,373,169. The greater part of this production is building sand, in the total output and value of which the State ranks first. Both Pennsylvania and New York are exceeded in quantity by Indiana, which is credited with 6,221,775 tons, valued at $1,035,352. Ohio, having the largest output and value of molding sand, ranks third, the total production of sand and gravel being 2,424,274 tons, valued at $1,254,442. The order of other States in rank of value is Illinois, Missouri, and Indiana, each producing sand and gravel valued at over $1,000,000.

Glass sand, which on account of the purity of sand required commands the highest average price, increased in production from 1,060,334 short tons, valued at $1,107,730, in 1905, to 1,089,430 short tons, valued at $1,208,788, in 1906, an increase in quantity of 29,096 short tons and in value of $101,058. Pennsylvania ranks first in quantity and value of production of this material, the output being reported as 342,967 short tons, valued at $510,910; West Virginia comes next, with an output of 158,093 tons, valued at $227,225; Illinois is third, producing 238,178 tons, valued at $156,684. Other States having an output of over $50,000 in value are, in order of rank, New Jersey, Ohio, and Missouri.

The molding sand reported in 1906 amounted to 3,371,103 tons, valued at $2,063,151; in 1905 this product was reported as 3,084,098 tons, valued at $2,102,423; there was, therefore, in 1906, an increase in quantity of 287,005 tons and a decrease in value of $39,272. This includes sand used for all kinds of molding—brass, steel, iron, brick, pig bed, etc. The price of this sand varies from 30 cents to over $1.50 per short ton, according to the grade of the sand and the class of work done. Ohio reports the largest output of this sand, the production for 1906 being 816,540 tons, valued at $555,910. Pennsylvania, New Jersey, Illinois, and New York follow in the order named, each having an output valued at over $100,000.

The most universal use of sand is for building, and 14,388,378 tons of this sand, valued at $5,166,532, were reported in 1906, as compared with 10,127,750 tons, valued at $4,284,740, in 1905, an increase of 4,260,628 tons in quantity and of $881,792 in value. This total includes sand for concrete building, all mortar sand, and sand for rough and fine plastering, and the value per ton varies from 25 cents to $1. New York reports a larger output than any other State—3,369,194 tons, valued at $1,045,844. Pennsylvania, Missouri, Illinois, Indiana, and Ohio come next, in the order named. The greater part of this material is dredged from the seabeaches on Long Island and from the Delaware, Ohio, Tennessee, Mississippi, and Missouri rivers, and is obtained very cheaply.

The following table shows the sand and gravel output, by States and uses, for 1905 and 1906:

Production of sand and gravel in the United States in 1905 and 1906, by States and uses, in short tons.

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	65,673	54,005	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	1,302,543	803,349
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	1,060,334	1,107,730	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	23,204,967	11,223,645

[a] Includes Florida, Maine, North Carolina, Oklahoma, South Carolina, Utah, Washington, and Wyoming.

Production of sand and gravel in the United States in 1905 and 1906, by States and uses, in short tons—Continued.

1906.

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			61,295	$24,000	86,443	$48,818			9,000	$2,500	6,000	$4,800			53,299	$49,798	216,037	$129,916
Arkansas			545	520	125,680	62,752			51,975	14,521			28,025	$17,731	8,200	8,688	214,425	104,212
California	7,324	$6,124	4,987	6,064	16,624	6,675			25,446	7,130			1,132	1,615	179,861	81,816	235,374	109,424
Colorado	750	938	12,139	7,717	30,417	9,672	3,000	$1,000	1,000	300			900	900			48,206	20,527
Connecticut			1,446	1,426	13,187	4,040											14,633	5,466
Delaware			220	110	31,878	12,751			30,327	12,131	22,416	10,161	30	38			84,871	35,191
Georgia	6,000	6,000	57,550	18,988	227,972	73,177	1,875	900	26,575	6,575	2,625	1,710	5,400	3,666	7,800	6,800	335,797	117,816
Hawaii													5,985	9,294	2,375	1,750	8,360	11,044
Illinois	238,178	156,684	372,307	216,087	868,014	314,071	1,070	428	70,000	27,400	86,490	38,038	64,903	32,068	956,597	258,265	2,657,559	1,043,041
Indiana	38,940	29,259	142,252	71,368	753,542	310,806	65	20	103,305	13,016	114,405	17,799	2,816,567	149,389	2,252,699	443,695	6,221,775	1,035,352
Iowa			4,952	5,152	127,271	45,158	1,800	1,400	8,550	2,100			14,975	4,863	27,125	15,707	184,673	74,380
Kansas			288,155	65,310					5,000	1,000			34	14	729	438	293,918	66,762
Kentucky	2,400	2,040	67,825	36,484	303,992	153,547			35,512	11,448	3,000	2,300	12,485	5,674	161,663	81,643	586,877	293,136
Louisiana					152,545	96,657			113,839	20,328			113,741	20,942	561,609	310,522	941,734	448,449
Maryland	10,000	14,000	13,200	6,000	463,531	186,605			80	56			28,865	19,375	98,541	59,761	614,217	285,797
Massachusetts	6,829	31,738	4,190	4,350	81,168	38,076	8,000	5,200					3,620	6,410	9,846	7,318	113,653	93,092
Michigan	600	3,000	61,387	26,108	403,199	127,937			4,000	400	5,000	2,500	51,005	12,140	72,598	25,614	597,789	197,699
Minnesota			27,470	25,181	82,041	38,474							5,685	5,470	29,824	8,816	145,020	77,941
Mississippi			251	375	8,637	2,875							8,300	4,460	51,375	25,550	68,563	33,260
Missouri	101,862	65,393	89,249	51,922	2,276,485	722,913	9,808	5,970	62,533	12,531	500	280	49,364	29,673	474,857	147,696	3,064,658	1,036,378
Montana					2,000	900											2,000	900
Nebraska					148,465	34,000			19,860	2,830			7,942	953	1,150	525	177,417	38,308
New Jersey	102,658	83,031	422,794	290,054	533,681	195,249	105,014	101,700	47,993	17,094	22,750	11,300	261,148	188,152	123,424	71,735	1,619,462	958,315
New Mexico													1,250	1,500			1,250	1,500
New York	1,500	1,200	215,368	151,268	3,369,194	1,045,844	22,647	7,110	32,528	14,948	7,019	3,678	59,102	22,574	390,127	126,547	4,097,485	1,373,169
Ohio	71,329	71,246	816,540	555,910	796,472	275,799	16,600	12,000	16,348	7,443	71,204	92,148	55,394	43,328	580,387	196,568	2,424,274	1,254,442
Oregon					91,843	60,000									154,407	47,644	246,250	107,644
Pennsylvania	342,967	510,910	555,449	399,091	2,288,006	808,679	7,949	6,851	154,387	110,809	77,797	46,094	367,397	291,786	1,438,923	306,591	5,232,875	2,480,811
Tennessee			23,599	15,443	276,195	127,497	1,425	675	28,250	10,700	2,875	1,250	15,710	6,680	283,952	96,818	632,006	259,063
Texas			2,687	1,859	150,616	74,106			6,700	820			45,007	4,657	109,100	77,925	314,110	159,367
Vermont			1,500	712	1,987	1,225							77,350	9,375	750	300	81,587	11,612
Virginia			26,654	15,466	272,396	91,265	1,000	500	4,370	1,970	21,376	8,028	8,602	4,072	780	650	335,178	121,951
Washington			3,300	6,200	114,032	46,473									176,239	92,052	293,571	144,725
West Virginia	158,093	227,225	10,616	7,745	123,259	62,346			31,844	21,267			12,322	8,490	58,724	13,301	394,858	340,374
Wisconsin			55,973	33,907	122,718	70,020			1,260	1,260	800	800	6,200	14,074	114,659	51,413	301,610	171,474
Other States [a]			27,203	18,334	44,888	18,125			8,189	1,949			1,260	2,668	48,390	14,594	129,930	55,670
Total	1,089,430	1,208,788	3,371,103	2,063,151	14,388,378	5,166,532	180,253	143,754	898,871	322,526	444,257	240,886	4,129,700	922,031	8,430,010	2,630,540	32,932,002	12,698,208

[a] Includes Florida, Maine, North Carolina, Oklahoma, South Carolina, Utah, and Wyoming.

IMPORTS.

Sand valued at $85,566 was imported into the United States in 1906, as compared with imports valued at $48,710 in 1905 and at $55,312 in 1904, an increase in 1906 over 1905 of $36,856.

SLATE.

By A. T. Coons.

PRODUCTION.

There were 9 States reporting a commercial output of slate in the United States in 1906—Pennsylvania, Vermont, Maine, Virginia, Maryland, California, New York, Arkansas, and Georgia, named in the order of value of output. Besides these States Arizona, New Jersey, Tennessee, and Utah have deposits more or less developed. The production for 1906 was reported as valued at $5,668,346, while in 1905 the output was valued at $5,496,207, an increase in 1906 of $172,139. In 1905 there was a decrease of $120,988, as compared with 1904, when the value was $5,617,195, and in 1904 the decrease was $639,690 from $6,256,885 in 1903, when the value was the largest that has been reported.

There has been a gradual decrease in the number of squares of slate made in this country, due to a decrease of export trade, the English market, where American slates found considerable sale for several years, being now supplied either from the Welsh quarries, in consequence of the settlement of strikes in these quarries, or by small-sized, cheaper French roofing slates. The decrease is also due to labor troubles in the building trades for the last four or five years, to strikes in the slate quarries, and to the fact that the present building conditions in large cities do not call for slate roofs, the roofs being more nearly flat, and the large number of patent-roofing processes and tiles being cheaper and more convenient than the slate. This condition is, however, offset outside of cities, especially in the vicinity of quarries, by the high price of wooden shingles and the great durability of slate roofing. The scarcity and high price of labor has also been a factor in the decreased output. During the last five years smaller sizes of slate have been sold, making the average value lower. The roofing slate in 1906 was reported as 1,214,742 squares, valued at $4,448,786; in 1905 the figures reported were 1,241,227 squares, valued at $4,574,550, a decrease for 1906 in quantity of 26,485 squares and in value of $125,764. The decrease in average value per square was very slight—from $3.69 in 1905 to $3.66 in 1906—only 3 cents.

Slate for milled stock—that is, slate for use in making electrical supplies, table tops, mantels, sanitary ware, blackboards, pencils, vaults, etc.—has been increasing in value, the demand for material of this class steadily increasing. The output for 1906 was larger than for any year previously reported on, the value being $1,219,560, as against $921,657 in 1905, an increase of $297,903.

The following table shows the value of roofing and milled slate quarried in the United States in 1905 and 1906, by States:

Value of roofing and milled slate produced in the United States in 1905 and 1906, by States.

1905.

State.	Roofing slate.		Value of milled stock.	Total value.
	Number of squares.	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
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

1906.

State.	Number of squares.	Value.	Value of milled stock.	Total value.
Arkansas	....	....	$5,000	$5,000
California	10,000	$80,000	....	80,000
Georgia	1,000	5,000	....	5,000
Maine	18,498	100,916	137,765	238,681
Maryland	25,288	129,965	1,004	130,969
New Jersey	....	....	....	....
New York	10,788	60,000	12,360	72,360
Pennsylvania	755,966	2,710,249	811,900	3,522,149
Vermont	354,134	1,189,799	251,531	1,441,330
Virginia	39,068	172,857	....	172,857
Total	1,214,742	4,448,786	1,219,560	5,668,346

A "square" of slate is the number of slates required to lay 100 square feet of roof, allowing a 3-inch lap. The estimated weight of roofing slate of ordinary thickness is 650 pounds to the square, and the slate is generally shipped in carload lots of from 50 to 90 squares per carload.

The following table shows the value of slate for roofing purposes and for milled stock from 1902 to 1906, inclusive:

Value of roofing slate and milled stock, 1902–1906.

	Roofing slate.		Value of milled stock.	Total value.
	Number of squares.	Value.		
1902	1,435,168	$4,950,428	$745,623	$5,696,051
1903	1,378,194	5,345,078	911,807	6,256,885
1904	1,233,757	4,669,289	947,906	5,617,195
1905	1,241,227	4,574,550	921,657	5,496,207
1906	1,214,742	4,448,786	1,219,560	5,668,346

The following table shows the average price of roofing slate per square since 1901:

Average annual price per square of roofing slate for the entire country.

1901	$3.15	1904	$3.78
1902	3.45	1905	3.69
1903	3.88	1906	3.66

The following table shows the total value of the slate production of the United States from 1902 to 1906, inclusive:

Value of slate produced in the United States, 1902–1906, by States.

State.	1902.	1903.	1904.	1905.	1906.
Arkansas	$4,000	$4,709	$14,300	$10,000	$5,000
California	31,500	70,000	39,200	40,000	80,000
Georgia	4,000	....	4,500	7,500	5,000
Maine	206,558	231,230	181,168	224,254	238,681
Maryland	118,084	137,631	133,972	151,215	130,969
New Jersey	32,000	33,403	....	5,360	....
New York	126,718	111,998	71,543	66,646	72,360
Pennsylvania	3,547,322	3,959,906	3,633,246	3,491,905	3,522,149
Tennessee	....	....	607	....	....
Utah	....	....	300	....	....
Vermont	1,464,918	1,592,652	1,408,151	1,352,541	1,441,330
Virginia	160,951	115,356	130,208	146,786	172,857
Total	5,696,051	6,256,885	5,617,195	5,496,207	5,668,346

IMPORTS.

There is practically no slate imported into this country. In 1905 slate valued at $8,941 was imported in the form of chimney pieces, mantels, tables, etc., exclusive of roofing slate valued at $913; in 1906 the importations were valued at $9,471, of which $9,243 was for mantels. chimney pieces, tables, etc., and $228 for roofing slate.

EXPORTS.

The value of roofing slate exported from this country in 1906 was $255,785; it was $408,309 in 1905, and $838,683 in 1903. These figures show a decrease in 1906 of $142,524 as compared with 1905 and of $582,898 as compared with 1903.

The chief slate export trade of this country is to the United Kingdom, Canada, and British Australasia. In the fiscal year ending June 30, 1906, the total exports were valued at $355,950. Of this total about two-thirds went to the United Kingdom, about 12 per cent to Canada and British Australasia each, about 7 per cent to Denmark, and small quantities to the Netherlands, British West Indies, Mexico, Venezuela, Cuba, British South Africa, and British East Indies. Broadly speaking, for a number of years past the exports have gone to the countries named in about the same relative proportions. During the same period the chief ports whence the exports have been shipped have been New York, Baltimore, Philadelphia, Boston and Charlestown, Mass., and Buffalo Creek, N. Y., in the order named.

SLATE INDUSTRY BY STATES.

Arkansas.—Lack of transportation facilities still prevents the successful operation of the deposits of slate in Arkansas.

California.—There was no change in the operations in the California slate district other than an increased production—from 5,000 squares, valued at $40,000, in 1905 to 10,000 squares, valued at $80,000, in 1906.

Georgia.—The slate quarries in Georgia were worked only part of the time in 1906, much of the work done being development work.

Maine.—There was an increase of $14,427 in the Maine slate production in 1906, the output in 1905 being valued at $224,254 and in 1906 at $238,681. The increase was in value of milled stock, which increased from $117,983 in 1905 to $137,765 in 1906, or $19,782. Roofing slate decreased slightly, both in quantity and in value—from 19,865 squares, valued at $106,271, in 1905 to 18,498 squares, valued at $100,916, in 1906, a decrease of 1,367 squares in quantity and of $5,355 in value. There was an increase of 10 cents in average price per square—from $5.35 in 1905 to $5.45 in 1906.

The producing localities were Blanchard, Brownville, and Monson, Piscataquis County. Producers reported an excellent demand for slate but a scarcity of good labor.

Maryland.—There was a decrease of $20,246 in the value of the slate output in Maryland in 1906. The roofing slate decreased from 25,845 squares, valued at $149,315, in 1905 to 25,288 squares, valued at $129,965, in 1906, a loss of 557 squares in quantity and of $19,350 in value. The milled stock decreased from $1,900 in 1905 to $1,004 in 1906, or $896. The Maryland slate was produced at Cardiff, Harford County, a continuation of the Peach bottom region at Delta, York County, Pa. The average price per square was $5.77 in 1905 and $5.14 in 1906, a decrease of 63 cents per square in 1906.

New Jersey.—The slate deposits near Newton, Sussex County, were not operated in 1906.

New York.—The slate output reported from New York in 1906 was valued at $72,360; in 1905 the value reported was $66,646—an increase in 1906 of $5,714. The increase was in value of milled stock, which was $12,360 in 1906 and $1,595 in 1905, a gain of $10,765. The number of squares increased from 10,354 in 1905 to 10,788 in 1906, or 424 squares, but the value decreased $5,051, or from $65,051 in 1905 to $60,000 in 1906. The slate producers all reported a better demand, but it was for the smaller sizes of slate at less price per square.

The entire production is the red slate from Granville and Middle Granville, Washington County.

Pennsylvania.—Pennsylvania from the three producing counties—Northampton, Lehigh, and York—produced 62.13 per cent of the slate output of the United States. This slate was valued at $3,522,149, an increase of $30,244, compared with the output of $3,491,905 in 1905. There was, however, a loss in quantity and value of roofing slate, which decreased from 802,170 squares, valued at $2,879,671, in 1905 to 755,966 squares, valued at $2,710,249, in 1906—a decrease in quantity of 46,204 squares and in value of $169,422. The average price per square for the two years, however, was the same, $3.59.

This loss in production was due somewhat to a labor strike of two months in the Bangor region during the spring of 1906. Wages were reported as higher and cost of supplies greater than in 1905, but the general demand was good and steadier than in that year, squares of small slate being more called for than the larger slate. Milled slate increased in value from $612,234 in 1905 to $811,900 in 1906, a gain of $199,666. The demand for this kind of slate for use as electrical supplies, blackboards, table tops, mantels, sanitary ware, vaults, school slates, pencils, etc., has increased each year, with every prospect for future increase. Of the roofing slate the number of squares produced in Pennsylvania represents 62.23 per cent of the quantity of roofing slate produced in the United States. Northampton County produced 71.16 per cent of the Pennsylvania output and 44.28 per cent of the total for the United States, Lehigh County 27.32 per cent of the Pennsylvania output and 17 per cent of the total, and York County

1.52 per cent of the Pennsylvania output and 0.94 per cent of the total. In milling slate Pennsylvania produced 66.57 per cent of the total value of this output for the United States, Northampton County producing 75.68 per cent of the Pennsylvania output and 50.37 per cent of the total, and Lehigh County 24.32 per cent of the Pennsylvania output and 16.19 per cent of the total. York County produced none of this class of slate.

The following table shows the output of slate in Pennsylvania, by counties, in 1905 and 1906:

Slate production in Pennsylvania in 1905 and 1906, by counties.

County.	Number of squares.	Value.	Milled slate.	Total value.
1905.				
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
1906.				
York	11,468	$59,833		$59,833
Lehigh	206,505	741,933	$197,487	939,420
Northampton	537,993	1,908,483	614,413	2,522,896
Total	755,966	2,710,249	811,900	3,522,149

Vermont.—Vermont ranks next to Pennsylvania in slate production both in quantity and value of roofing slate and in value of milled stock, producing 29.15 per cent of the quantity of roofing slate and 20.62 per cent of the total value of milled stock and 25.43 per cent of the total value of the output. The production increased in 1906 from $1,352,541 in 1905 to $1,441,330 in 1906, an increase of $88,789. The increase was both in the quantity and value of roofing slate and in the value of milled stock. The roofing slate increased from 339,001 squares, valued at $1,174,246, in 1905 to 354,134 squares, valued at $1,189,799, in 1906, an increase in quantity of 15,133 squares and in value of $15,553, and the milled stock increased from $178,295 in 1905 to $251,531 in 1906, a gain of $73,236.

Almost the entire output is from Rutland County, in the vicinity of Castleton and West Castleton, Poultney, Fair Haven, North and South Poultney, Hydeville, Wells, Pawlet, and West Pawlet, with a small output from Northfield, Washington County.

The average price per square of roofing slate was $3.36 in 1906 and $3.46 in 1905, a decrease of 10 cents per square. However, both demand and trade conditions were reported as better than in 1905, but labor was high and hard to obtain.

Virginia.—The slate in Virginia is, commercially, entirely confined to roofing slate, and the output was 39,068 squares, valued at $172,857, in 1906, as compared with 36,102 squares, valued at $146,786, in 1905, an increase for 1906 of 2,966 squares in quantity and of $26,071 in value. The average price per square in 1906 was $4.42 and in 1905 $4.07, an increase of 35 cents. The producers reported the demand excellent, prices somewhat irregular, and labor scarce and high. The slate was quarried commercially in 1906 at Arvonia, Ore Bank, and Penlan, Buckingham County.

STONE.

By A. T. Coons.

INTRODUCTION.

For simplicity of treatment the kinds of stone covered by the figures given in this report are classified as granite, trap rock, sandstone, bluestone, limestone, and marble.

Granite includes true granites and other igneous rocks, as gneiss, mica schist, andesite, syenite, trachyte, quartz porphyry, lava, tufa, diabase, trap rock, basalt, diorite, gabbro, and a small quantity of serpentine. Rocks of these kinds are as a rule quarried commercially in quantities too small to permit their being tabulated separately, but the trap rock output of California, Connecticut, Massachusetts, New York, New Jersey, and Pennsylvania represents an important industry, and it is therefore considered advisable to show the value of this stone separately. The trap rock from California includes a considerable quantity of basalt.

Sandstone includes the quartzites of South Dakota and Minnesota, but the fine-grained sandstones of New York and Pennsylvania, known to the trade as bluestone, are the product of a separate industry, and their production is shown apart from that of the other sandstone. This bluestone is also quarried in New Jersey and West Virginia. In Kentucky most of the sandstone quarried and sold is known locally as freestone. The figures given for sandstone do not include the value of the grindstones, whetstones, and pulpstones, made from sandstone quarried in Michigan, Ohio, and West Virginia. Neither does the total sandstone value include sandstone crushed into sand and used in the manufacture of glass and as molding sand.

Limestone does not include limestone burned into lime, bituminous limestone, nor limestone entering into the manufacture of Portland cement. It includes, however, a small quantity of stone sold locally as marble.

Marble includes a small quantity of serpentine quarried and sold as marble in Georgia, Washington, and Pennsylvania.

The values given in this report represent the net value of the stone to the quarrymen—that is, the selling value exclusive of any freight charges. When the stone is cut or dressed by the quarrymen and sold in this manner, the value of the dressed stone is given. This applies especially to the stone quarried for use as building and monumental stone. The value of crushed stone is the net value crushed at the point of shipment.

PRODUCTION.

The following table shows the value of the different kinds of stone produced in the United States from 1896 to 1906, inclusive:

Value of the different kinds of stone produced in the United States, 1896-1906.

Year.	Granite.	Trap rock.	Sandstone.	Bluestone.	Marble.	Limestone.	Total.
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
1906	18,569,705	3,736,571	[b] 7,147,439	2,021,898	7,582,938	27,320,243	66,378,794

[a] Estimated. [b] Does not include the value of grindstones and whetstones.

From this table it is seen that the total reported value of the stone quarried in the United States in 1906, exclusive of the products mentioned above, was $66,378,794. The corresponding value for 1905 was $63,798,748, an increase for 1906 of $2,580,046. In 1905 the gain was $5,033,033; in 1904 it was only $1,332,574; in 1903 it was $2,634,459, and in 1902 it was $7,514,499. The increase for 1906 over 1896 is $42,413,565. The production of 1902, 1903, 1904, and 1905 was affected by strikes in the building trades, but continued increase in the production of crushed stone and, in 1905, of stone for furnace flux caused increased values in the totals. In 1906 almost all the producers, and especially the small quarrymen, stated that the cost of production had increased on account of increased cost of supplies, high wages, and lack of common labor; and that less stone was produced on account of the cheaper production and increased use of concrete, cement, and concrete blocks.

Granite, trap rock, marble, bluestone, and limestone increased in value, while the value of sandstone decreased.

Granite, trap rock, etc., represented 33.60 per cent of the total output in 1906, and increased in value from $20,637,693 in 1905 to $22,306,276 in 1906, a gain of $1,668,583. Trap rock increased in value from $3,074,554 in 1905 to $3,736,571 in 1906, or $662,017. Granite increased from $17,563,139 in 1905 to $18,569,705 in 1906, a gain of $1,006,566.

Sandstone and bluestone represented 13.80 per cent of the total stone output in 1906. Their value in 1906 was $9,169,337, which, compared with a value of $10,006,774 in 1905, shows a decrease of $837,437. Bluestone increased in value from $1,931,625 in 1905 to $2,021,898 in 1906, a gain of $90,273. Sandstone decreased in value from $8,075,149 in 1905 to $7,147,439 in 1906, a loss of $927,710.

Marble represented 11.42 per cent of the total stone output in 1906, the total value being $7,582,938; in 1905 the value was $7,129,071, a gain for 1906 of $453,867.

Limestone represented 41.16 per cent of the total stone output of the United States in 1906, and was valued at $27,320,243; in 1905 the value was $26,025,210, a gain for 1906 of $1,295,033.

The following table shows the value of the various kinds of stone produced in 1905 and 1906, by States and Territories:

Value of various kinds of stone produced in 1905 and 1906, by States and Territories.

1905.

State or Territory.	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
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
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.

Value of various kinds of stone produced in 1905 and 1906, by States and Territories—Continued.

1906.

State or Territory.	Granite.	Sandstone.	Marble.	Limestone.	Total value.
Alabama		$40,467	$85,000	$579,344	$704,811
Alaska			(a)		(a)
Arizona	$32,042	33,149		40	65,231
Arkansas	118,903	55,703	16,900	48,844	240,350
California	1,429,207	642,166	103,048	80,205	2,254,626
Colorado	65,402	286,544		373,158	725,104
Connecticut	1,385,369	(b)		1,171	1,386,540
Delaware	146,346				146,346
Florida				1,450	1,450
Georgia	792,315		919,356	16,042	1,727,713
Hawaii	23,346				23,346
Idaho	400	11,969		12,600	24,969
Illinois		19,125		2,942,331	2,961,456
Indiana		30,740		3,725,565	3,756,305
Indian Territory		615		44,622	45,237
Iowa		5,601		493,815	499,416
Kansas		42,809		849,203	892,012
Kentucky		125,123		795,408	920,531
Maine	2,560,021			2,000	2,562,021
Maryland	883,881	9,533	176,495	170,046	1,239,955
Massachusetts	3,790,211	260,721	271,934	10,750	4,333,616
Michigan		65,395		656,269	721,664
Minnesota	626,069	285,633		632,115	1,543,817
Missouri	150,009	20,951	(c)	1,988,334	2,159,294
Montana	114,005	37,462		141,082	292,549
Nebraska		6,899		276,381	283,280
Nevada			5,000		5,000
New Hampshire	818,131				818,131
New Jersey	958,110	215,142		221,141	1,394,393
New Mexico		42,574	500	125,493	168,567
New York	927,483	d e 1,905,892	557,954	2,204,724	5,596,053
North Carolina	778,847	3,531		30,583	812,961
North Dakota		44			44
Ohio		1,426,645		3,025,038	4,451,683
Oklahoma	18,847	40,246		127,361	186,454
Oregon	58,961	25,950		7,480	92,391
Pennsylvania	1,043,140	d 2,724,874	171,632	4,865,130	8,804,776
Rhode Island	622,812			678	623,490
South Carolina	247,998			10,400	258,398
South Dakota		145,966			145,966
Tennessee		14,136	635,821	481,952	1,131,909
Texas	168,061	111,533		239,125	518,719
Utah	4,948	37,529	1,400	248,868	292,745
Vermont	2,941,724		4,576,913	7,829	7,526,466
Virginia	340,900	5,100		260,343	606,343
Washington	459,975	169,500	59,985	49,192	738,652
West Virginia		113,369		628,602	741,971
Wisconsin	798,213	181,986		891,746	1,871,945
Wyoming	600	24,715	1,000	53,783	80,098
Total	f 22,306,276	9,169,337	7,582,938	27,320,243	66,378,794

a Included with Washington.
b Included with New York.
c Included in limestone.
d Includes bluestone.
e Includes a small output for Connecticut.
f Includes trap rock and other igneous rocks.

The following table shows the rank of the States and Territories in 1905 and 1906, according to value of production, and the percentage of the total produced by each State or Territory:

Rank of States and Territories in 1905 and 1906, according to value of production, and percentage of total produced by each State or Territory.

1905.				1906.			
Rank of State.	State or Territory.	Total value.	Percentage of total.	Rank of State.	State or Territory.	Total value.	Percentage of total.
1	Pennsylvania	$7,956,177	12.47	1	Pennsylvania	$8,804,776	13.27
2	Vermont	6,993,765	10.96	2	Vermont	7,526,466	11.34
3	New York	5,364,222	8.41	3	New York [a]	5,596,053	8.43
4	Ohio	4,595,265	7.20	4	Ohio	4,451,683	6.71
5	Illinois	3,541,005	5.55	5	Massachusetts	4,333,616	6.53
6	Massachusetts	3,263,058	5.11	6	Indiana	3,756,305	5.66
7	Indiana	3,204,680	5.02	7	Illinois	2,961,456	4.46
8	Maine	2,721,223	4.27	8	Maine	2,562,021	3.86
9	California	2,531,928	3.97	9	California	2,254,626	3.40
10	Missouri	2,446,429	3.83	10	Missouri	2,159,294	3.25
11	Wisconsin	1,791,447	2.81	11	Wisconsin	1,871,945	2.82
12	Georgia	1,754,787	2.75	12	Georgia	1,727,713	2.60
13	Minnesota	1,331,949	2.09	13	Minnesota	1,543,817	2.33
14	New Jersey	1,276,781	2.00	14	New Jersey	1,394,393	2.10
15	Maryland	1,257,838	1.97	15	Connecticut	1,386,540	2.09
16	Kentucky	1,025,044	1.61	16	Maryland	1,239,955	1.87
17	Connecticut	1,014,064	1.59	17	Tennessee	1,131,909	1.71
18	Kansas	1,003,006	1.57	18	Kentucky	920,531	1.39
19	Tennessee	992,566	1.56	19	Kansas	892,012	1.34
20	Washington	919,110	1.44	20	New Hampshire	818,131	1.23
21	West Virginia	842,627	1.32	21	North Carolina	812,961	1.23
22	New Hampshire	838,371	1.31	22	West Virginia	741,971	1.12
23	Colorado	816,751	1.28	23	Washington [b]	738,652	1.11
24	Michigan	667,877	1.05	24	Colorado	725,104	1.09
25	Virginia	667,050	1.05	25	Michigan	721,664	1.09
26	North Carolina	585,561	.92	26	Alabama	704,811	1.06
27	Alabama	560,210	.88	27	Rhode Island	623,490	.94
28	Rhode Island	556,664	.87	28	Virginia	606,343	.91
29	Iowa	461,126	.72	29	Texas	518,719	.78
30	Texas	427,321	.67	30	Iowa	499,416	.75
31	Arkansas	304,291	.48	31	Utah	292,745	.44
32	South Carolina	297,284	.47	32	Montana	292,549	.44
33	Utah	290,728	.46	33	Nebraska	283,280	.43
34	Montana	274,669	.43	34	South Carolina	258,398	.39
35	Nebraska	225,239	.35	35	Arkansas	240,350	.36
36	South Dakota	200,061	.31	36	Oklahoma	186,454	.28
37	Oklahoma	195,246	.31	37	New Mexico	168,567	.25
38	Delaware	178,428	.28	38	Delaware	146,346	.22
39	New Mexico	110,922	.17	39	South Dakota	145,966	.22
40	Oregon	95,159	.15	40	Oregon	92,391	.13
41	Arizona	69,393	.11	41	Wyoming	80,098	.12
42	Wyoming	59,431		42	Arizona	65,231	.10
43	Idaho	37,870		43	Indian Territory	45,237	
44	Hawaii	33,550		44	Idaho	24,969	
45	Indian Territory	9,510	.23	45	Hawaii	23,346	.15
46	Florida	5,800		46	Nevada	5,000	
47	Nevada	1,500		47	Florida	1,450	
48	North Dakota	1,055		48	North Dakota	44	
49	Alaska	710					
	Total	63,798,748	100.00		Total	66,378,794	100.00

[a] Includes a small output of sandstone from Connecticut.
[b] Includes Alaska marble.

From this table it is seen that Pennsylvania, producing chiefly limestone and sandstone but also granite and marble, reported the greatest value of stone output for the entire United States, which was 13.27 per cent of the total; Vermont, producing granite, marble, and a small quantity of limestone, was second, with 11.34 per cent of the total; New York, producing sandstone, limestone, granite, and marble, ranked third; Ohio, producing limestone and sandstone, was fourth; Massachusetts, producing granite, marble, sandstone, and limestone, was fifth; Indiana was sixth, followed by Illinois, Maine, California, and Missouri, each producing stone valued at over $2,000,000.

The following table is given to show the total values of the stone used for various purposes in 1905 and 1906; 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 1905 and 1906.

1905.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving stone.	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

1906.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving stone.	Crushed stone.
Granite	$8,536,420	$4,116,075	$50,609	$787,237	$1,652,927	$5,504,327
Sandstone	4,275,669		1,097,438	1,074,369	694,995	889,894
Limestone	5,092,916		109,632	289,615	531,275	11,073,265
Marble	2,782,620	2,657,813				
Total	20,687,625	6,773,888	1,257,679	2,151,221	2,879,197	17,467,486

From this table it appears that the total value of building stone increased from $20,240,809 in 1905 to $20,687,625 in 1906, a gain of $446,816. Granite represented in 1906 41.26 per cent of this building stone; limestone, 24.62 per cent; sandstone, 20.67 per cent; and marble, 13.45 per cent.

Monumental stone increased in value from $6,112,585 in 1905 to $6,773,888 in 1906, a gain of $661,303. Of the monumental stone 60.76 per cent was granite in 1906 and 39.24 per cent marble.

Flagstone in 1906 decreased in value $130,308, or from $1,387,987 in 1905 to $1,257,679 in 1906. Sandstone represented 87.26 per cent of the flagstone output in 1906. The proportion of granite and limestone was small.

Curbstone increased in value from $2,090,839 in 1905 to $2,151,221 in 1906, or $60,382. Sandstone represented 49.94 per cent of this output in 1906; granite, 36.60 per cent; and limestone, 13.46 per cent.

Paving stone decreased in value from $3,082,340 in 1905 to $2,879,197 in 1906, a loss of $203,143. Granite was 57.40 per cent of the total paving material; sandstone, 24.14 per cent; and limestone, 18.46 per cent.

Crushed stone increased in value from $16,419,614 in 1905 to $17,467,486 in 1906, or $1,047,872. Of the total for 1906, 63.39 per cent was limestone; 31.51 per cent granite, including trap rock; and 5.10 per cent sandstone.

The following tables show the quantity and value of crushed stone produced in the United States in 1905 and 1906, by States and Territories and uses.

Production of crushed stone in 1905 and 1906, by States and Territories and uses, in short tons.

1905.

State or Territory.	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

Production of crushed stone in 1905 and 1906, by States and Territories and uses, in short tons—Continued.

1906.

State or Territory.	Road making.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	17,040	$9,380			10,192	$7,280	27,232	$16,660
Arizona							0	0
Arkansas	27,390	22,577	30,000	$26,000	63,059	61,264	120,449	109,841
California	396,029	327,457	65,031	34,904	651,590	453,648	1,112,650	816,009
Colorado	7,210	3,832	22,000	7,600	49,697	26,139	78,907	37,571
Connecticut	387,288	231,001	47,803	20,750	280,731	152,448	715,822	404,199
Delaware	10,299	6,814	56,839	37,129	74,928	48,849	142,066	92,792
Florida					250	100	250	100
Georgia	23,862	19,400	290,450	151,365	107,700	82,450	422,012	253,215
Hawaii	2,796	4,476	300	150	9,184	6,645	12,280	11,271
Illinois	1,235,186	686,292	737,028	389,065	1,090,679	709,907	3,062,893	1,785,264
Indiana	658,727	321,891	477,737	169,695	243,834	119,222	1,380,298	610,808
Indian Territory			50,000	20,000	50,000	20,000	100,000	40,000
Iowa	59,362	38,339	60,803	26,268	251,686	142,124	371,851	206,731
Kansas	62,952	39,877	1,119,416	533,173	50,034	34,228	1,232,402	607,278
Kentucky	332,137	222,877	578,502	250,237	79,508	50,827	990,147	523,941
Maine	14,580	9,931			17,045	11,504	31,625	21,435
Maryland	168,191	156,245	197,126	116,306	171,944	190,993	537,261	463,544
Massachusetts	504,289	390,517	69,930	28,000	398,787	329,174	973,006	747,691
Michigan	145,155	78,437	206,375	103,442	94,536	61,852	446,066	243,731
Minnesota	138,380	102,246	31,509	24,741	241,563	190,027	411,452	317,014
Missouri	360,785	294,511	671,803	336,752	524,969	379,994	1,557,557	1,011,257
Montana	4,555	6,000					4,555	6,000
Nebraska	20,000	16,000	49,968	29,980	135,462	112,253	205,430	158,233
New Hampshire	14,200	10,350	1,770	426	13,660	9,918	29,630	20,694
New Jersey	604,010	451,174	260,044	147,191	400,804	259,964	1,264,858	858,329
New Mexico			350,167	139,217	12,500	6,000	362,667	145,217
New York	1,307,524	844,226	771,106	369,940	1,276,893	734,055	3,355,523	1,948,221
North Carolina	51,972	49,274	299,391	134,800	79,964	60,762	431,327	244,836
Ohio	1,728,163	931,146	951,888	426,305	632,942	300,035	3,312,993	1,657,486
Oklahoma	12,700	9,050	157,500	90,000	15,600	10,175	185,800	109,225
Oregon	59,247	34,223	15,918	7,111	17,175	8,342	92,340	49,676
Pennsylvania	822,774	517,751	1,757,718	1,000,044	1,221,162	782,640	3,801,654	2,300,435
Rhode Island	53,112	41,018			3,150	3,765	56,262	44,783
South Carolina	9,320	6,825	24,111	11,796	78,007	56,896	111,438	75,517
South Dakota	225	180	300	157	23,940	24,000	24,465	24,337
Tennessee	43,175	23,725	420,083	192,614	115,657	75,063	578,915	291,402
Texas	28,600	19,450	59,872	26,067	125,881	67,829	214,353	113,346
Utah	13,100	13,030			20	15	13,120	13,045
Vermont	5,284	4,045	2,402	1,100	2,840	2,472	10,526	7,617
Virginia	31,308	35,141	159,490	80,436	118,553	107,377	309,351	222,954
Washington	15,640	13,262	12,250	9,500	6,203	4,963	34,093	27,725
West Virginia	38,507	21,140	145,525	71,260	55,982	32,980	240,014	125,380
Wisconsin	596,476	363,214	181,067	86,575	392,605	250,870	1,170,148	700,659
Wyoming			1,800	810	2,364	1,207	4,164	2,017
Total	10,011,550	6,376,324	10,335,022	5,100,906	9,193,280	5,990,256	29,539,852	17,467,486

In 1906 Pennsylvania reported the largest production of crushed stone, followed by New York, Illinois, Ohio, and Missouri, in the order named. Each of these States had an output represented by more than $1,000,000. In 1905 the rank of the States producing crushed stone was Illinois, Pennsylvania, New York, Ohio, and Missouri.

The following table shows the quantity and value of crushed stone produced in the United States in 1905 and 1906, by uses and kinds of stone:

Quantity and value of crushed stone produced in the United States in 1905 and 1906, by kinds and uses, in short tons.

1905.

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

1906.

Kind.	Road making.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity	Value.	Quantity.	Value.
Granite	858,289	$722,807	1,066,784	$545,771	1,016,494	$893,886	2,941,567	$2,162,464
Trap rock	2,109,404	1,496,140	799,094	477,022	2,145,690	1,368,701	5,054,188	3,341,863
Limestone	6,685,781	3,857,500	8,106,850	3,899,396	5,493,958	3,316,369	20,286,589	11,073,265
Sandstone	358,076	299,877	362,294	178,717	537,138	411,300	1,257,508	889,894
Total	10,011,550	6,376,324	10,335,022	5,100,906	9,193,280	5,990,256	29,539,852	17,467,486

From this table it appears that, with the exception of sandstone, which decreased in quantity and value of output, the production of crushed stone increased decidedly in 1906, amounting to 29,539,852 short tons, valued at $17,467,486, as compared with 27,860,622 short tons in 1905, valued at $16,419,614, an increase in quantity of 1,679,230 short tons and in value of $1,047,872.

Crushed granite increased from 2,656,326 short tons, valued at $2,145,600, in 1905 to 2,941,567 tons, valued at $2,162,464, in 1906, an increase in quantity of 285,241 tons and in value of $16,864.

Crushed trap rock increased from 4,277,041 short tons, valued at $2,778,106, in 1905 to 5,054,188 short tons, valued at $3,341,863, in 1906, an increase in quantity for 1906 of 777,147 tons and in value of $563,757.

Crushed limestone increased from 19,334,168 short tons, valued at $10,487,638, in 1905 to 20,286,589 short tons, valued at $11,073,265, in 1906, an increase in quantity of 952,421 tons and in value of $585,627.

Crushed sandstone decreased from 1,593,087 short tons, valued at $1,008,270, in 1905 to 1,257,508 tons, valued at $889,894, in 1906, a decrease of 335,579 tons, valued at $118,376.

Crushed stone for road making decreased from 10,418,010 short tons, valued at $6,712,044, in 1905 to 10,011,550 tons, valued at $6,376,324, in 1906, a decrease of 406,460 tons, valued at $335,720.

Crushed stone for railroad ballast increased from 10,105,573 tons, valued at $4,827,711, in 1905 to 10,335,022 tons, valued at $5,100,906, in 1906, an increase of 229,449 tons, valued at $273,195.

Crushed stone for concrete showed the greatest increase, from 7,337,039 tons, valued at $4,879,859, in 1905 to 9,193,280 tons, valued at $5,990,256, in 1906, an increase in quantity of 1,856,241 and in value of $1,110,397.

In 1906, 63.39 per cent of the total of the crushed stone output was limestone, 19.13 per cent trap rock, 12.38 per cent granite, and 5.10 per cent sandstone.

The total average value per ton for 1906 was 59 cents, the same as in 1905. In 1906 the average price per ton of granite was 74 cents; trap rock, 66 cents; limestone, 54 cents, and sandstone, 73 cents; in 1905 the average values were, granite, 81 cents; trap rock, 65 cents; limestone, 54 cents; and sandstone, 63 cents.

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 1905 and 1906:

Exports of stone from the United States in 1905 and 1906.

Kind.	1905.	1906.
Marble and stone, unmanufactured	$265,023	$355,343
All others	710,876	780,539
Total	975,899	1,135,882

Imports of stone into the United States in 1905 and 1906.

Kind.	1905.	1906.
Marble:		
In block, rough, etc	$817,555	$892,717
Sawed or dressed	103	306
Slabs or paving tiles	63,942	93,760
All other manufactures	302,645	220,150
Mosaic cubes	47,455	48,183
Total	1,231,700	1,255,116
Onyx:		
In block, rough, etc	54,081	76,385
Sawed or dressed		
Slabs or tiles	176	
All other manufactures	6,261	1,482
Total	60,518	77,867
Granite:		
Dressed	$102,488	$145,144
Rough	4,940	20,931
Total	107,428	166,075
Stone (other):		
Dressed	14,711	16,354
Rough	64,587	41,255
Total	79,298	57,609
Grand total	1,478,944	1,556,667

These tables do not include the figures for slate or lime, as they are included under their respective reports.

These tables show an increase of $159,983 in the value of the stone exported, from $975,899 in 1905 to $1,135,882 in 1906.

The total imports increased from $1,478,944 in 1905 to $1,556,667 in 1906, a gain of $77,723.

GRANITE.

Total production.—The figures given in this report as representing the value of granite production in the United States include also the value of small quantities of gneiss, mica schist, lava, tufa, trachyte, andesite, syenite, quartz porphyry, trap, basalt, and allied igneous rocks. The quantities of these allied stones quarried are too small to tabulate separately. Trap rock, however, as already noted, represents an industry sufficient by itself to make it advisable to show the value of this stone separately, although its value is included in the grand total of granite.

The value of the total output of granite, trap, etc., in 1906 was $22,306,276, as compared with a value of $20,637,693 in 1905, an increase of $1,668,583. The increase in 1905 over the total value for 1904 was only $622,668; the gain in 1904 over 1903 was $1,578,938, which nearly equals the gain for 1906. In 1905 the granite trade felt the effects of builders' strikes, of the recent demand for concrete blocks and cement work, and of the high prices and the scarcity of labor. In 1906 the effect of trade strikes was not so evident, but notwithstanding the large increase in production the quarrymen, especially the small producers, reported a decrease of trade due to the use of cement and concrete, to high wages, to high price of supplies, and to inability to secure common labor.

The increase in 1906 was due mainly to contracts taken out for large buildings and to the demand for crushed stone.

In 1905 Maine ranked first among the granite-producing States, with an output of $2,713,795; Massachusetts second, with an output of $2,663,329; Vermont third, with an output of $2,571,850, and California fourth, with an output of $1,700,818.

In 1906 the rank in output of the States producing granite to the value of $1,000,000 or more was as follows: Massachusetts, $3,790,211; Vermont, $2,941,724; Maine, $2,560,021; California, $1,429,207; Connecticut, $1,385,369, and Pennsylvania, $1,043,140.

The increase in Massachusetts was caused by unusually large contracts for stone for large buildings. Vermont showed an increase in value of both building and monumental stone. Maine decreased in value of building and monumental stone and paving blocks. California increased in value of stone for concrete work and for breakwater and railroad use. Connecticut increased in output of building-stone and of stone for riprap work, and Pennsylvania increased in value of crushed stone.

Of the other States, Arizona increased on account of a large quantity of granite of poor quality taken out for railroad repair work, and Arkansas, Minnesota, New Jersey, New York, North Carolina, Rhode Island, and Texas, also increased in value of output, but Colorado, Delaware, Georgia, Hawaii, Idaho, Indian Territory, Maryland, Missouri, Montana, New Hampshire, Oklahoma, Oregon, South Carolina, Utah, Virginia, and Wisconsin decreased in value of output, most of the quarrymen reporting decreased demand due to the high prices caused by high wages, scarcity of labor, and the increased cost of materials, and to the increased use of cement and concrete blocks.

The output from Arizona, Colorado, Hawaii, Idaho, Oregon, Utah, and Wyoming includes considerable volcanic rock and tufa. California's output includes basalt and trap rock; the output of Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania includes a large quantity of trap rock.

The production of some of the other States includes, besides these varieties of igneous rock, gneiss, mica schist, syenite, andesite, diabase, etc., but only in small quantities, as compared with the total production.

Building stone.—Building stone, including rough and dressed granite sold by producers, was valued at $8,536,420 in 1906, an increase of $1,237,623 as compared with $7,298,797 in 1905. This was 74.17 per cent of the total granite increase. The rough stone sold by the quarrymen was valued at $1,869,316 in 1906 and at $1,888,010 in 1905, a decrease of $18,694 in 1906 in this class of material. The dressed stone sold by the producers was valued at $6,667,104 in 1906 and at $5,410,787 in 1905, an increase of $1,256,317. Massachusetts showed the greatest increase for this class of stone, from $824,999 in 1905 to $1,750,695 in 1906, a gain of $925,696. This increase is accounted for by the fact that in 1906 the stone for the new Pennsylvania Railroad station in New York City was taken out, dressed, and made ready for shipment at the Milford quarries. The building stone includes, besides stone for buildings, for their decoration, and for foundations, a large quantity of heavy masonry stone used in building bridges. In 1905 Maine reported the largest quantity of building stone, rough and dressed, valued at $2,083,089; Vermont came second, with a value of $1,282,079; and Massachusetts was third, with a value of $1,026,424. In 1906, Massachusetts ranked first, with an output of $1,987,356; Maine was second, with an output of $1,763,154, and Vermont third, with an output of $1,475,731. Maine showed a decrease in output, and the other States an increase. Other States prominent in the production of granite for building stone are, in the order of value for 1906: Connecticut, New Hampshire, North Carolina, Maryland, California, Pennsylvania, Rhode Island, New York, Minnesota, and Georgia. In 1905 the order was as follows: Connecticut, Maryland, California, New Hampshire, North Carolina, Pennsylvania, Georgia, and New York, each of these States producing building stone, rough and dressed, valued at over $100,000. The output of Connecticut, ranking fourth in each year for this class of stone, increased $203,695, or from $394,571 in 1905 to $598,266 in 1906. New Hampshire rose from seventh place in 1905 to fifth place in 1906, with increase of $101,550, from $331,537 in 1905 to $433,087 in 1906. North Carolina rose from eighth place in 1905, with an output of $303,851, to sixth place in 1906, with an output of $351,764, an increase of $47,913. Maryland fell from fifth place in 1905 to seventh place in 1906; and California, on account of conditions incident to the earthquake disturbances in the spring of 1906, fell from sixth place to eighth.

Monumental stone.—Monumental stone, including stone cut and dressed by the producers and also the rough stock sold by them to retail monumental dealers, was valued at $4,116,075 in 1906, as compared with $3,842,368 in 1905, an increase of $273,707. Of the total, $2,293,554 was the value of the rough stock and $1,822,521 the value of the cut or dressed stones sold by producers. In 1905 the corresponding figures were rough stock valued at $1,920,443 and cut or dressed stone valued at $1,921,925, an increase of $373,111 in the value of rough stock and a decrease of $99,404 in the value of cut or dressed stone for the year 1906.

Vermont produces more rough stock and sells more dressed monumental stone than any other State. The output of this class of stone in Vermont in 1906 was $1,444,442 and in 1905 $1,249,774, an increase of $194,668. Massachusetts ranks next to Vermont with an output of $724,614 in 1906 and $614,075 in 1905, an increase of $110,539. The next States in order of production of monumental stone are Rhode Island, Minnesota, Maine, Wisconsin, New Hampshire, and Connecticut, these States each producing over $100,000 in value. In 1905 New Hampshire ranked third, followed by Rhode Island, Wisconsin, Minnesota, California, and Maine. Production of this class of stone increased in 1906 in Rhode Island, Minnesota, Maine, Wisconsin, and Connecticut, and decreased in New Hampshire and California.

Paving blocks.—The value of paving blocks decreased from $2,133,873 in 1905 to $1,652,927 in 1906, a decrease of $480,946. Connecticut, Delaware, Maine, Maryland, New Hampshire, Oklahoma, South Carolina, Virginia, and Washington increased in value of output, while the other States decreased or gave the same value of output. In 1906 the five States producing highest values in paving blocks were, in order, Maine, Wisconsin, Massachusetts, California, and Georgia, each producing over $100,000. In 1905 the order was Wisconsin, Maine, Georgia, Massachusetts, and California.

Curbstone.—Granite curbing in 1906 was produced to the value of $787,237; in 1905 the value of the output was $762,430, an increase for 1906 of $24,807. Georgia and North Carolina were the chief States producing this class of stone.

Flagstone.—Granite flagstones valued at $50,609 were reported in 1906; the value in 1905 was given as $38,838, which shows increase of $11,771 in 1906. South Carolina and New Hampshire reported the greatest output of this material.

Rubble.—Rubble, including a great variety of stone used for rude masonry, foundations, and walls, was valued at $363,463 in 1906, as compared with $383,446 in 1905, a decrease of $19,983 for 1906. Massachusetts, Maryland, Wisconsin, and Pennsylvania reported the largest output of this material.

Riprap.—Broken and other loose stone for foundations, especially in harbors and rivers, was produced in 1906 to the value of $329,289; in 1905 the value reported was $256,409, an increase for 1906 of $72,880.

Crushed stone.—The value of crushed granite, including trap, in 1905 was $4,923,706; in 1906, the value was $5,504,327, an increase of $580,621. These figures represent an output of 6,933,367 tons in 1905 and of 7,995,755 tons in 1906, an increase of 1,062,388 tons. The figures given above include trap rock, basalt, etc., as well as true granite. A separation of the trap and basalt from the granite shows that the total for 1906 includes 5,054,188 tons of trap and basalt, valued at $3,341,863, and 2,941,567 tons of granite, valued at $2,162,464.

Of the total output for 1906, 2,967,693 tons, valued at $2,218,947, were used for road making; 1,865,878 tons, valued at $1,022,793, for railroad ballast, and 3,162,184 tons, valued at $2,262,587, for concrete. In 1905, 3,519,224 tons, valued at $2,519,734, represented the output for road making; 1,168,908 tons, valued at $658,943, for railroad ballast, and 2,245,235 tons, valued at $1,745,029, for concrete. These figures show a decrease in 1906 of 551,531 tons in quantity and of $300,787 in value for road making, but an increase of 696,970 tons in quantity and of $363,850 in value for railroad ballast, and an increase of 916,949 tons and $517,558 for concrete. The large increase of crushed stone for concrete is of especial interest as emphasizing the increased use of concrete in construction.

In 1906 New Jersey ranked first in value of output of crushed stone, followed by Pennsylvania, Massachusetts, California, New York, Connecticut, and Maryland, each State producing over $250,000; in 1905 the order was New Jersey, California, New York, Massachusetts, Pennsylvania, Maryland, Connecticut, and Virginia. In 1906 New Jersey ranked first in value of road-making material, followed by Massachusetts, New York, Pennsylvania, and Connecticut. Pennsylvania reported the largest value for railroad ballast, followed by Georgia, New Jersey, and North Carolina. California reported the largest value for concrete, followed by New York, New Jersey, Massachusetts, Pennsylvania, Maryland, and Connecticut.

Other uses.—Stone used for "other" purposes includes a large quantity of stone used for jetty work and breakwater work, especially in the States of California, Massachusetts, New York, and Washington. Much of the stone reported as used for other purposes in California and Arizona was used in repairing the break in the Colorado River, which required a large quantity of stone, sand, gravel, and clay.

The following table shows the value of the granite, trap, etc., produced in the United States in 1905 and 1906, by States and Territories and uses:

Value of granite, trap, etc., produced in United States in 1905 and 1906, by States and Territories and uses.

1905.

State or Territory.	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

State or Territory.	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

Value of granite, trap, etc., produced in United States in 1905 and 1906, by States and Territories and uses—Continued.

1906.

State or Territory.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.	Curbing.	Flagging.
	Building.	Monumental.	Other.					
Arizona	$7,800	$3,000	$21,042				$50	
Arkansas	1,000	500	100				11,250	
California	67,903	50,541	119,057	$255,189	$34,285	$197,425	66,217	
Colorado	13,450	28,508			18,000		4,000	
Connecticut	163,351	44,433	13,880	434,915	64,019	62,645	19,064	$2,235
Delaware	9,997			7,629		7,783	7,509	734
Georgia	109,215	56,010	400	26,350		123,211	189,524	750
Hawaii								
Idaho	400							
Maine	349,668	78,802	54,179	1,413,486	192,577	336,979	66,786	5,299
Maryland	211,524	80,780	9,430	113,693	1,730	51,539	27,745	3,788
Massachusetts	236,661	435,280	117,847	1,750,695	289,334	199,457	89,469	4,080
Minnesota	23,686	100,086	1,300	141,171	189,319	50,000	13,587	1,850
Missouri	199	28,475		25,800		26,295	1,375	
Montana	51,020	500		18,700	13,210		13,500	
New Hampshire	90,751	91,044	2,337	342,336	98,622	89,878	52,939	9,690
New Jersey	38,679	730	500	25,795		53,916		
New York	19,729	623	109,750	162,766	4,368		227	
North Carolina	62,059	17,477	748	289,705	5,733	33,428	124,499	3,762
Oklahoma	350	4,070	100	9,500		113	600	640
Oregon	5,848	200	24				673	
Pennsylvania	216,358	3,935	13,808	20,052		22,980	3,375	74
Rhode Island	10,310	159,525	1,387	184,614	171,700	42,532	3,500	600
South Carolina	26,910	35,690	25,507	8,564		11,340	45,605	10,700
Texas	12,665	20,961	48,349	1,400	44,500	250	500	
Utah	1,273	3,500	9					116
Vermont	50,869	993,220	1,335	1,424,862	451,222	9,557	6,818	
Virginia	18,158	15,804	200		16,936	29,536	14,339	1,216
Washington	68,363	16,196	252,068	8,447	366	16,240	20,980	
Wisconsin	520	23,664		1,435	226,600	287,823	3,106	5,075
Wyoming	600							
Total	1,869,316	2,293,554	798,466	6,667,104	1,822,521	1,652,927	787,237	50,609

State or Territory.	Crushed stone.			Rubble.	Riprap.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Arizona				$150			$32,042
Arkansas	$20,000	$25,000	$37,862	8,191	$15,000		118,903
California	144,815	33,819	408,744	12,121	33,982		1,429,207
Colorado	332		1,112				65,402
Connecticut	231,001	20,750	152,448	6,081	170,060	$487	1,385,369
Delaware	6,814	37,129	48,849	3,962	15,940		146,346
Georgia	19,400	150,690	81,400	27,515	7,000	850	792,315
Hawaii	4,476	150	6,645			12,075	23,346
Idaho							400
Maine	9,931		11,504	18,243	1,875	20,692	2,560,021
Maryland	125,655	5,803	171,869	52,563	4,290	23,472	883,881
Massachusetts	357,309	28,000	216,289	61,567	3,107	1,116	3,790,211
Minnesota	31,397	16,700	34,950	19,553	660	1,810	626,069
Missouri	300		63,858	150	3,557		150,009
Montana	6,000			11,075			114,005
New Hampshire	10,350	426	9,918	15,167	2,323	2,350	818,131
New Jersey	437,134	139,041	245,864	2,500	5,283	8,668	958,110
New York	253,365	45,000	267,076	323	112	64,144	927,483
North Carolina	18,691	134,800	60,762	5,688	4,140	17,355	778,847
Oklahoma			400	509	2,565		18,847
Oregon	34,223	7,111	8,342	2,070	470		58,961
Pennsylvania	232,551	289,525	192,638	36,631	169	11,044	1,043,140
Rhode Island	41,018		3,765	666	745	2,450	622,812
South Carolina	6,825	11,796	56,896	6,665	750	750	247,998
Texas	7,200	2,067	13,294		16,875		168,061
Utah				50			4,948
Vermont	1,725	1,100	472	544			2,941,724
Virginia	34,981	64,386	85,077	28,477	31,790		340,900
Washington	13,262	9,500	4,963	41,549	8,041		459,975
Wisconsin	170,192		77,590	1,453	555	200	798,213
Wyoming							600
Total	2,218,947	1,022,793	2,262,587	363,463	329,289	167,463	22,306,276

The following table shows the value of the production of granite, trap, etc., in the United States from 1902 to 1906, inclusive:

Value of granite, trap, etc., produced in the United States, by States and Territories, 1902–1906.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Arizona	$3,000	$3,000	$2,500	$3,700	$32,042
Arkansas	12,115	47,136	52,616	90,312	118,903
California	1,137,679	1,627,592	1,742,330	1,700,818	1,429,207
Colorado	66,023	100,791	91,132	73,802	65,402
Connecticut	812,141	1,101,425	854,784	949,888	1,385,369
Delaware	276,753	369,166	245,272	178,428	146,346
Georgia	803,778	672,947	942,466	971,207	792,315
Hawaii	6,688		22,042	33,550	23,346
Idaho	12,910	2,750		1,500	400
Indian Territory		4,030	5,152	1,800	
Kansas					
Maine	2,659,450	2,586,765	2,400,509	2,713,795	2,560,021
Maryland	758,203	837,787	815,471	957,048	883,881
Massachusetts	3,451,397	2,720,066	2,868,305	2,663,329	3,790,211
Michigan					
Minnesota	478,989	403,906	405,956	481,908	626,069
Mississippi			440		
Missouri	157,708	150,409	155,716	180,579	150,009
Montana	77,050	25,993	33,890	126,430	114,005
Nevada	2,090	7,450	1,200		
New Hampshire	1,147,097	854,513	927,487	838,371	818,131
New Jersey	948,474	943,171	833,518	834,709	958,110
New York	651,014	549,015	622,986	765,777	927,483
North Carolina	338,750	218,947	297,749	564,578	778,847
Oklahoma		5,000	26,930	18,920	18,847
Oregon	38,429	118,411	235,213	85,330	58,961
Pennsylvania	661,062	829,535	900,530	870,848	1,043,140
Rhode Island	734,623	710,291	684,952	556,364	622,812
South Carolina	598,848	476,863	382,428	297,284	247,998
South Dakota	(a)	(a)	900		
Texas	60,003	173,325	348,317	132,193	168,061
Utah	1,479	3,803	7,980	13,630	4,948
Vermont	1,570,423	1,810,179	2,447,979	2,571,850	2,941,724
Virginia	282,046	299,335	510,788	452,390	340,900
Washington	147,273	209,095	422,508	681,730	459,975
Wisconsin	369,137	573,391	724,422	825,625	798,213
Wyoming			557		600
Total	18,264,632	18,436,087	20,015,025	20,637,693	22,306,276

[a] Value of quartzite included in sandstone.

The following table shows the value of the trap produced in the United States in 1905 and 1906, by States and uses:

Value of trap produced in the United States in 1905 and 1906, by States and uses.

1905.

State.	Building.	Paving.	Crushed stone.			Other.	Total.
			Road making.	Railroad ballast.	Concrete.		
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

1906.

State.	Building.	Paving.	Road making.	Railroad ballast.	Concrete.	Other.	Total.
California	$46,414	$136,310	$97,787	$9,019	$392,379	$6,514	$688,423
Connecticut	5,162	340	228,353	20,750	148,439	8,301	411,345
Massachusetts	16,540		286,412	28,000	131,343	500	462,795
New Jersey	17,660	52,700	432,134	92,728	245,564	16,100	856,886
New York			250,215	45,000	264,076	64,144	623,435
Pennsylvania	8,907	3,662	201,239	281,525	186,900	11,454	693,687
Total	94,683	193,012	1,496,140	477,022	1,368,701	107,013	3,736,571

From this table it appears that the value of trap increased from \$3,074,554 in 1905 to \$3,736,571 in 1906, an increase of \$662,017.

California, Connecticut, Massachusetts, New Jersey, and Pennsylvania increased in value of output, and New York decreased.

Of the crushed stone, the stone for road making decreased from \$1,762,811 in 1905 to \$1,496,140 in 1906, a loss of \$266,671. Railroad ballast increased from \$230,376 in 1905 to \$477,022 in 1906, a gain of \$246,646. Concrete showed the large increase of \$583,782, from \$784,919 in 1905 to \$1,368,701 in 1906.

The following table shows the number and value of paving blocks produced in 1905 and 1906, by States:

Number and value of paving blocks produced in 1905 and 1906, by States and Territories.

State or Territory.	Paving blocks.			
	1905.		1906.	
	Number.	Value.	Number.	Value.
Arkansas	11,425	\$457		
California	6,504,735	250,801	4,495,391	\$197,425
Connecticut	1,045,215	43,931	823,878	62,645
Delaware	183,150	6,836	162,281	7,783
Georgia	7,946,000	296,750	3,927,500	123,211
Maine	8,188,596	324,858	8,658,437	336,979
Maryland	869,000	38,900	1,126,082	51,539
Massachusetts	6,594,650	270,308	4,936,078	199,457
Minnesota	1,487,496	98,530	744,150	50,000
Missouri	1,529,364	69,640	624,453	26,295
Montana	50,000	3,500		
New Hampshire	2,084,202	76,822	2,298,145	89,878
New Jersey	1,935,607	58,322	1,752,767	53,916
New York	420,800	20,600		
North Carolina	1,139,675	48,234	974,330	33,428
Oklahoma			2,250	113
Oregon	2,000	80		
Pennsylvania	820,982	35,026	543,485	22,980
Rhode Island	1,503,794	82,641	834,001	42,532
South Carolina	348,500	9,604	348,615	11,340
Texas	5,000	250	10,000	250
Vermont	413,898	16,628	282,930	9,557
Virginia	913,440	19,220	1,385,000	29,536
Washington	14,000	420	230,000	16,240
Wisconsin	6,395,236	361,515	5,110,586	287,823
Total	50,406,765	2,133,873	39,270,359	1,652,927

From this table it will be seen that the number and value of paving blocks decreased from 50,406,765 blocks, valued at \$2,133,873, in 1905, to 39,270,359 blocks, valued at \$1,652,927, in 1906, a decrease of 11,136,406 in number and of \$480,946 in value. The average value per thousand was \$42.33 in 1905 and \$42.09 in 1906. Paving blocks vary in price from \$15 per thousand to about \$80 per thousand, according to size and regularity of shape. Quarrymen generally reported that at the prices obtained for the paving blocks it did not pay for making them at the present cost of labor.

In many localities, especially in the New England States, 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. Some men go around the country and blast and trim up bowlders and sell the blocks if there is a demand for them. Many of these men are foreigners, and it is almost impossible to get a record of either the number or the value of the blocks they make except through the firms to which they sell, which are often the large quarrymen.

SANDSTONE.

Sandstone showed more than any other variety of stone the effect of the use of cement for foundations, building material, paving, flagging, and curbing, and the use of concrete blocks for buildings, and this effect was not offset, as in granite and limestone, by any other great increase in output, ganister rock being the only product showing a decided increase in value of production. As with the other kinds of stone, scarcity and high price of labor and cost of fuel and supplies lessened the activity of the trade.

The total value of the output of sandstone in 1906 was reported as $9,169,337; in 1905 the value of the output was $10,006,774, a decrease of $837,437 for 1906. The total value for 1906 is the smallest since 1901, when the value of the total output was $8,138,680.

Pennsylvania, New York, and Ohio, with values, respectively, of $2,724,874, $1,905,892, and $1,426,645, contributed the largest quantity of sandstone to the total output of the United States, these three States producing 66.06 per cent of the total in 1906. In 1905 the rank of the States was the same, Pennsylvania's production being valued at $2,487,939, New York's at $1,831,756, and Ohio's at $1,744,472, an increase in 1906 of $236,935 for Pennsylvania, an increase of $74,136 for New York, and a decrease of $317,827 for Ohio. The production of these three States in 1905 was 60.6 per cent of the total.

In New York and Pennsylvania part of the sandstone output is known to the trade as bluestone, the production of which is given in a separate table. A small part of New York's output in 1906 is really the value of the Connecticut output, Connecticut's production being included in that for New York in order to conceal individual figures.

Of the other States producing sandstone, California, Colorado, Minnesota, Massachusetts, and New Jersey report the largest output, each, however, showing a decrease for 1906. An increase for 1906 is shown by Alabama, Indiana, Nebraska, New York, Oklahoma, Oregon, Pennsylvania, Tennessee, Utah, Virginia, Washington, and Wisconsin; a decrease is shown in the other States.

Building stone.—The chief use of sandstone is for building purposes, the output for which, including both the rough and the cut or sawed stone sold by the producers, was valued at $4,275,669 in 1906 and at $4,702,189 in 1905, a decrease of $426,520. These figures for 1906 included rough stone valued at $1,765,649 and cut or sawed stone valued at $2,510,020, and for 1905 rough stone valued at $2,114,270 and cut or sawed stone valued at $2,587,919, a decrease of $348,621 for rough building stone and of $77,899 for the dressed stone. Pennsylvania, Ohio, California, and New York, with values of $1,317,290, $867,111, $514,173, and $472,284, respectively, were the ranking States in the building-sandstone output in 1905; in 1906 the order was Pennsylvania, New York, Ohio, and California, with values of $1,346,140, $724,164, $659,611, $400,083, respectively, Ohio and New York changing places, with increases in 1906 of $28,850 for Pennsylvania and $251,880 for New York and with decreases of $207,500 for Ohio and $114,090 for California. The Pennsylvania output includes a considerable quantity of fine-grained sandstone known locally as bluestone, which, besides the common use for construction work, is employed extensively for the trimming of buildings, such as sills, lintels, copings, and steps. The value of this stone for 1906 was $268,290, as compared with $292,062 in 1905, a decrease of $23,772. The rest of the Pennsylvania building-stone output is largely for railroad bridges, being used by the Pennsylvania Railroad and other railroads in renewing bridges and elevating the tracks. It is also used in the construction and the ornamentation of buildings.

The building stone from Ohio is used chiefly in the construction of buildings; some is used for heavy bridge masonry.

The California building stone is used chiefly for regular construction work, but some is used for bridges. The decrease for 1906 is due to the demoralized condition of trade incident to the earthquake and the fire.

The New York sandstone output, like that of Pennsylvania, includes a quantity of bluestone. In 1906 the value of this bluestone from New York was $492,552, an increase of $141,547, as compared with $351,005 in 1905.

Rubble.—Rubble used in all kinds of rough building of walls and foundations decreased from $527,918 in 1905 to $525,108 in 1906, a loss of $2,810. The greater part of this sandstone is from Pennsylvania.

Paving.—Paving blocks to the value of $694,995 was produced in 1906, a decrease of $46,687 from the 1905 output, which was $741,682. New York and Pennsylvania furnished the greater part of this material.

Flagstone.—Flagging to the value of $1,097,438 was produced in 1906, a decrease of $123,910, as compared with $1,221,348, reported in 1905. Ohio, New York, and Pennsylvania, with outputs, respectively, of $383,457, $366,423, and $277,623, furnished most of this class of stone, practically all of the New York and Pennsylvania stone of this class being bluestone.

Curbstone.—Curbing to the value of $1,074,369 was reported in 1906, an increase of $29,386 over $1,044,983 in 1905. New York, Pennsylvania, and Ohio, with outputs, respectively, of $375,539, $305,470, and $251,509, were the chief States producing this class of stone. About half of the New York and Pennsylvania output for curbing was bluestone.

Crushed stone.—In 1906 1,257,508 tons of crushed sandstone, valued at $889,894, were reported, as compared with 1,593,087 tons in 1905, valued at $1,008,270, a decrease in 1906 of 335,579 tons in quantity and of $118,376 in value. The greater part of the crushed stone was for concrete, a use which increased from 371,415 tons, valued at $311,044, in 1905 to 537,138 tons, valued at $411,300, in 1906, a gain of 165,723 tons and of $100,256. Crushed sandstone for road making decreased from 452,268 tons, valued at $355,269, in 1905, to 358,076 tons, valued at $299,877, in 1906, a decrease of 94,192 tons and of $55,392. Sandstone for railroad ballast decreased from 769,404 tons, valued at $341,957, in 1905, to 362,294 tons, valued at $178,717, in 1906, a decrease of 407,110 tons and of $163,240. Pennsylvania, California, and Massachusetts produce the most of this class of stone.

Ganister.—Ganister rock is reported in 1906 from but six States, Pennsylvania, Colorado, Wisconsin, Ohio, Maryland, and Illinois, in the order of value of output. In 1905 seven States reported output of this material, Pennsylvania, Colorado, Wisconsin, Ohio, Maryland, Illinois, and Kansas, in the order of value of output. In 1906 the production increased $97,943, from $186,123 in 1905 to $284,066 in 1906.

Riprap.—Riprap valued at $290,952 was reported in 1905, and at $231,654 in 1906, a decrease of $59,298. Pennsylvania, Texas, and Ohio reported the greater part of this output.

Other purposes.—Sandstone for other purposes, valued at $96,144, was reported in 1906, as against $283,309 in 1905, a decrease of $187,165 in 1906. This includes stone for monumental work and for posts and coverings.

The total output does not include sandstone made into abrasives, such as grindstones, whetstones, oilstones, and pulpstones, nor does it include sandstone ground into sand and used for glass sand, molding sand, and polishing sand.

The following table shows the value of the sandstone production of the United States in 1905 and 1906, by States and Territories and uses:

Value of sandstone produced in the United States in 1905 and 1906, by States and Territories and uses.

1905.

State or Territory.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road making.	Railroad ballast.	Concrete.		
Alabama	$100						$24,507
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	444,768	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 1905 and 1906, by States and Territories and uses—Continued.

1905—Continued.

State or Territory.	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	294,719
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

1906.

State or Territory.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road making.	Railroad ballast.	Concrete.		
Alabama							$25,492
Arizona	$4,358						1,625
Arkansas	2,879	$1,746	$977		$22,952		350
California	100,483	299,600	178,548	$585	33,942		63
Colorado	67,139	15,301		7,600	25,027	$40,522	1,314
Connecticut							
Idaho	5,088	756					
Illinois	7,735	4,885	200			1,500	705
Indiana	4,550	19,240					1,200
Indian Territory	467						
Iowa	4,184	30	150				32
Kansas	23,496	700					
Kentucky	64,161	41,762		7,500	500		2,875
Maryland	3,661		8		100	5,760	
Massachusetts	53,016	52,402	33,208		112,885		
Michigan	35,272	18,950					770
Minnesota	13,112	58,789	11,619		37,918		7,531
Missouri	6,802	7,298					1,400
Montana	4,257	30,477					465
Nebraska	374				18		6,500
New Jersey	119,413	21,250	9,400	200	3,150		1,000
New Mexico	4,040	3,225		30,324			
New York	230,102	494,062	6,600		2,365		2,040
North Carolina		2,000					
North Dakota	10						
Ohio	310,256	349,355	6,800	19,300	13,575	6,750	38,350
Oklahoma	22,908	8,650	50		2,075		50

Value of sandstone produced in the United States in 1905 and 1906, by States and Territories and uses—Continued.

1906—Continued.

State or Territory.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road making.	Railroad ballast.	Concrete.		
Oregon	$25,845	$105	....	....	....	....	....
Pennsylvania	510,299	835,841	$34,000	$108,391	$103,120	$196,804	$66,626
South Dakota	26,101	30,356	180	157	14,000	....	13,964
Tennessee	250	10,531	....	100	....	....	....
Texas	8,713	21,302	9,000	1,000	23,850	....	40,983
Utah	600	2,014					
Virginia	1,250	250	....	....	3,600	....	....
Washington	41,982	59,700	....	....	....	....	1,923
West Virginia	27,169	32,186	3,734	3,560	12,105	....	1,076
Wisconsin	21,071	82,357	5,403	....	43	32,730	15,320
Wyoming	14,606	4,900	....	....	75	....	....
Total	1,765,649	2,510,020	299,877	178,717	411,300	284,066	231,654

State or Territory.	Rubble.	Paving.	Flagging.	Curbing.	Other.	Total.
Alabama	$14,975				....	$40,467
Arizona	1,036	....	....	....	$26,130	33,149
Arkansas	2,225	$25	$4,636	$19,873	40	55,703
California	18,050	....	....	8,642	2,253	642,166
Colorado	29,655	16,225	33,703	44,543	5,515	286,544
Connecticut	....	....	....	....	....	(a)
Idaho	6,125	....	....	....	....	11,969
Illinois	1,500	2,500	50	50	....	19,125
Indiana	1,350	....	150	4,250	....	30,740
Indian Territory	140	8	....	....	....	615
Iowa	460	....	30	113	602	5,601
Kansas	1,975	2,450	6,546	6,297	1,345	42,809
Kentucky	3,450	1,200	1,875	1,800	....	125,123
Maryland	....	....	....	4	....	9,533
Massachusetts	6,860	....	....	....	2,350	260,721
Michigan	10,403	....	....	....	....	65,395
Minnesota	31,209	72,012	2,708	42,193	8,542	285,633
Missouri	3,115	100	418	318	1,500	20,951
Montana	2,110	....	....	....	153	37,462
Nebraska	....	7	....	....	....	6,899
New Jersey	45,000	500	5,650	2,950	6,629	215,142
New Mexico	3,010	....	....	375	1,600	42,574
New York	48,362	374,278	366,423	375,539	6,121	[b] 1,905,892
North Carolina	895	....	....	....	636	3,531
North Dakota	4	20	....	....	10	44
Ohio	36,696	350	383,457	251,509	10,247	1,426,645
Oklahoma	6,263	....	115	60	75	40,246
Oregon	....	....	....	....	....	25,950
Pennsylvania	152,971	112,456	277,623	305,470	21,273	2,724,874
South Dakota	27,875	32,300	654	320	59	145,966
Tennessee	3,000	....	75	150	30	14,136
Texas	5,903	....	....	630	152	111,533
Utah	17,645	16,750	20	400	100	37,529
Virginia	....	....	....	....	....	5,100
Washington	2,410	62,922	....	....	563	169,500
West Virginia	14,418	592	10,185	8,125	219	113,369
Wisconsin	23,084	100	1,120	758	....	181,986
Wyoming	2,934	200	2,000	....	....	24,715
Total	525,108	694,995	1,097,438	1,074,369	96,144	9,169,337

[a] Included in New York. [b] Includes Connecticut.

The following table shows the value of the sandstone production in the United States from 1902 to 1906, inclusive, by States and Territories:

Value of sandstone production in the United States, 1902–1906, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	$42,706	$42,933	$12,788	$28,107	$40,467
Arizona	107,910	526,875	91,960	65,558	33,149
Arkansas	85,917	61,172	63,950	58,161	55,703
California	462,328	762,327	735,662	685,668	642,166
Colorado	366,161	389,132	281,142	453,029	286,544
Connecticut	128,579	119,417	117,696	62,618	(a)
Georgia	1,250				
Idaho	13,777	11,856	9,320	22,265	11,969
Illinois	32,200	26,293	47,377	29,115	19,125
Indiana	37,593	32,651	22,681	15,421	30,740
Indian Territory				2,198	615
Iowa	15,061	19,011	9,300	9,335	5,600
Kansas	105,509	102,128	130,516	79,617	42,809
Kentucky	128,470	93,742	93,622	280,579	125,123
Louisiana			8,315		
Maryland	15,405	2,170	8,998	12,984	9,533
Massachusetts	487,366	372,478	320,861	367,461	260,721
Michigan	188,073	121,350	74,868	123,123	65,395
Minnesota	347,472	363,262	319,209	294,640	285,433
Missouri	56,990	49,402	44,455	27,686	20,951
Montana	85,152	68,036	64,232	45,116	37,462
Nebraska	168	1,067	142	120	6,899
Nevada	6,115	2,370	10,558	1,500	
New Jersey	406,726	364,337	236,426	294,719	215,142
New Mexico	12,291	7,510	133,390	101,522	42,574
New York	b 1,408,699	b 1,756,501	b 1,755,524	b 1,831,756	b c 1,905,892
North Carolina	4,825	600	250	4,483	3,531
North Dakota				1,055	44
Ohio	2,078,754	1,793,379	1,808,062	1,744,472	1,426,645
Oklahoma	} 25,309	6,500	2,995	12,914	40,246
Oregon		2,912	6,186	1,229	25,950
Pennsylvania	b 2,800,108	b 3,255,073	b 2,641,510	b 2,487,939	b 2,724,874
South Dakota	110,789	163,067	338,970	193,408	145,966
Tennessee	7,670	20,649	24,868	8,715	14,136
Texas	165,565	114,381	209,313	123,281	111,533
Utah	105,011	71,279	70,168	43,429	137,529
Virginia	2,500	4,471	13,522	2,000	5,100
Washington	30,725	47,430	88,185	124,910	169,500
West Virginia	423,532	252,204	287,381	171,309	113,369
Wisconsin	207,086	142,445	158,503	161,741	181,986
Wyoming	90,691	91,849	30,986	33,591	24,715
Total	10,594,483	11,262,259	10,273,891	10,006,774	9,169,337

a Included in New York. b Includes bluestone. c Includes Connecticut.

The following table shows the value and uses of the bluestone produced in New York and Pennsylvania in 1905 and 1906:

Value and uses of bluestone produced in New York and Pennsylvania in 1905 and 1906.

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

1906.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
New York	$492,552	$365,483	$235,791	$600	$44,508	$1,138,934
Pennsylvania	268,290	265,481	170,103	54,994	124,096	882,964
Total	760,842	630,964	405,894	55,594	168,604	2,021,898

From this table it appears that the variety of sandstone known as bluestone in New York and Pennsylvania increased somewhat in value, from $1,931,625 in 1905 to $2,021,898 in 1906, a gain of $90,273. This increase was in the value of building stone and flagging, which with curbing are the chief uses of this class of stone. Both New York and Pennsylvania increased in value of output in 1906, New York from $1,105,464 in 1905 to $1,138,934 in 1906, or $33,470, and Pennsylvania from $826,161 in 1905 to $882,964 in 1906, or $56,803. The bluestone output of these two States in 1906 represented 22.05 per cent of the total sandstone output of the United States. New Jersey and West Virginia also produced sandstone known to the trade as bluestone.

MARBLE.

The marble output in the United States in 1906 was valued at $7,582,938, as compared with $7,129,071 in 1905, an increase of $453,867.

Vermont produces the greater part of the marble of the United States, the value reported by this State being $4,576,913 in 1906 as compared with $4,410,820 in 1905, an increase of $166,093. The increase in 1906 was smaller than in 1905, a loss due to the fact that considerably less rough stone was sold for building in 1906 than in 1905. The increase in value of Vermont marble from 1902, when the value was $2,628,164, to 1906 has been $1,948,749. The increase in 1905 over 1904, when the figures were $4,004,669, was $406,151. The output of this State represented 60.36 per cent of the total marble output of the United States in 1906 and 61.87 per cent in 1905. The marble from this State as sold by the producers is principally dressed stone for monumental, building, and interior work, and for electrical work, mosaic work, etc., and represented, in 1906, about 1,400,000 cubic feet.

Georgia ranks second in the marble-producing States, its value of output, $919,356 in 1906, representing 12.12 per cent of the total of the United States; in 1905 the output was $774,550, or 10.86 per cent, a gain of $144,806. The greater part of this stone is sold rough to the manufacturers and contractors for building and monumental work, and represented about 875,000 cubic feet in 1906.

The next States in order of output in 1906 were Tennessee, with an output of $635,821, representing about 375,000 cubic feet; New York with $557,954, and Massachusetts with $271,934; in 1905 New York, with an output of $795,721, exceeded Tennessee, whose output was $582,229; and the output of Massachusetts in 1905 was but $166,360, an increase for 1906 of $53,592 for Tennessee, a decrease for New York of $237,767, and an increase for Massachusetts of $105,574. In 1906 Alabama, Alaska, Arkansas, Califorina, Maryland, Nevada, Pennsylvania, and Utah increased in value of output of marble, while New Mexico, Washington, and Wyoming decreased. The output from Alabama, Alaska, Arkansas, and Nevada represented either new or renewed operations. As to Alaska only the figures for rough stone are included.

Missouri produced some marble in 1906, but the figures are included in those for limestone to avoid disclosure of individual production.

Pennsylvania's output includes a production of serpentine from Northampton County, and small quantities of serpentine are also included in the report from Georgia.

The outputs of California, New Mexico, Utah, and Wyoming include small quantities of onyx.

The greater part of the marble output is for building and monumental work, the values for the two being nearly equal in 1906.

Building stone.—The figures for 1906 were, for building stone, rough and dressed, $2,782,620, a decrease of $145,020 from the figures for 1905, which were $2,927,640. The total includes $1,222,695 for rough building and $1,559,925 for dressed building; in 1905 the rough building marble sold was valued at $1,759,190 and the dressed building at $1,168,450, showing for 1906 a decrease of $536,495 for rough stock and an increase of $391,475 in dressed marble. The value of Vermont's building marble, $1,163,945, represented 41.83 per cent of the total; the Georgia output, valued at $487,856, represented 17.53 per cent, and the New York output, valued at $363,713, 13.07 per cent of the total.

Monumental stone.—In 1906 the total monumental marble was valued at $2,657,813 and in 1905 at $2,270,217, an increase of $387,596. In 1906 the total includes $442,941 as the value of rough monumental stock and $2,214,872 the value of dressed monumental stone; the corresponding figures for 1905 are $1,099,938 for rough monumental stone and $1,170,279 for dressed stone, a decrease of $656,997 for rough stock and an increase of $1,044,593 for dressed stone. Vermont, with a value of $2,060,533 for this class of stone, produced 77.53 per cent of the total; Georgia and New York ranked next in production of monumental stone.

Ornamental stone.—The greater part of the small quantity of ornamental marble was produced in Vermont, and this stone increased in value from $13,643 in 1905 to $44,523 in 1906.

Interior stone.—Vermont, Tennessee, and Massachusetts produced most of the marble for interior work, the total value for 1906 being $1,722,445, as against $1,682,651 for 1905, an increase of $39,794 in 1906.

Other marble.—Rough stone for other purposes includes chiefly waste stone sold to lime burners, carbonic-acid factories, pulp mills, and for road material. The dressed stone for other purposes includes considerable stone for electrical work and mosaics.

The following table shows the value of the marble produced in the United States in 1905 and 1906, by States and Territories and uses:

Value of the marble product, 1905 and 1906, by States and Territories and uses.

1905.

State or Territory.	Rough.			Dressed.					Total.
	Building.	Monumental.	Other purposes.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.	
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

Value of the marble product, 1905 and 1906, by States and Territories and uses—Cont'd.

1906.

State or Territory.	Rough.			Dressed.					Total.
	Building.	Monumental.	Other purposes.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.	
Alabama	$26,500			$48,500	$10,000				$85,000
Alaska									(a)
Arkansas	7,000	$2,400		7,500					16,900
California	10,638	5,210		2,400	8,300	$2,000	$73,000	$1,500	103,048
Georgia	425,356	332,500	$75,000	62,500	24,000				919,356
Maryland	91,000	16,400	9,495	59,600					176,495
Massachusetts	1,995	15	10,600	113,380	100		140,844	5,000	271,934
Missouri									(b)
Nevada	5,000								5,000
New Mexico		500							500
New York	240,853	30,200	21,846	122,860	140,195		2,000		557,954
Pennsylvania	16,306	560	4,000	125,766	13,500	5,000	6,500		171,632
Tennessee	210,421			40,100	6,000		358,100	21,200	635,821
Utah		1,400							1,400
Vermont	186,626	52,756	4,607	977,319	2,007,777	32,523	1,097,001	218,304	4,576,913
Washington		1,000	3,985		5,000	5,000	45,000		c 59,985
Wyoming	1,000								1,000
Total	1,222,695	442,941	129,533	1,559,925	2,214,872	44,523	1,722,445	246,004	7,582,938

a Included in Washington.
b Included in limestone to prevent disclosure of individual figures.
c Includes Alaska.

The following table shows the value of the marble produced in the United States from 1902 to 1906, inclusive, by States and Territories:

Value of marble produced in the United States, 1902–1906, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	(a)	(a)	(a)		$85,000
Alaska			(a)	$710	(b)
Arizona		(a)	(a)		
Arkansas	(a)		(a)	1,000	16,900
California	$92,298	$78,329	$87,659	95,540	103,048
Connecticut	(a)	(a)	(a)		
Georgia	660,517	565,605	690,714	774,550	919,356
Maryland	(a)	83,672	73,814	138,404	176,495
Massachusetts	165,489	154,228	183,388	166,360	271,934
Missouri		(a)	(a)		(c)
Montana	(a)				
Nevada					5,000
New Mexico	(a)	(a)	4,250	2,200	500
New York	577,298	748,160	565,987	795,721	557,954
North Carolina		4,365	2,741		
Pennsylvania	160,423	93,200	90,390	97,887	171,632
Tennessee	518,256	485,905	505,259	582,229	635,821
Utah	(a)	3,200	3,950	1,150	1,400
Vermont	2,628,164	3,011,505	4,004,669	4,410,820	4,576,913
Washington	61,176	40,117	23,098	60,000	59,985
Wyoming		3,100	2,000	2,500	1,000
Other States	d 180,561	e 91,300	f 59,916		
Total	5,044,182	5,362,686	6,297,835	7,129,071	7,582,938

a Included in "Other States."
b Included in Washington.
c Included in limestone.
d Includes Alabama, Arkansas, Connecticut, Maryland, Montana, New Mexico, and Utah.
e Includes Alabama, Arizona, Connecticut, Missouri, and New Mexico.
f Includes Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

The following table shows the various uses to which the marble quarried in 1902, 1903, 1904, 1905, and 1906 was put:

Distribution and value of output of marble, 1902–1906, among various uses.

Use.	1902.	1903.	1904.	1905.	1906.
Sold by producers in rough state	$2,275,429	$2,454,263	$2,599,052	$2,987,542	$1,795,169
Dressed for building	1,038,302	1,111,072	988,671	1,168,450	1,559,925
Ornamental purposes	7,300	51,359	21,554	13,643	44,523
Dressed for monumental work	956,870	1,062,339	1,211,389	1,170,279	2,214,872
Interior decoration in buildings	679,913	663,553	1,257,963	1,682,651	1,722,445
Other uses	86,368	20,100	219,206	106,506	246,004
Total	5,044,182	5,362,686	6,297,835	7,129,071	7,582,938

From this table it appears that while the rough marble sold to manufacturers, dealers, and contractors, decreased in value, the dressed stone of all kinds sold by the quarrymen increased.

LIMESTONE.

The value of the limestone in this report does not include the value of stone burned into lime or the value of the lime burned from the stone, this being in a special report on lime. However, a considerable quantity of limestone, valued at $822,330, is included, more or less of which was eventually burned into lime and used by alkali works, sugar refineries, glass factories, paper mills, carbonic-acid plants, or burned for use as fertilizer on land. A large quantity of limestone used in the manufacture of Portland cement is also not included in this report, as its value enters into and is included in the value of the cement.

The total limestone output increased in value from $26,025,210 in 1905 to $27,320,243 in 1906, an increase of $1,295,033.

Limestone crushed for concrete, railroad ballast, and macadam increased in value, as did limestone for furnace flux, paving, curbing, and for use in the manufacture of sugar, paper, carbonic acid, and alkalies; limestone for building, flagstone, rubble, and riprap, decreased in value. Limestone producers, especially those selling stone for building, rubble, curbing, and flagstones, report the increased use of cement and concrete, and the increased cost of production on account of high price of supplies and wages. The producers of limestone for flux, crushed stone, and stone for use in the arts report increased demand at higher prices.

The chief States producing limestone in 1906 were, in order, Pennsylvania, Indiana, Ohio, Illinois, New York, and Missouri, each reporting over $1,900,000. The total output of these six States amounted to $18,751,122, or 68.63 per cent of the total. In 1905 the rank of these six principal producing States was Pennsylvania, Illinois, Indiana, Ohio, Missouri, and New York, their combined output being $18,260,577, or 70.16 per cent of the total. The other States reporting a value over $450,000 in 1906 were, in order of output, Wisconsin, Kansas, Kentucky, Michigan, Minnesota, West Virginia, Alabama, Iowa, and Tennessee. In 1905 these States ranked as follows: Kansas, Wisconsin, Kentucky, West Virginia, Minnesota, Michigan, Alabama, and Iowa.

In 1906 twenty-seven States and Territories—Alabama, California, Colorado, Georgia, Indiana, Indian Territory, Iowa, Kentucky, Maryland, Michigan, Minnesota, Montana, Nebraska, New Jersey, New Mexico, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Dakota, Tennessee, Texas, Utah, Virginia, Wisconsin, Wyoming—increased in the value of their limestone output; the remaining States—Arizona, Arkansas, Connecticut, Florida, Idaho, Illinois, Kansas, Maine, Massachusetts, Missouri, Oklahoma, Oregon, Vermont, Washington, and West Virginia—showed decreases.

Crushed stone.—The greatest item in value of the limestone production is for stone crushed and used for road making, railroad ballast, and concrete, which was valued at $11,073,265, representing 20,286,589 short tons of crushed stone; in 1905 these figures were 19,334,168 short tons, valued at $10,487,638, an increase of 952,421 tons in quantity and of $585,627 in value. In 1906 the total was divided into 6,685,781 tons, valued at $3,857,500, for road making and macadam; 8,106,850 tons, valued at $3,899,396, for railroad ballast; and 5,493,958 tons, valued at $3,316,369, for concrete, which, compared with the itemized output for 1905—road making, 6,446,518 tons, valued at $3,837,041; railroad ballast, 8,167,261 tons, valued at $3,826,811; and concrete, 4,720,389 tons, valued at $2,823,786—shows an increase of 239,263 tons and of $20,459 for road making; a decrease of 60,411 tons in quantity, with an increase of $72,585 in value for railroad ballast; and the very significant increase of 773,569 tons and of $492,583 for concrete.

Illinois ranked first in 1906 in the production of crushed limestone, followed by Ohio, New York, Pennsylvania, Missouri, Indiana, Kansas, Kentucky, and Wisconsin, each reporting values varying from $1,785,064 to $447,431, the nine States representing 83.83 per cent of the total quantity and 83.49 per cent of the total value of crushed limestone.

Ohio produced the most crushed limestone for road making, followed by Illinois and New York; Pennsylvania the most railroad ballast, followed by Kansas and Ohio; and Illinois, the most crushed stone for concrete, followed by Pennsylvania and New York.

Furnace flux.—The next greatest value shown by the figures representing the production of limestone is that for furnace flux, which was $7,612,692 in 1906, as compared with $7,004,265 in 1905, an increase for 1906 of $608,427. These figures represent outputs of 16,077,202 long tons in 1906, and 15,387,891 long tons in 1905, an increase in 1906 of 689,311 tons. Pennsylvania, Ohio, West Virginia, and Alabama are the ranking States in this class of material, Pennsylvania in 1906 producing 41.62 per cent of the total value of the flux. The average value of flux per long ton for 1906 was 47 cents.

Building stone.—Limestone for building purposes, including rough and dressed stone sold by producers, was valued at $5,092,916 in 1906, compared with $5,312,183 in 1905, a decrease of $219,267. The rough building stone sold by the quarrymen in 1906 was valued at $2,726,897, the dressed stone at $2,366,019; the figures for 1905 were, rough stone, $3,114,446; cut or sawed stone, $2,197,737, a decrease in value of rough building stone sold in 1906 of $387,549 and an increase in the value of sawed or cut stone of $168,282.

Indiana, with a total output of building stone valued at $2,636,421, produced 51.77 per cent of the total building limestone in 1906; in 1905 the building limestone from this State was valued at $2,492,960, or 46.93 per cent of the total, an increase of $143,461 for the State. This building stone is quarried chiefly in Lawrence and Monroe counties, and is universally known as "Bedford limestone," from Bedford, Lawrence County, from which place the greatest shipments have been made. A comparatively small quantity of this Bedford stone is used for flagstone, curbstone, monumental stone, crushed stone, and some, not included in this report, for making cement and lime. The total value of the output from Lawrence County in 1906 was $1,460,743; from Monroe County, $1,162,062, a total of $2,622,805 for the two counties; in 1905 the total for the two counties was $2,393,475, with a value of $1,550,076 for Lawrence County and of $843,399 for Monroe County, an increase of $229,330 in the total for 1906, an increase of $318,663 for Monroe County, and a decrease of $89,333 for Lawrence County. The total of these counties in 1906 represented 9,282,004 cubic feet of stone, of which 5,586,282 cubic feet were sold rough and 3,695,722 cubic feet were sawed or cut stone.

Missouri ranks next to Indiana in the production of building limestone with an output, including rough and dressed stone, of $690,625, an increase of $101,790 over 1905, when the value was $588,835. This stone is chiefly from Carthage, Jasper County.

Riprap.—Limestone for riprap valued at $550,385 was taken out in 1906 as against an output valued at $573,181 in 1905, a decrease of $22,796 in 1906. Material of this class was quarried chiefly in Missouri and Ohio.

Rubble.—Limestone for rubble was valued at $924,275 in 1906 and at $945,717 in 1905, a decrease of $21,442. The greater part of this was reported from Illinois.

Chemical industries.—About three-eighths of the value of $822,330 shown as the value of the limestone sold to chemical industries includes stone quarried and used by alkali works in New York and Michigan in the manufacture of all kinds of alkaline salts. Nearly one-fourth is stone quarried in Michigan, Wyoming, Utah, California, Colorado, Idaho, and Nevada and sold to sugar factories for use in the process of refining sugar. A little more than one-fourth represents the value of limestone from Pennsylvania, Ohio, Missouri, Indiana, Illinois, and New York sold to glass factories. Other stone included under this heading is stone used by paper mills and by farmers who buy the stone to burn into lime for use as fertilizer on their land. In 1905 this stone was classed under stone used for other purposes.

The following table shows the value of limestone in the United States in 1905 and 1906 by States and Territories and uses:

Value of the production of limestone in the United States in 1905 and 1906, by States and Territories and uses.

1905.

State or Territory.	Rough building.	Dressed building.	Paving.	Curbing.	Flagging.	Rubble.	Riprap.
Alabama	$100	$35,000					$89,063
Arizona	135						
Arkansas	22,710	63,971	$300	$946	$731	$39,850	198
California	1,000						
Colorado							
Connecticut							
Florida		5,000				500	
Georgia						960	100
Idaho	105						
Illinois	123,140	73,246	53,410	10,373	16,204	388,845	35,000
Indiana	1,155,728	1,337,232	5,421	134,898	29,699	33,438	9,984
Indian Territory							
Iowa	137,805	35,387	7,576	3,366	12,337	48,341	39,004
Kansas	98,571	41,525	13,338	9,196	5,095	37,500	13,645
Kentucky	91,987	80,098	3,675	25,112	1,917	6,022	5,340
Maine							
Maryland	42,691	75	100	15	131		500
Massachusetts	58,175	3,000					
Michigan	17,071			160		744	1,568
Minnesota	161,292	102,464	544	6,939	14,524	75,845	29,885
Missouri	319,822	269,013	6,546	12,704	12,244	190,934	153,512
Montana	4,066				150		
Nebraska	19,957	100	65	42	16	22,447	21,496
New Jersey	845	30					
New Mexico	600					600	6,000
New York	183,833	80,692	500	29,660	15,792	21,538	14,679
North Carolina							
Ohio	218,364	13,107	5,474	2,390	3,972	22,487	68,094
Oklahoma	17,194	2,540	175	415	3,260	4,068	200
Oregon	3,000	800					300
Pennsylvania	158,875	1,485	110,208	24,367	5,689	7,265	16,487
Rhode Island							
South Dakota	448						
Tennessee	37,653	14,400	250	4,652	400	1,868	6,895
Texas	36,840	7,438		1,825	747	9,533	20,649
Utah	8,960						
Vermont	205					2,700	
Virginia	5,390	700					120
Washington	3,400						
West Virginia	71						200
Wisconsin	183,263	30,434	24,203	16,326	4,893	28,482	40,262
Wyoming	1,150			40		1,750	
Total	3,114,446	2,197,737	231,785	283,426	127,801	945,717	573,181

State or Territory.	Crushed stone.			Flux.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.			
Alabama	$3,725		$7,275	$395,935	$1,005	$532,103
Arizona						135
Arkansas	14,600	$2,012	9,500			154,818
California	3,000	510	2,700	3,677	39,015	49,902
Colorado				265,493	24,427	289,920
Connecticut				1,558		1,558
Florida			300			5,800
Georgia		5,000	1,000	1,270	700	9,030
Idaho					14,000	14,105
Illinois	793,401	655,276	594,293	582,873	185,829	3,511,890
Indiana	222,441	84,007	30,364	117,790	28,257	3,189,259
Indian Territory		3,624	1,888			5,512
Iowa	65,543	14,262	81,974		6,196	451,791
Kansas	28,913	618,189	25,365	2,000	30,052	923,389
Kentucky	202,532	250,115	65,427	7,733	4,507	744,465
Maine					7,428	7,428
Maryland	31,823	36,210	32,608		5,249	149,402
Massachusetts				4,733		65,908
Michigan	112,113	43,649	107,396	109,883	152,170	544,754
Minnesota	47,139	11,700	98,379		6,690	555,401
Missouri	376,349	381,018	488,252	16,624	11,146	2,238,164
Montana				98,907		103,123
Nebraska	24,050	29,442	79,311	16,000	12,193	225,119
New Jersey	1,750		10,825	133,889	14	147,353
New Mexico						7,200
New York	451,115	344,976	352,627	300,441	175,115	1,970,968
North Carolina	16,500					16,500

Value of the production of limestone in the United States in 1905 and 1906, by States and Territories and uses—Continued.

1905—Continued.

State or Territory.	Crushed stone.			Flux.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.			
Ohio	$790,138	$461,235	$248,578	$872,353	$144,601	$2,850,793
Oklahoma	22,675	90,000	21,185		1,700	163,412
Oregon	4,500					8,600
Pennsylvania	255,471	597,940	322,218	2,842,202	157,296	4,499,503
Rhode Island				300		300
South Dakota			6,205			6,653
Tennessee	39,427	81,093	48,930	165,754		401,622
Texas	7,000	14,500	14,143	57,599	1,573	171,847
Utah	890		150	203,644	18,875	232,519
Vermont	350		6,000	1,794	46	11,095
Virginia	5,254	9,333	11,157	180,076		212,660
Washington				43,450	5,620	52,470
West Virginia	32,559	81,550	32,300	516,250	8,388	671,318
Wisconsin	284,083	7,870	123,406	53,337	7,522	804,081
Wyoming		2,700		8,100	9,600	23,340
Total	3,837,041	3,826,811	2,823,786	7,004,265	1,059,214	26,025,210

1906.

State or Territory.	Rough building.	Dressed building.	Paving.	Curbing.	Flagging.	Rubble.	Riprap.
Alabama	$200	$22,394					$67,028
Arizona	40						
Arkansas	7,561	37,612				$621	
California	8,985		$200	$5,000		2,500	
Colorado						3,153	
Connecticut							
Florida	300	1,050					
Georgia	2,840		350			670	
Idaho							
Illinois	105,410	25,343	176,646	5,550	87,775	378,582	48,825
Indiana	1,169,762	1,466,679	6,731	174,135	24,798	24,254	10,780
Indian Territory	500	500				3,622	
Iowa	105,203	31,350	6,527	8,030	7,032	84,553	35,810
Kansas	95,009	36,528	17,492	14,081	4,578	34,351	18,494
Kentucky	116,164	93,675	760	15,387	1,123	6,864	22,355
Maine							
Maryland	8,393		44	20	715		
Massachusetts	775						
Michigan	9,368	641	90,723	75		4,654	1,204
Minnesota	124,051	152,385	4,629	4,867	11,096	112,565	51,476
Missouri	302,627	387,998	9,100	8,516	24,732	128,430	191,755
Montana	5,117		150			875	
Nebraska	30,685	1,230	7,500	10,200		11,878	20,140
New Jersey	2,106						
New Mexico	1,800					2,400	2,400
New York	180,627	64,595	4,100	10,648	11,229	12,692	13,453
North Carolina							
Ohio	155,905	7,894	1,480	1,100	478	6,395	86,215
Oklahoma	2,350	900			741	2,440	11,000
Oregon	3,000			180			200
Pennsylvania	74,625	8,728	139,643	1,455	2,309	8,480	4,029
Rhode Island							
South Dakota	400						
Tennessee	18,597	7,800		4,212	62	11,135	7,422
Texas	38,705	10,949	32,929	407		6,604	12,842
Utah	11,192	500				1,300	
Vermont	2,619					600	
Virginia	3,448	1,080		275			323
Washington	1,200						
West Virginia	461						745
Wisconsin	136,272	26,010	32,271	27,473	11,464	74,307	33,893
Wyoming						350	
Total	2,726,897	2,366,019	531,275	289,615	109,632	924,275	550,385

Value of the production of limestone in the United States in 1905 and 1906, by States and Territories and uses—Continued.

1906—Continued.

State or Territory.	Crushed stone.			Flux.	Sugar factories, etc.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Alabama	$9,380		$7,280	$473,062			$579,344
Arizona							40
Arkansas	1,600	$1,000	450				48,844
California	4,094	500	10,962	25,000	$22,964		80,205
Colorado	3,500			301,913	39,592	$25,000	373,158
Connecticut				1,171			1,171
Florida			100				1,450
Georgia		675	1,050	10,417	40		16,042
Idaho					12,600		12,600
Illinois	686,092	389,065	709,907	384,282	17,433	9,419	2,942,331
Indiana	321,891	169,695	119,222	210,124	9,455	18,059	3,725,565
Indian Territory		20,000	20,000				44,622
Iowa	38,189	26,268	142,124			8,129	493,815
Kansas	39,877	533,173	34,228		5	21,087	849,203
Kentucky	222,877	242,737	50,327	15,170		7,971	795,408
Maine					2,000		2,000
Maryland	30,582	110,503	19,024		40	725	170,046
Massachusetts				9,875	100		10,750
Michigan	78,437	103,442	61,852	81,517	224,356		656,269
Minnesota	59,230	8,041	117,159	150	3,625	1,641	632,115
Missouri	294,211	336,752	316,136	28,381	11,591	38,105	1,988,334
Montana				134,940			141,082
Nebraska	16,000	29,980	112,235	6,600	29,891	42	276,381
New Jersey	4,640	7,950	10,950	195,235		260	221,141
New Mexico		108,893	6,000			4,000	125,493
New York	584,261	324,940	464,614	294,659	221,192	17,714	2,204,724
North Carolina	30,583						30,583
Ohio	924,346	407,005	286,460	1,013,497	48,806	85,457	3,025,038
Oklahoma	9,000	90,000	7,700			3,230	127,361
Oregon					3,600	500	7,480
Pennsylvania	251,200	602,128	486,882	3,168,186	76,073	41,394	4,865,130
Rhode Island				678			678
South Dakota			10,000				10,400
Tennessee	23,725	192,514	75,063	139,227		2,595	481,952
Texas	3,250	23,000	30,685	75,764		3,990	239,125
Utah	13,030		15	198,671	23,910	250	248,868
Vermont	2,320		2,000	250		40	7,829
Virginia	160	16,050	18,700	219,707			260,343
Washington				38,831	8,761	400	49,192
West Virginia	17,406	67,700	20,875	513,413	6,865	1,137	628,602
Wisconsin	187,619	86,575	173,237	71,972	7,940	22,713	891,746
Wyoming		810	1,132		51,491		53,783
Total	3,857,500	3,899,396	3,316,369	7,612,692	822,330	313,858	27,320,243

The following table shows the value of limestone, by States, from 1902 to 1906, inclusive:

Value of limestone, 1902–1906, by States and Territories.

State or Territory.	1902.	1903.	1904.	1905.	1906.
Alabama	$524,049	$502,510	$498,723	$532,103	$579,344
Arizona			250	135	40
Arkansas	30,310	153,291	106,147	154,818	48,844
California	100,848	229,376	74,670	49,902	80,205
Colorado	157,355	175,078	124,600	289,920	373,158
Connecticut	1,472	1,968	830	1,558	1,171
Florida	25,608	20,756	34,278	5,800	1,450
Georgia	39,865	10,450	15,200	9,030	16,042
Idaho	2,025	752	5,900	14,105	12,600
Illinois	2,736,964	2,726,470	2,690,822	3,511,890	2,942,331
Indiana	2,553,502	2,621,068	2,789,500	3,189,259	3,725,565
Indian Territory		650	6,076	5,512	44,622
Iowa	535,933	536,906	442,585	451,791	493,815
Kansas	663,178	480,609	799,286	923,389	849,203
Kentucky	577,854	695,602	692,417	744,465	795,408
Maine	3,000	1,863	2,955	7,428	2,000
Maryland	126,613	65,732	128,421	149,402	170,046
Massachusetts	14,869	9,656	7,566	65,908	10,750
Michigan	413,148	390,473	501,708	544,754	656,269
Minnesota	754,987	609,471	517,940	555,401	632,115
Missouri	1,181,359	1,874,740	2,277,969	2,238,164	1,988,334
Montana	95,950	131,594	109,765	103,123	141,082
Nebraska	145,323	187,718	236,780	225,119	276,381
New Jersey	58,172	66,915	76,710	147,353	221,141
New Mexico				7,200	125,493
New York	1,857,893	2,007,911	1,636,255	1,970,968	2,204,724
North Carolina	21,063		12,088	16,500	30,583
Ohio	2,119,441	2,349,661	2,406,355	2,850,793	3,025,038
Oklahoma	50,516	50,690	92,246	163,412	127,361
Oregon		3,000	5,390	8,600	7,480
Pennsylvania	3,990,644	4,343,643	3,708,750	4,499,503	4,865,130
Rhode Island	1,190	883	312	300	678
South Carolina	350	950	225		
South Dakota	65,305	26,215	3,954	6,653	10,400
Tennessee	246,418	356,961	288,053	401,622	481,952
Texas	146,162	188,015	252,745	171,847	239,125
Utah	87,200	125,610	170,447	232,519	248,868
Vermont	6,397	9,955	9,653	11,095	7,829
Virginia	292,129	232,744	165,459	212,660	260,343
Washington	27,744	75,649	71,857	52,470	49,192
West Virginia	434,758	405,077	460,303	671,318	628,602
Wisconsin	801,701	701,347	738,684	804,081	891,746
Wyoming	4,090	150	15,090	23,340	53,783
Total	20,895,385	22,372,109	22,178,964	26,025,210	27,320,243

Production of blast-furnace flux in 1905 and 1906, by States, in long tons.

State.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Alabama	764,173	$395,935	803,643	$473,062
California	3,677	3,677	28,758	25,000
Colorado	544,984	265,493	552,651	301,913
Connecticut	4,236	1,558	3,455	1,171
Georgia	2,850	1,270	17,793	10,417
Illinois	1,576,081	582,873	909,375	384,282
Indiana	243,822	117,790	500,702	210,124
Kansas	4,000	2,000	....	....
Kentucky	20,497	7,733	33,987	15,170
Massachusetts	11,722	4,733	16,528	9,875
Michigan	294,895	109,883	162,603	81,517
Minnesota	....	....	200	150
Missouri	29,922	16,624	43,574	28,381
Montana	238,563	98,907	304,600	134,940
Nebraska	20,000	16,000	12,000	6,600
New Jersey	265,042	133,889	363,508	195,235
New York	574,047	300,441	513,452	294,659
Ohio	2,163,554	872,353	3,098,346	1,013,497
Pennsylvania	6,325,503	2,842,202	6,396,765	3,168,186
Rhode Island	200	300	542	678
Tennessee	340,342	165,754	250,835	139,227
Texas	88,274	57,599	122,804	75,764
Utah	260,016	203,644	262,808	198,671
Vermont	3,589	1,794	500	250
Virginia	393,662	180,676	467,341	219,707
Washington	65,500	43,450	41,171	38,831
West Virginia	1,028,622	516,250	1,019,931	513,413
Wisconsin	106,640	53,337	149,330	71,972
Wyoming	13,478	8,100	....	....
Total	15,387,891	7,004,265	16,077,202	7,612,692

ABRASIVE MATERIALS.

By Douglas B. Sterrett.

INTRODUCTION.

The abrasive materials that are included in this report are as follows: Oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, 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 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 the 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]

The features of the year in the production of abrasive materials were the further decrease in the production of grindstones and pulpstones and the lowest recorded figure for corundum and emery. The latter is offset by the increased quantity of artificial abrasives, the alundum or artificial corundum output being the largest so far recorded, and carborundum being stronger than in 1905, though

[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, 1904.
[e] Ann. Rept. North Carolina Geol. Surv., vol. 1, 1905; Bull. U. S. Geol. Survey No. 269, 1905.

still below the large production of 1904. All of the other natural abrasive materials listed in these tables showed an increased value in 1906 over 1905.

The total value of the natural abrasive materials produced during 1906 was $1,473,393, as compared with $1,427,980 in 1905, an increase of $45,413. There are given in the following table the values of the different abrasive materials produced in the United States from 1902 to 1906:

Value of abrasives produced in the United States, 1902–1906.

Kind of abrasive.	1902.	1903.	1904.	1905.	1906.
Oilstones and scythestones	$221,762	$366,857	$188,985	$244,546	$268,070
Grindstones and pulpstones	667,431	721,446	881,527	777,606	744,894
Buhrstones and millstones	59,808	52,552	37,338	37,974	48,590
Pumice	2,750	2,665	5,421	5,540	16,750
Infusorial earth and tripoli	53,244	76,273	44,164	64,637	72,108
Crystalline quartz	84,335	76,908	a 74,850	a 88,118	a 121,671
Garnet	132,820	132,500	117,581	148,095	157,000
Corundum and emery	104,605	64,102	57,235	61,464	44,310
Total	1,326,755	1,493,303	1,407,101	1,427,980	1,473,393

a Including feldspar used for abrasive purposes.

There were 25 different States which contributed to the production of natural abrasive materials in 1906, 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 1906.

1. OHIO: Grindstones, pulpstones, oilstones and scythestones.
2. NEW YORK: Millstones, infusorial earth, and emery.
3. ARKANSAS: Oilstones.
4. MICHIGAN: Grindstones and scythestones.
5. CONNECTICUT: Infusorial earth and crystalline quartz.
6. MISSOURI: Grindstones and infusorial earth.
7. MINNESOTA: Feldspar.
8. NEW HAMPSHIRE: Scythestones.
9. MASSACHUSETTS: Emery.
10. VERMONT: Scythestones.
11. INDIANA: Scythestones.
12. WEST VIRGINIA: Grindstones.
13. NEBRASKA: Pumice.
14. VIRGINIA: Millstones.
15. PENNSYLVANIA: Millstones, crystalline quartz, and garnet.
16. CALIFORNIA: Infusorial earth.
17. WISCONSIN: Crystalline quartz.
18. ILLINOIS: Infusorial earth.
19. NORTH CAROLINA: Millstones.
20. KENTUCKY: Infusorial earth.
21. MARYLAND: Infusorial earth.
22. GEORGIA: Infusorial earth.
23. MONTANA: Grindstones.
24. KANSAS: Emery.
25. WYOMING: Grindstones.

In 1905 there were 23 States that contributed to the production of abrasive materials. Of these South Dakota and Idaho had no production in 1906, while Illinois, Kansas, Kentucky, and Maryland are new on the list.

The total value of the artificial abrasives manufactured during 1906 amounted to $777,081, as compared with $701,400 in 1905, an increase of $75,681. In quantity the total production in 1906 amounted to 11,774,300 pounds; as compared with 9,820,000 pounds in 1905 and 11,870,380 in 1904. This is an increase of 1,954,300 pounds over 1905 and a decrease of 86,080 pounds from the large production of 1904. The quantity of artificial abrasives—carborundum, crushed steel, and alundum (artificial corundum)—produced in the United States during the last five years is shown in the following table:

Artificial abrasives produced in the United States, 1902–1906, in pounds.

Kind of abrasive.	1902.	1903.	1904.	1905.	1906.
Carborundum	3,741,500	4,759,890	7,060,380	5,596,000	6,225,300
Crushed steel	735,000	755,000	790,000	612,000	837,000
Alundum (artificial corundum)	....	....	4,020,000	3,612,000	4,712,000

The total estimated value of all abrasive materials consumed in the United States for the years 1902 to 1906, inclusive, are given in the table following:

Total value of all abrasive materials consumed in the United States, 1902–1906.

Year.	Natural abrasives.	Artificial abrasives.	Imports.	Total value.
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	2,784,001
1906	1,473,393	777,081	909,964	3,160,438

BUHRSTONES AND MILLSTONES.

PRODUCTION.

The production of buhrstones and millstones in the United States during 1906 was valued at $48,590. This is an increase of $10,616, though the value still falls below that for 1901, 1902, and 1903, all of which were over $50,000. The production came from 22 producers in the following 4 States: New York, 14 producers; Virginia, 3; North Carolina, 2; and Pennsylvania, 3. Though stone suitable for buhrstones and millstones is found in other States, there was no production from them reported to this office.

In the following table are given the values, by States, of buhrstones and millstones produced in the United States from 1902 to 1906:

Value of buhrstones produced in the United States, 1902–1906, by States.

State.	1902.	1903.	1904.	1905.	1906.
New York	$39,570	$35,441	$24,585	$25,915	$28,848
Virginia	11,435	9,812	4,759	8,186	15,611
North Carolina and Vermont	6,825	5,902	[a] 6,500	[a] 2,522	[a] 1,507
Pennsylvania	1,978	1,397	1,494	1,351	2,624
Total	59,808	52,552	37,338	37,974	48,590

[a] No production of buhrstones from Vermont in 1904, 1905, and 1906.

The following table gives the value of buhrstones produced in the United States since 1880:

Value of buhrstones produced in the United States, 1880–1906.

1880	$200,000	1894	$13,887
1881	150,000	1895	22,542
1882	200,000	1896	22,567
1883	150,000	1897	25,932
1884	150,000	1898	25,934
1885	100,000	1899	28,115
1886	140,000	1900	32,858
1887	100,000	1901	57,179
1888	81,000	1902	59,808
1889	35,155	1903	52,552
1890	23,720	1904	37,338
1891	16,587	1905	37,974
1892	23,417	1906	48,590
1893	16,639		

IMPORTS.

The value of the imports of buhrstones and millstones into the United States has not varied greatly during the last three years, and is given in the following table for the last five years:

Value of buhrstones and millstones imported into the United States, 1902–1906.

Year.	Rough.	Made into millstones.	Total.	Year.	Rough.	Made into millstones.	Total.
1902	$15,243	$915	$16,158	1905	$30,478	$938	$31,416
1903	21,160	8,481	29,641	1906	32,921	277	33,198
1904	30,117	2,269	32,386				

CORUNDUM AND EMERY.

Corundum, and its modification, emery, furnish the best natural abrasive known, except diamond, the use of which is limited by its high price. The purer forms of corundum make a very satisfactory abrasive material, and one which is probably the equal of any of the artificial abrasives. The quality of emery as an abrasive is determined by the quantity of the iron ore, magnetite or hematite, mechanically mixed with the corundum, being better, the smaller the percentage of iron. The production of these minerals in the United States is limited by a scarcity of supply and by competition with Canadian corundum, Asia Minor emery, and the artificial abrasives.

In the United States, corundum has been mined for abrasive purposes in some quantity in North Carolina, Georgia, and Montana. The output of emery is from Massachusetts and New York, with a little from Kansas. The deposits yielding corundum are for the most part idle in the United States, while in Canada the production of corundum is steadily increasing in Ontario, where deposits are known to exist in the counties of Peterborough, Hastings, and Renfrew.[a] In Ontario the principal occurrence of corundum is in a pink syenite, composed chiefly of feldspar with a little mica, hornblende, magnetite, and other accessory minerals. At the next important deposit the corundum occurs in nepheline-syenite. Corundum crystals from one of the Ontario mines were found on analysis to carry between 92.62 per cent and 94.72 per cent A_2O_3. The corundum-ore rock at the Canadian mines is quarried out in large quantities, and the corundum is separated out by crushing and concentrating on various forms of tables. The cost of producing finished corundum, including mining, milling, concentrating, sizing, packing, and general expenses is over $40 per ton.

PRODUCTION.

The production of corundum and emery in the United States in 1906 amounted to 1,160 short tons valued at $44,310, as compared with 2,126 tons valued at $61,464 in 1905. The whole production came from Massachusetts and New York, except a small quantity from Kansas. The following table gives the total quantity and value of the corundum and emery produced in the United States since 1881:

[a] Kerr, D. G., Corundum in Ontario; Can. Min. Rev., November, 1906.

Annual production of corundum and emery, 1881–1906, in 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	1906	1,160	44,310

IMPORTS.

The demand for corundum and emery in 1906 in the United States was principally supplied by imports. The latter amounted to $521,082 in value, as compared with $347,425 in 1905, and exceeded the home production by nearly 12 times. 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, 1902–1906.

Year.	Grains.		Ore and rock.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Long tons.*			
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
1906	4,655,668	215,357	13,841	286,386	19,339	521,082

[a] Including emery rock valued at $5,488. [b] Including emery rock valued at $7,338.

CANADIAN CORUNDUM.

The production of Canadian corundum in 1906 amounted to 2,274 short tons, valued at $204,973, as compared with 1,644 short tons, valued at $149,153, in 1905, an increase of 630 short tons in quantity and of $55,820 in value.

In the following table are given the quantity and value of the production of Canadian corundum during the last five years:

Production of Canadian corundum, 1902–1906.

1902	short tons..	805	$88,616	1905	short tons..	1,644	$149,153
1903	do....	916	92,940	1906	do....	2,274	204,973
1904	do....	919	101,050				

CRYSTALLINE QUARTZ AND FELDSPAR.

PRODUCTION.

The production of crystalline quartz and feldspar in the United States during 1906 amounted to 24,082 short tons, valued at $121,671, as compared with 19,039 tons, valued at $88,118, in 1905. This is an increase of 5,043 tons in quantity and of $33,553 in value. In quantity the production was exceeded only by that of 1903, which was 31,940 tons, while the value was greater in 1906 than for any previous year. There was a large increase in the production of abrasive feldspar, which figures prominently in the total production. The production of crystalline quartz in 1906 was obtained from the following States, named in order of their relative importance and with the number of producers in each: Connecticut, 3; Pennsylvania, 1; Wisconsin, 1. In the following table is given the quantity and value of crystalline quartz produced in the United States from 1895 to 1903, inclusive, and of crystalline quartz and feldspar for the years 1904 to 1906:

Production of crystalline quartz, 1895–1906.

1895	short tons	9,000	$27,000	1901	short tons	14,050	$41,500
1896	do	6,000	18,000	1902	do	15,104	84,335
1897	do	7,500	22,500	1903	do	8,938	76,908
1898	do	8,312	23,990	1904	do	[a]31,940	[a]74,850
1899	do	13,600	39,000	1905	do	[a]19,039	[a]88,118
1900	do	14,461	40,705	1906	do	[a]24,082	[a]121,671

GARNET.

PRODUCTION.

The production of abrasive garnet in 1906 in the United States amounted to 4,650 short tons, valued at $157,000. This falls short by 400 tons in quantity, but exceeds in value by $8,905 the production for 1905, which amounted to 5,050 short tons, valued at $148,095. In quantity and value the production is the next largest recorded, being exceeded only in 1905 in quantity and in 1901 in value. The average price per ton was $33.77, which is the highest since 1902, and is a large increase over $29.32 in 1905. The production came chiefly from New York, with part from Pennsylvania.

No production of garnet was reported from North Carolina in 1906, though it is expected there will be large production in 1907. According to reports,[b] the mine in Madison County owned by Mr. F. O. Werden, of Philadelphia, Pa., is being operated with an estimated production of 125 tons of garnet per month. The mine is to be equipped with steam drills and lighted by electricity, and it is hoped the output will be greatly increased. The product from this mine is used chiefly for commercial purposes, though it is said several very fine clear stones have been found.

In the following table are given the quantity and value of the abrasive garnet produced in the United States since 1895:

Production of abrasive garnet, 1895–1906.

1895	short tons	3,325	$95,050	1901	short tons	4,444	$158,100
1896	do	2,686	68,877	1902	do	3,926	132,820
1897	do	2,554	80,853	1903	do	3,950	132,500
1898	do	2,967	86,850	1904	do	3,854	117,581
1899	do	2,765	98,325	1905	do	5,050	148,095
1900	do	3,185	123,475	1906	do	4,650	157,000

[a] Includes feldspar used for abrasive purposes.

[b] Eng. and Min. Jour., August 10, 1907.

GRINDSTONES AND PULPSTONES.

PRODUCTION.

The production of grindstones and pulpstones during 1906 amounted to $744,894, as compared with $777,606 in 1905, a decrease of $32,712. Of the total value of the 1906 production $50,000 was contributed by pulpstones, which is practically the same as in 1905. The production came from the following States, named in the order of their relative importance: Ohio, Michigan, West Virginia, Montana, Missouri, and Wyoming. This is the same order as in 1905, though the production of Missouri and Wyoming were reported as the same. In the following table is given the value of the production of grindstones and pulpstones during the last five years:

Value of the production of grindstones and pulpstones, 1902–1906.

	1902.	1903.	1904.	1905.	1906.
Grindstones	$644,343	$687,476	$820,207	$726,536	$694,894
Pulpstones	23,088	33,970	61,320	51,070	50,000
Total	667,431	721,446	881,527	777,606	744,894

In the following table are given the values of the grindstones and pulpstones produced in the United States from 1903 to 1906, by States:

Value of grindstones and pulpstones produced in the United States, 1903–1906, by States.

State.	1903.	1904.	1905.	1906.
Ohio	$646,776	$767,552	$644,315	$644,720
Michigan	70,550	112,500	111,500	78,500
West Virginia, Missouri, and Montana	4,120	[a] 1,475	[a] 21,791	[a] 21,674
Total	721,446	881,527	777,606	744,894

[a] Including a small production from Wyoming in 1904, 1905, and 1906.

The value of the production of grindstones and pulpstones in the United States from 1880 to 1906 is shown in the following table:

Value of grindstones produced in the United States, 1880–1906.

1880	$500,000	1894	$223,214
1881	500,000	1895	205,768
1882	700,000	1896	326,826
1883	600,000	1897	368,058
1884	570,000	1898	489,769
1885	500,000	1899	675,586
1886	250,000	1900	710,026
1887	224,400	1901	580,703
1888	281,800	1902	667,431
1889	439,587	1903	721,446
1890	450,000	1904	881,527
1891	476,113	1905	777,606
1892	272,244	1906	744,894
1893	338,787		

IMPORTS.

The imports consist principally of pulpstones and a few grindstones for use in glass and optical trades; they are obtained from Newcastle-upon-Tyne and from Wales and Scotland. The value of these imports amounted to $134,136, as compared with $113,752 in 1905. No distinction has been made between finished and unfinished products since 1883. The value of the imports of pulpstones and grindstones has shown a steady increase during the last five years and are given in the following table:

Value of grindstones imported and entered for consumption in the United States, 1902–1906.

1902	$76,906	1905	$113,752
1903	85,705	1906	134,136
1904	93,152		

CANADIAN PRODUCTION.

The value of production of grindstones in Canada during 1906 amounted to $61,624, as compared with $57,200 in 1905. The value per ton of the product was but slightly greater than that for 1905, though much better than in 1904. In the following table are given the quantity in short tons, value, and average value per short ton of the Canadian production of grindstones during the last four years:

Production of grindstones in Canada, 1903–1906, in 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
1906	5,545	61,624	11.11

INFUSORIAL EARTH AND TRIPOLI.

The uses for infusorial earth are varied.[a] Large quantities are used as an absorbent for nitroglycerine along with wood pulp in the manufacture of dynamite. The paint industry also utilizes a large quantity of infusorial earth as a wood filler, and it is also used in packing for boilers, in fire and heat retarding cements, and in certain kinds of vulcanized rubber. As an abrasive it is used in polishing metals, especially by jewelers, and is sold under the name electro-silicon.

PRODUCTION.

The production of infusorial earth in 1906 amounted to 8,099 short tons, valued at $72,108, a decrease in quantity of 2,878 tons and an increase in value of $7,471 over the output of 1905, which amounted to 10,977 short tons, valued at $64,637. The production came from 7 States named in order of their output: Missouri, California, Georgia, Maryland, New York, Kentucky, and Connecticut. Deposits of infusorial earth are known to exist in about 20 States, many of which have been producers at some time.

[a] Eng. and Min. Jour., October 20, 1906.

In the following table are given the quantity and value of infusorial earth produced in the United States since 1880:

Production of infusorial earth, 1880–1906.

1880.......short tons..	1,833	$45,660	1894 ......short tons..	2,584	$11,718
1881............do....	1,000	10,000	1895............do....	4,954	20,514
1882............do....	1,000	8,000	1896............do....	3,846	26,792
1883............do....	1,000	5,000	1897............do....	3,833	22,835
1884............do....	1,000	5,000	1898............do....	2,733	16,691
1885............do....	1,000	5,000	1899............do....	4,334	37,032
1886............do....	1,200	6,000	1900............do....	3,615	24,207
1887............do....	3,000	15,000	1901............do....	4,020	52,950
1888............do....	1,500	7,500	1902............do....	5,665	53,244
1889............do....	3,466	23,372	1903............do....	9,219	76,273
1890............do....	2,532	50,240	1904............do....	6,274	44,164
1891............do............		21,988	1905............do....	10,977	64,637
1892............do............		43,655	1906............do....	8,099	72,108
1893............do............		22,582			

IMPORTS.

There is an importation of infusorial earth or tripoli into the United States each year which is not separately recorded by the Department of Commerce and Labor, but is included with rottenstone used for similar purposes. The value of the imports of rottenstone and tripoli in 1906 amounted to $25,990, as compared with $18,986 in 1905, $23,022 in 1904, and $34,977 in 1903. No record is kept of the number of tons of this material imported.

OILSTONES AND SCYTHESTONES.

PRODUCTION.

The production of oilstones and scythestones in the United States during 1906 amounted to $268,070 in value, as compared with $244,546 in 1905. This is an increase of $23,524 over 1905, though it falls short of the large production of 1903 by $98,787. The production came from the same States as in 1905 and in the following order: Arkansas, Ohio, New Hampshire, Vermont, Indiana, and Michigan. With the exception of Ohio and Vermont, which have changed places, the order is the same as that for 1905. The production of Arkansas, Indiana, and two-thirds of that of Ohio is in oilstones and whetstones; while that of New Hampshire, Vermont, Michigan, and one-third of that of Ohio is in scythestones.

In the following table is given the value of the oilstones and scythestones produced in the United States from 1891 to 1906:

Value of oilstones and scythestones produced in the United States, 1891–1906.

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	1906..........................	268,070

IMPORTS AND EXPORTS.

The value of the imports of hones, oilstones, and whetstones in 1906 amounted to $83,863, as compared with $61,609 in 1905, a gain of $18,110. The imports amount to less than one-third of the home production and are largely offset by exports of the Arkansas oilstones and the New Hampshire scythestones. The value of these exports can not be given, however, since no separate record is kept for them. 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, oilstones, and whetstones, 1902–1906.

1902	$56,456	1905	$65,753
1903	65,763	1906	83,863
1904	61,609		

PUMICE.

The larger part of the pumice used in the United States is shipped from the island of Lipari. Although deposits of pumice are known to exist at a number of localities in the United States, only those most favorably located as regards mining and transportation facilities can be worked in competition with the imported material. Among the States that have produced pumice are Nebraska, South Dakota, and Idaho, in order of relative importance of production.

Pumice stone is found on the beach all along the east coast of New South Wales and Queensland.[a] It is thought it was probably washed to the Australian coast by the waves, after floating many miles across the ocean from eruptions in volcanic islands. Such pumice must be of good quality, as only the lightest would stand such a trip. It would be necessary to free this pumice of sand which it may have picked up along the beaches before it would be of value for painter's work.

The value of pumice as an abrasive is claimed to be improved by a German invention, under which artificial pumice[b] stone is made from a mixture of sand and clay. This stone is made in five different grades, varying in hardness, grain, and firmness. The different grades are adapted to various uses, as in the leather, felt, and woolen industries; in stucco and sculpture work; in the working and polishing of wood, metals, and stones, especially of lithographic stone.

PRODUCTION.

The production of pumice in the United States in 1906 amounted to 12,200 tons, valued at $16,750, as compared with 1,832 tons, valued at $5,540 in 1905. This is an increase of 10,368 tons in quantity and of $11,210 in value. This large increase in production came from Nebraska from the deposits near Orleans, Harlan County, and Ingham, Lincoln County, which are being extensively worked by the Cudahy Packing Company, of South Omaha. Since the increased production was used by the company producing the pumice, the value was reported as the cost of quarrying and shipping. This brings the average value per ton for the total output in 1906 to $1.37, as compared with $3.02 in 1905. If the whole of the output had been placed on the market, the value received would have been considerably higher. The Nebraska pumice is chiefly a volcanic ash or powdered pumice and is used in the manufacture of scouring and cleaning preparations.

[a] Paint, Oil and Drug Review, June 20, 1906.

[b] Pacific Miner, March 1906.

The production of pumice in the United States during the last five years is given in the following table:

Production of pumice in the United States, 1902–1906, in 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
1906	12,200	16,750	1.37

IMPORTS.

The imports of pumice are recorded by the Department of Commerce and Labor only by value. In 1906 this value amounted to $111,695, as compared with $77,489 in 1905, an increase of $34,206. The importation of pumice since 1903 is given in the following table:

Value of pumice imported into the United States, 1903–1906.

1903	$83,920
1904	77,211
1905	$77,489
1906	111,695

ARTIFICIAL ABRASIVES.

Under the head of artificial abrasives are included carborundum, crushed steel, and alundum or artificial corundum. These abrasives have won a place for themselves in the commercial world which is being strengthened yearly. The total production for 1906 amounted to 11,774,300 pounds, valued at $777,081, as compared with 9,820,000 pounds, valued at $701,400 in 1905, and with 11,870,380 pounds, valued at $830,926 in 1904.

CARBORUNDUM.

The use for carborundum is being extended each year. Besides its use and value as an abrasive, it is being used for many other purposes. For grinding and abrasive purposes it is manufactured into wheels of all shapes and sizes, adapted to nearly every use from dental points and disks to large cutting wheels. Large quantities are used in granite and marble cutting and polishing. Carborundum is used in buffing leather and in the manufacture of carborundum paper and cloth for shoemakers and for wood and metal workers. For other purposes than abrasives, carborundum is used for the ground work for ornamental signs, is inlaid into brake shoes, is used for linings to furnaces, for molds for metal castings, and for many other purposes.

PRODUCTION.

The production of carborundum in 1906 amounted to 6,225,300 pounds, as compared with 5,596,000 pounds in 1905, and with 7,060,380 pounds in 1904. The price ranges from 7 to 10 cents per pound. The use of carborundum for abrasive purposes has grown so extensively that the Carborundum Company of Niagara Falls found it necessary to establish a branch factory in Germany.[a] This plant

[a] The Tradesman, September 15, 1906.

was placed at Relsholz, a suburb of Düsseldorf, where it would have good opportunities for the distribution of its product.

According to Consul McFarland,[a] of Reichenberg, Austria, a sample carborundum wheel manufactured by the Luther Brothers Company, of North Milwaukee, Wis., when tried by a leading machinist of Bohemia, was strongly praised and created a demand for a supply in that region.

The following table shows the quantity of carborundum manufactured in the United States since 1892:

Production of carborundum, 1892–1906.

1892	pounds..	1,000	1900	pounds..	2,634,900
1893	do....	15,200	1901	do....	3,838,175
1894	do....	52,200	1902	do....	3,741,500
1895	do....	226,000	1903	do....	4,759,890
1896	do....	1,207,800	1904	do....	7,060,380
1897	do....	1,256,400	1905	do....	5,596,000
1898	do....	1,447,200	1906	do....	6,225,300
1899	do....	1,741,245			

CRUSHED STEEL.

PRODUCTION.

The production of crushed steel in 1906 amounted to 837,000 pounds, valued at $58,590, as compared with 612,000 pounds in 1905, valued at $56,840. In the following table is given the quantity of crushed steel produced each year since 1898:

Production of crushed steel in the United States, 1898–1906.

1898	pounds..	660,000	1903	pounds..	755,000
1899	do....	675,000	1904	do....	790,000
1900	do....	700,000	1905	do....	612,000
1901	do....	690,000	1906	do....	837,000
1902	do....	735,000			

ALUNDUM, OR ARTIFICIAL CORUNDUM.

Alundum, or artificial corundum, is manufactured by the Norton Emery Wheel Company, at Niagara Falls. Pure bauxite is first given a preliminary heating in a large electric furnace, to drive off the combined water. The anhydrous bauxite is then melted in an electric furnace of special design, until it has all run together in a homogeneous mass, forming an ingot of pure alundum. This mass is removed from the furnace and after crushing and rolling is sized off into grades.

It is claimed[b] that alundum is harder than the natural corundum and will readily scratch ruby or sapphire. It has all the properties of a good abrasive, combining purity, toughness, and sharp fracture, with hardness.

The production of alundum in 1906 amounted to 4,712,000 pounds, valued at $282,720, as compared with 3,612,000 pounds, valued at $252,840 in 1905.

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[a] Daily Cons. Rept., February 19, 1906.

[b] The Iron Age, November 8, 1906.

ARSENIC.

By Frank L. Hess.

INTRODUCTION.

The United States daily pours great quantities of arsenic fumes from its smelter stacks, thus wasting thousands of tons yearly. And yet with such an incessant waste this country imported in 1906 more than 8,000,000 pounds of arsenic and arsenic compounds, at a cost of approximately $375,000. During the same time there was produced in this country only a little more than one-sixth of the quantity imported, valued at but $63,460.

Arsenic ores, especially arsenopyrite or mispickel, are widely distributed, particularly in the granitic and highly metamorphosed rocks, and it is in countries whose rocks are of these classes that the principal deposits are found. Ores of tin, copper, and antimony are frequently accompanied by arsenical ores. The most common are arsenopyrite or mispickel, a sulpharsenide of iron (FeAsS), containing 46 per cent of arsenic; realgar, the red sulphide (AsS), containing 70.1 per cent of arsenic; orpiment, the yellow sulphide (As_2S_3), containing 61 per cent of arsenic, and enargite, a sulpharsenate of copper (Cu_3AsS_4), containing 19.1 per cent of arsenic. From this latter ore, with some tennantite ($4Cu_2S.As_2S_3$), considerable quantities of arsenic are obtained at the huge Washoe smelter, at Anaconda, Mont. Native arsenic, a tin-white brittle substance, occupying a position midway between the metals and the nonmetals, is found sparingly in veins in a considerable number of places, but is not of importance as an ore.

The principal countries producing arsenic ores are France, Germany, England, Turkey, Portugal, Spain, Canada, and the United States.

In England, as in the United States, a large part of the arsenic produced is obtained as a by-product in smelting other ores. English smelters are not allowed to pour arsenical fumes into the atmosphere, and compliance with the law gives added profit from the arsenic trioxide (As_2O_3), or white arsenic, saved. Much arsenopyrite occurs in Devonshire and Cornwall; in the latter place with tin ore.

France, Germany, Portugal, Spain, and Turkey have very large worked deposits of arsenic ores, and during recent years the first two have surpassed England in production. No statistics of mineral production are gathered by the Turkish Government, so that figures given are ordinarily only estimates, but the Turkish output of arsenic is known to be large.

In the United States the great bulk of arsenic produced is obtained from smelter fumes. There are, however, but two smelters which have plants for saving it—the Washoe smelter, already mentioned, and the smelter of the American Smelters Securities Company at Everett, Wash. The latter plant uses flue dust, both from its own and from other smelters of the company, and also some arsenic ore from Montecristo, Wash. A smaller plant, belonging to the Mineral Creek Mining and Smelting Company, is located at Mineral, Lewis County, Wash., and makes arsenic trioxide from realgar. All three plants produce arsenic only in the form of white arsenic (As_2O_3).

The arsenic plant of the Washoe smelter has been described by L. S. Austin in the Transactions of the American Institute of Mining Engineers.[a]

The only other known production was a few hundred tons of arsenical pyrite mined at Pine Pond, town of Kent, Putnam County, N. Y. The pyrite was shipped abroad. Arsenical pyrite also occur in Orange and Essex counties, N. Y., but was not mined during the year. It is occasionally accompanied by scorodite, a hydrous arsenate of iron.[b]

A plant for the manufacture of arsenic trioxide from arsenopyrite was erected several years ago at Rewald, Floyd County, Va. It made but a small production, and was idle during 1906.

PRODUCTION AND IMPORTS.

The production and imports of the United States for the last six years have been as follows:

Production and imports of arsenic, 1901–1906, in short tons.

Year.	Production.		Imports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value
1901	300	$18,000	3,495	$316,525	3,795	$334,525
1902	1,353	81,180	4,055	280,055	4,408	361,235
1903	611	36,691	4,179	294,602	4,790	331,293
1904	36	2,185	3,400	243,380	3,436	245,565
1905	754	35,210	3,838	256,540	4,592	291,750
1906	737	63,460	3,987	350,045	4,724	413,505

Imports include metallic arsenic, white arsenic (arsenic trioxide), and arsenic sulphides (orpiment and realgar). Paris green and London purple have been imported for consumption during the last three years as follows: 28,498 pounds, valued at $985, in 1904; 44,931 pounds, valued at 1,118, in 1905, and 311,293 pounds, valued at $21,347, in 1906. Under the customs regulations there is no record of importations of Scheele's green, lead arsenate, lead arsenite (pink arsenoid), barium arsenite (white arsenoid), green arsenoid, aniline arseniate, or other arsenic salts than those given in the statement above.

[a] Austin, L. S., Trans. Am. Inst. Min. Eng., vol. 37, 1906, pp. 480–482.

[b] Newland, D. H. The mining and quarry industry of New York State: Rept. of operations and production during 1906, N. Y. State Museum, Bull. 112, Albany, 1907, p. 10–12.

FOREIGN PRODUCTION OF ARSENIC.

In 1905[a] Austria produced 3 tons of arsenic ore, valued at $160; France,[b] 3,998 tons of ore, valued at $21,357; Germany, 5,416 tons of ore, valued at $98,532; Great Britain, 718 tons ore (pyrites), valued at $7,540, and 1,711 tons, presumably white arsenic, valued at $36,469; Japan, 9 tons white arsenic, valued at $492; Ontario,[c] 549 tons ore, valued at $2,693; Portugal, 1,721 tons white arsenic, valued at $58,220, and 24 tons of arsenical pyrites, valued at $151; Spain, 4,790 tons of arsenical pyrites, valued at $16,131. Turkey is estimated to have an output of about 2,200 tons of arsenic ore per year. For 1906 but few figures are available, but it is known that Germany[d] produced 3,364 tons, Ontario[e] 1,440 tons, and Sweden[f] 56 tons of white arsenic. The values are unknown.

PRICES.

More than half of the white arsenic (arsenic trioxide) produced in this country was sold in 1906 at an average of 4.3 cents per pound, and with the exception of a smaller lot of 7 tons, which sold at 5 cents per pound, the remainder of the production is estimated at the same price, 4.3 cents. In New York prices on large lots ranged from 4.5 cents to 12 cents per pound, averaging a little under 6.5 cents for white arsenic, while realgar, the red sulphide, was from 0.5 cent to 0.75 cent lower. Paris green sold at 20 to 21 cents per pound in 5-ton lots in New York.

TECHNOLOGY.

Arsenic trioxide (As_2O_3) or "white arsenic" or "arsenious acid" is what is ordinarily meant by the general term of "arsenic." It is used as an insecticide in the preservation of hides and of stuffed skins of animals and birds, in sheep and cattle dips and arsenic soap, and as a wood preservative, where it also prevents fungoid growth. It is used to prevent the growth of weeds and grass, in the making of some enamels, and many tons are used in the manufacture of glass. It is used as a fixer, or conveyer, of aniline colors in calico printing, and also enters into the manufacture of the dyes themselves. The use of arsenic as a poison for undesirable animals is familiar.

The greatest demand for arsenic is for making Paris green, used as a pigment, and as an insecticide on plants. Its toxic effect limits the former use. If pure, it is comparatively harmless to plant life, owing to its insolubility, but the trioxide is often present in some quantity, and if Paris green is then used largely it is fatal to plants, especially in dry climates, where it is not soon washed off by rains. Paris green is a copper aceto-arsenide and should contain:

	Per cent.
Arsenic trioxide (As_2O_3)	58.65
Copper oxide (CuO)	31.29
(C_2H_3O)	10.06

[a] Statistics of production in foreign countries during 1905, unless otherwise credited, are from the British Mines and Quarries, General Rept. and Statistics, pt. 4, for 1905, London, 1907.
[b] Statistique de L'Industrie Minérale et de l'Appareils à Vapeur en France and Algérie pour L'Année 1905, Paris, 1906, p. 41.
[c] Report of the Bureau of Mines (Ontario), 1906, vol. 15, pt. 1, p. 23.
[d] Judd, Edward K., Min. Ind. during 1906, 1907, p. 51.
[e] Arsenical contents of 5,335 tons of arsenical nickel-silver cobalt ore shipped from the cobalt district during 1906; letter from Mines Branch, Dept. of Mines, Canadian Geological Survey.
[f] Sveriges Officiella Statistik, Bergshandteringen, 1906, Stockholm, 1907, p. 17.

It is made by boiling verdigris, a mixture of basic acetates of copper, with arsenic trioxide. Scheele's green, a copper-hydrogen-arsenite, containing—

	Per cent.
Arsenic trioxide (As_2O_3)	52.32
Copper oxide (CuO)	42.37
Water (H_2O)	4.81

is also used as an insecticide.

London purple, also much used as an insecticide—

is a by-product in the manufacture of aniline dyes, and is thought to be composed mainly of calcium arsenite with some coloring impurity, mostly rosaniline arsenite. Besides London purple, there are two other preparations, Paris and English purple, which have practically the same composition. London purple analyzed by the New Jersey experiment station gave this analysis:

Analysis of London purple.

	Per cent.
Water (H_2O)	3.27
Arsenic trioxide (As_2O_3)	41.44
Lime (CaO)	24.32
Alumina (Al_2O_3) Iron oxide (Fe_2O_3)	3.37
Sulphuric anhydride (SO_3)	.31
Dye, by difference	27.97

It is made by boiling a waste product consisting of dye and arsenious oxide with lime to make the insoluble calcium arsenite.[a]

Arsenic also enters into red, yellow, and gray colors. In medicine arsenic is used as a tonic, and it performs a similar office in various stock foods and medicines. Realgar burns with a fine white light, and is much used in pyrotechnics, either as the natural sulphide or as the artificial product made by fusing together arsenic and sulphur.

In metallurgy arsenic has but little use. It makes lead hard, and arsenical work lead from the silver-lead smelters is sometimes used for shot. The presence of arsenic, unless in minute quantity, in brass or bronze, makes them brittle, though small quantities of less than 0.5 per cent give cleaner castings and a greater ductility to Muntz metal.[b]

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[a] Haywood, J. K. The adulteration and analysis of the arsenical insecticides, Jour. Amer. Chem. Soc., vol. 22, 1900, pp. 571–572.
[b] Sperry, E. S., Mech. Eng., vol. 17, 1906, pp. 763–764.

BORAX.

By Charles G. Yale.

INTRODUCTION.

In the borax industry of the United States there have been no noticeable changes in prices since 1905 and no marked difference in supply or market demand. The industry is one that is little influenced by competition. The leaders of the industry say that the working of the pure-food law has to some extent lessened the demand for borax and boric acid for use as preservatives. In other lines, however, consumption has increased. This applies mainly to preparations for domestic uses, such as soap, bath powders, etc.

PRODUCTION.

The entire output of borax in the United States continues to be derived from San Bernardino, Inyo, and Ventura counties, in California, most of it from the first-named county. The total output of crude borax for the year 1906 was 58,173 short tons, valued at $1,182,410, as against 46,334 short tons in 1905, valued at $1,019,154. The figures for 1906 show an increase over 1905 of 11,839 short tons in quantity and of $163,256 in value. Until 1903 the annual statistics were based on quantity and value of refined product, but since then the crude material has been taken as the basis. The prepared borax is essentially a manufactured product. The quantity of crude material mined (borate of lime or colemanite), with varying richness of boric acid, is readily ascertained, so the plan has been adopted of calculating the value of the crude material in accordance with the percentage of boric acid contained. This matter was explained more in detail in the chapter on this subject in the report for 1905.

The statistics of production of borax in California from 1895 to 1906, inclusive, are given in the following table, the values for the years 1903 to 1906, inclusive, being based on the boric-acid content of the number of crude tons of borate of lime or colemanite mentioned:

Production of borax in California, 1895–1906.

1895	short tons	5,959	$595,900	1901	short tons	23,231	$1,012,118
1896	do	6,754	675,400	1902	do	[a]20,004	2,538,614
1897	do	8,000	1,108,000	1903	do	[b]34,430	661,400
1898	do	8,000	1,120,000	1904	do	[b]45,647	698,810
1899	do	20,357	1,139,882	1905	do	[b]46,334	1,019,154
1900	do	25,837	1,013,251	1906	do	[b]58,173	1,182,410

[a] Refined product, including 2,600 short tons of crude, valued at $91,000. [b] Crude product.

IMPORTS.

The following table shows the imports of borax and borates into the United States from 1902 to 1906, inclusive:

Imports of borax and borates into the United States, 1902–1906, in pounds.

Year.	Borax.		Borates, calcium, and sodium (crude) and refined sodium borate.		Boric acid	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	791,425	27,343	57,711	2,436	986,021	33,200

REVIEW OF THE BORAX INDUSTRY IN 1906.

CALIFORNIA.

As previously stated, the counties of San Bernardino, Inyo, and Ventura, in California, continue to produce the borax output of the United States. During the year under review no new properties other than those mentioned in the report of 1905 have been opened or made productive.

Inyo County.—In this county the Western Borax Company is working "marsh mud," which is concentrated by boiling, and the solution is then crystallized. The Lila C. mine, owned by the Pacific Coast Borax Company, is in this county and being worked in 1907, so that it is expected that in the future the largest output of borax in the State will come from this county, as hereinafter explained.

It is appropriate in connection with an account of the borax industry in 1906 to mention certain important events occurring in 1907 which have had a decided influence on the borax industry generally and on the source, by counties, particularly. Hitherto most of the borax has come from San Bernardino County, but in future Inyo County will be the leader in output. The Lila C. mine, owned by the Pacific Coast Borax Company, to which their productive operations have been transferred since the abandonment of the old mine at Daggett, has been known for a great many years as a rich, undeveloped deposit. It is one of the many deposits acquired by the company in the Death Valley region which have been commercially unavailable through their remoteness from railroads. The recent mining developments in southwestern Nevada, combined with the needs of the borax and other mining industries in Death Valley, have warranted Mr. F. M. Smith, of the Pacific Coast Borax Company, and others in building the Tonopah and Tidewater Railroad from Ludlow, on the line of the Santa Fe Railway in the desert in San Bernardino County, northward past the Lila C. mine, 120 miles from Ludlow, and thence on to Bullfrog and Tonapah, Nev. The Lila C. colemanite mines lie 12 miles west of this road, and when the road was completed from Ludlow to this point early in the summer of 1907 shipments of ore commenced, the product being hauled by wagon from the mine to the railroad. A spur track is now under construction. With these shipping facilities provided the entire force of 200 men were transferred from the old mine at Daggett and production at that point was abandoned. The mines of the American Borax Company and Western Mineral Company near Daggett, however, still continue production.

The deposit at the Lila C. mine is a colemanite vein known to be about 2,000 feet long and from 6 to 18 feet wide, with a very steep dip. It carries a high-grade ore, that now (1907) being shipped carrying a boric acid content of about 40 per cent. The development work accomplished during the past three years consists of about 3,000 feet of shafts, drifts, and tunnels, and has blocked out an ore supply sufficient to last for years. The company will take its entire suply of crude material from this mine, shipping it to its refinery at Bayonne, N. J., and its production, according to present demands, is expected to be at the rate of 30,000 short tons of high-grade ore annually. The company looks entirely to its Death Valley holdings for the future, and its undeveloped supply is stated to be wonderfully large.

Los Angeles County.—Another deposit of importance found since the close of 1906 is that acquired by Mr. Henry Blumenberg, of the American Borax Company, near Lang, in the Soledad canyon, Los Angeles County. It is a vein of colemanite about 10 feet thick near the surface, but sufficient development has not been made on the property to prove its exact extent. The deposit is near a railroad line.

Ventura County.—Near a place called Griffin the Frazier Borate Mining Company is mining colemanite, which is not processed at the mine, but is shipped for refining to the Stauffer Chemical Company, at San Francisco. The Columbus Borax Company is also mining a borate of lime in this county.

San Bernardino County.—In this county there are three productive companies operating and one yielding by far the largest proportion of the borax of the State. The Western Mineral Company, near Daggett, produces a small output by making their material into solution and evaporating to dryness in solar vats, producing boric acid only. The American Borax Company, at the same place, works a low-grade "ore" and produces boric-acid concentrates, which are shipped to New Brighton, Pa., for refining. The process they use was described in detail in the report for 1904. The Palm Borate Company made no production in 1906, but has lately built a plant to treat the ore blocked out above their tunnel level. The most important mine in the county is the "Calico" deposit of colemanite owned by the Pacific Coast Borax Company, which has been described in previous reports. Some of this material, when of sufficiently high grade, is shipped directly East, while the lower grades are concentrated at Marion, near the mines. Since the close of the year under review work at the old mine has been abandoned entirely. This mine has for many years been the most productive one in this country and has yielded an immense quantity of ore since the discovery in the eighties. The workings in these colemanite veins extend to depths of about 600 feet. As depth has been attained the veins have narrowed, the boric-acid content has lessened, and the cost of mining has increased; hence the decision to abandon the mine.

The refiners of borax in the United States are: Borax Consolidated (Limited), Bayonne, N. J.; Pfizer & Co., Brooklyn, N. Y.; Brighton Chemical Company, New Brighton, Pa.; Thos. Thirkelson & Co., Chicago, Ill.; Stauffer Chemical Company, San Francisco, Cal.

As already stated, it has been considered proper to give the figures of production in terms of the crude material for the sake of uniformity. The cost of crude varies very materially with the different producers, owing to local conditions, longer or shorter hauls to railroads, etc. Some of it is also semirefined or concentrated up to even higher values before shipment, being subsequently fully refined at points distant from those of production. Some producers bring their product up to a higher percentage than others before shipping. Some high-class crude ore is shipped directly to the refineries and some as a roasted or semirefined product.

The various uses to which borax is put were given in detail in the chapter in the last report, so it is not necessary to repeat them in this chapter.

FLUORSPAR AND CRYOLITE.

By Ernest F. Burchard.

FLUORSPAR.

CHARACTER AND OCCURRENCE.

Fluorspar or fluorite, chemically calcium fluoride (CaF_2), consists of calcium and fluorine in the proportions of 51.1 to 48.9. The mineral is crystalline, only slightly harder than calcite, and consequently crushes easily. In color the spar ranges, according to purity, from a clear, slightly bluish glasslike substance through various brilliant shades, although much of it is white and opaque. The mineral is usually very pure, the greater part of the material marketed running 98 to 99 per cent, while material carrying less than 95 per cent of calcium fluoride finds little sale, except at a reduced price.

Fluorspar, associated with other minerals, has a broad distribution geographically and a wide range geologically. The deposits thus far exploited are, however, confined to five States—Arizona, Colorado, Illinois, Kentucky, and Tennessee.

The Arizona production has come mainly from the Castle Dome district, Yuma County. In 1902, 1903, and 1904 small quantities of fluorspar were shipped from this locality, but during the last two years there has been no production reported beyond that required for assessment work. In Colorado the fluorspar occurs in Boulder and Custer counties, along the Front Range. The chief deposits in Illinois and Kentucky occur in adjoining portions of the two States, Hardin and Pope counties in Illinois, being separated from the Kentucky counties, Crittenden, Livingston, and Caldwell, only by Ohio River. The great size and the purity of the fluorspar deposits of the Illinois-Kentucky district indicate that for many years they will continue the main source of domestic production. Prospecting with favorable results has been reported from Mercer County, in central Kentucky. The Tennessee production has been from Smith and Trousdale counties, near the central part of the State. A most recent addition to the list of possible producing States is California, since fluorspar deposits in San Bernardino County are now being investigated. Fluorspar is secured as a by-product of lead and zinc in Albemarle County, Va.; with gold tellurides at the Cripple Creek mines, Colorado, and at a number of other localities in quantities too small for use at present. Practically, wherever it has been mined, fluorspar occurs as a veinstone, although under widely different conditions. In the Kentucky-Illinois district it is the chief mineral or ore of value in many of the veins, lead and zinc being of secondary importance and in many places not valuable even as by-products, while in the Castle Dome district, jig concentrates of fluorspar are made incidental to concentrating the lead-silver ores.

PREPARATION AND USES.

The various uses of fluorspar depend on its chemical composition, fluxing properties, and phosphorescence when heated, and on its optical and gemlike properties. Its preparation involves separation from other minerals with which it is associated, the treatment comprising hand sorting, crushing, and jigging. Part of the high-grade ore is ground and shipped in barrels and sacks; the rest is sold in lump form. Where fluorspar is associated with zinc blende, complete separation of the two minerals has been difficult on account of their nearness in specific gravity. While fluorspar is useful in smelting iron ores it is harmful to zinc, and therefore the zinc-fluorspar concentrates have been of little value. Recently a new process for separating fluorspar and zinc has been reported as successful, which promises to increase the production of both minerals.

The three principal classes of consumers of fluorspar are, in order of importance, smelters and metallurgists, makers of opalescent glass and enameled wares, and chemical manufacturers. The highest grade, "American lump No. 1," which runs less than 1 per cent silica and is white or clear pale blue in color, is sold either ground or in lumps for use in the glass, enameling, and chemical industries, the latter including the manufacture of hydrofluoric acid. Grinding of the pure, clear spar can be dispensed with for some purposes, as it readily decrepitates to a powder when heated. The second grade, "American lump No. 2," is used by blast furnaces in the production of ferrosilicon and ferromanganese, and in basic open-hearth steel furnaces to give increased fluidity to the slag and to reduce the contents of phosphorus and sulphur. This grade includes colored spar and may run as high as 4 per cent silica, though mostly sold with a 3 per cent guaranty. The lowest grade, "gravel spar," including all that contains more than 4 per cent silica, as well as spar mixed with calcite, is used in iron and brass foundries, where it is of value in making the metal more fluid, in permitting the use of greater quantities of lower grades and scrap, and because it carries phosphorus, sulphur, and other impurities into the slag.

Fluorspar has been shown to possess a considerably higher quantitative efficiency as a flux than limestone, especially in smelting refractory ores, but in all metallurgical operations the proportions of the spar that can be used are limited, since its favorable effects do not increase indefinitely as the quantity is increased. In England and on the Continent the use of fluorspar is at present more common than in America, probably because its value has been better understood by European metallurgists. Other minor metallurgical uses are in extraction of aluminum from bauxite, in smelting gold ores, in refining copper, and in refining lead bullion. In the latter process the spar is first converted into hydrofluoric acid. Miscellaneous uses that have been reported are as a bonding for constituents of emery wheels, for carbon electrodes to increase their lighting efficiency while also decreasing the amount of current required, and as a constituent of Portland cement.

CONDITION OF THE MARKET.

Both in the early part of 1906 and at the close of the year the tendency of demand and prices was reported to be steadily upward, but the average values reported show a slight decrease below those of 1905.

Kentucky crude fluorspar ranged from \$3.60 to \$5, with an average value of \$4.22, per short ton. In the same State the ground material sold for slightly above \$10 per ton. In Illinois the crude spar brought from \$4 to \$5.32, averaging \$4.70, per short ton; and the refined ranged from \$9 to \$12, averaging \$10.83, per short ton. Colorado and Tennessee crude brought, respectively, \$6 and \$5 per short ton. These prices are for the spar packed in sacks and barrels free on board at the shipping points nearest to the mines.

PRODUCTION.

The total production of marketed fluorspar in 1906 is reported at 40,796 short tons, valued at \$244,025. Both these totals are less than those of 1905, which surpassed all previous records both in quantity and in average value per ton. This condition is doubtless due in large part to an overproduction in 1905, the surplus stock of which was sold throughout the following year, with the result that production was somewhat curtailed, although greater than in 1904. It is the custom of some producers to carry a reserve stock equal to about one year's production. There was, therefore, a large quantity on hand, unsold, at the close of 1906. The bulk of the production comes, as usual, from Illinois and Kentucky. The production reported from Illinois still retains the lead and maintains a steadier condition than that from Kentucky. In the latter State there is great need of better shipping facilities from certain localities in order to handle the present product and to develop the district properly. Arizona has reported no production since 1904, and the production reported from Colorado was far less than that of 1905, but Tennessee showed a substantial increase during 1906. Illinois in 1906 produced 28,268 short tons of fluorspar, valued at \$160,623. Of this total 4,529 tons were reported as ground spar, valued at \$47,224, the remainder being sold as lump and gravel. There were 800 tons reported as mined, but not sold. The production of ground spar showed a decided increase in this State during 1906. Kentucky produced in 1906 nearly 12,000 short tons of fluorspar, valued at about \$80,000. Of this total 4,321 tons were reported as ground spar, valued at \$43,318. About 1,200 tons of spar were reported mined in Kentucky, but not sold. In Tennessee the product was reported as all crude, 15 tons being unsold at the end of the year; in Colorado the product was likewise all lump and gravel.

The following table shows the quantity and value of fluorspar produced and sold in the United States in the years 1903 to 1906, inclusive, by States:

Quantity and value of fluorspar marketed in the United States, 1903–1906, in short tons, by States.

State.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Colorado					1,156	\$8,200	(b)	(b)
Illinois	11,413	\$57,620	17,205	\$122,172	33,275	220,206	28,268	\$160,623
Kentucky	30,835	153,960	19,096	111,499	22,694	132,362	[c] 12,528	[c] 83,402
Tennessee	[a] 275	[a] 2,037	[a] 151	[a] 1,084	260	1,720	(b)	(b)
Total	42,523	213,617	36,452	234,755	57,385	362,488	40,796	244,025

[a] Includes the production of Arizona.
[b] Included in Kentucky.
[c] Includes the production of Colorado and Tennessee.

The annual production of fluorspar in the United States since 1883 is given in the following table:

Production of fluorspar in the United States, 1883–1906.

1883......short tons..	4,000	$20,000	1895......short tons..	4,000	$24,000
1884............do....	4,000	20,000	1896............do....	6,500	52,000
1885............do....	5,000	22,500	1897............do....	5,062	37,159
1886............do....	5,000	22,000	1898............do....	7,675	63,050
1887............do....	5,000	20,000	1899............do....	15,900	96,650
1888............do....	6,000	30,000	1900............do....	18,450	94,500
1889............do....	9,500	45,835	1901............do....	19,586	113,803
1890............do....	8,250	55,328	1902............do....	48,018	271,832
1891............do....	10,044	78,330	1903............do....	42,523	213,617
1892............do....	12,250	89,000	1904............do....	36,452	234,755
1893............do....	12,400	84,000	1905............do....	57,385	362,488
1894............do....	7,500	47,500	1906............do....	40,796	244,025

IMPORTS.

There is considerable fluorspar imported at present, but the market is practically limited to the Atlantic coast, since the cost of freight from English seaports to points west of New York tends to restrict the field. English fluorspar has heretofore been cheap, at times selling at a price below the present cost of production, the shipments having been made from refuse dumps of abandoned lead mines, besides being brought to America as ballast, duty free. It is expected that the local and the American demand will consume these English fluorspar mill tailings within a few years, and that thenceforth the material can not be profitably exported to America, as the mines are closed.

The quantity of fluorspar imported into the United States in 1906 was not reported as such but was grouped with other imports by the Bureau of Statistics.

Good grades of imported fluorspar for chemical use have been recently sold at New York for $7.70 per ton, ex vessel.

CRYOLITE.

As in previous years, there was no production of cryolite reported from the United States. In January, 1907, Mr. J. H. Cameron, of St. Peters, Colo., reported striking a vein of cryolite at a depth of 110 feet in a shaft he was sinking to mine gold and silver-lead ores. On examination by Doctors Cross and Hillebrand, of the United States Geological Survey, the material proved to be a massive alteration product of cryolite, chemically a fluoride of aluminum, sodium, and magnesium.

Imports.—The suppiy of cryolite needed in the manufacture of sodium salts was obtained, as formerly, from Greenland. The quantity of cryolite imported in the year 1906 is reported by the Bureau of Statistics to have been 1,505 long tons, valued at $29,583. In 1905 there were imported 1,600 long tons, valued at $22,482, and in 1904, 959 tons, valued at $13,708. The largest quantity imported at any time since 1897 was in 1903, when 7,708 long tons were reported, valued at $102,879.

RECENT LITERATURE ON FLUORSPAR.

For details as to geologic relations, mining developments, and notes on the technology of the preparation and uses of fluorspar the reader is referred to the following recent literature:

Bain, H. F. Fluorspar deposits of the Kentucky-Illinois district: Mines and Minerals, November, 1904, pp. 182–183.

——— The fluorspar deposits of southern Illinois: Bull. U. S. Geol. Survey No. 255, 1905.

——— Principal American fluorspar deposits: Min. Mag., August, 1905, pp. 115–119.

Blake, W. P. Historical sketch of mining in Arizona: Report of the governor of Arizona to the Secretary of the Interior, 1899, pp. 106–107.

Emmons, S. F. Fluorspar deposits of southern Illinois: Trans. Am. Inst. Min. Eng., vol. 21, 1893, pp. 31–53.

Fohs, F. Julius. Fluorspar: Eng. and Min. Jour., January 6, 1906, pp. 45–46.

Miller, Arthur M. The lead and zinc bearing rocks of central Kentucky: Bull. No. 2, Kentucky Geol. Survey, 1905.

Phenis, Albert. Kentucky fluorspar, lead, and zinc: Mfrs. Record, November 22, 1906, p. 467.

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.

Watson, Thomas L. Lead and zinc deposits of Virginia: Bull. No. 1, Virginia Geol. Survey, 1905, p. 42.

Wheeler, G. D. Zinc in Crittenden County, Ky.: Eng. and Min. Jour., vol. 74, 1902, pp. 413–414.

GYPSUM AND GYPSUM PRODUCTS.

By Ernest F. Burchard.

CHARACTER OF GYPSUM.[a]

Pure gypsum is a hydrous lime sulphate having a chemical formula $CaSO_4.2H_2O$. This, when reduced to percentages of weight, corresponds to the following composition:

$$\text{Gypsum } (CaSO_4.\ 2H_2O) \ldots \left\{ \begin{array}{l} \text{Lime sulphate } (CaSO_4) \ldots \left\{ \begin{array}{ll} \text{Lime } (CaO) \ldots & 32.6 \\ \text{Sulphur trioxide} & \\ \quad (SO_3) \ldots & 46.5 \end{array} \right\} 79.1 \\ \text{Water } (H_2O) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 20.9 \end{array} \right.$$

Few deposits of rock gypsum large enough to be worked for plaster are, however, 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, and silica. Where the material occurs in an earthy, granular condition, it is known as gypsite, and this form of the mineral may carry 10 to 20 per cent of impurities.

Analyses.—The following analyses of rock gypsum and gypsite from various localities[b] are fairly representative of the materials used for plaster in different States. Silica, alumina, iron oxide, lime carbonate, and magnesium carbonate constitute the characteristic impurities.

Analyses of gypsum and gypsite.

	Silica (SiO_2).	Alumina (Al_2O_3) and iron oxide (Fe_2O_3).	Lime carbonate ($CaCO_3$).	Magnesium carbonate ($MgCO_3$).	Lime sulphate ($CaSO_4$).	Water (H_2O).
1	0.40	0.19	0.25	0.35	78.10	20.36
2	.05	.08		.11	78.51	20.96
3	.68	.16	Not det.	Not det.	78.08	20.14
4	.10	.70			79.26	19.40
5	.10	.10			78.55	20.94
6	.11		1.07		78.42	20.43
7	3.62	.45	4.09	.34	71.94	19.87
8	9.73	.78	4.32	Trace.	68.29	16.88

1. Gypsum from Blue Rapids, Kans.
2. Gypsum from Alabaster, Mich.
3. Gypsum from near Sandusky, Ohio.
4. Gypsum from Saltville, Va.
5. Gypsum from Hillsboro, New Brunswick.
6. Gypsum from Baddeck Bay, Nova Scotia.
7. Gypsite from Gypsum City, Kans.
8. Gypsite from Salina, Kans.

[a] The paper on Gypsum and Gypsum Products by E. C. Eckel in Mineral Resources for 1905 (pp. 1105–1115) gives a more detailed statement as to the character and occurrence of gypsum and a chemical and commercial classification of plasters.

[b] Eckel, E. C., Cements, limes, and plasters; Wiley & Sons, 1905, pp. 53–54.

RANGE AND DISTRIBUTION OF GYPSUM.

Gypsum occurs in sedimentary rocks of practically all ages, either in the crystalline form or as rock gypsum, and it is widely distributed over the world. It is found commonly in the vicinity of beds of rock salt. In the United States workable deposits are confined to beds of rock gypsum, which occur at comparatively few geological horizons. The gypsum beds east of Missouri River are, for the most part, in Paleozoic rocks, while those of the West are mostly of Mesozoic and Tertiary age. The white gypsum sands of Arizona and New Mexico are of fine-grained material that has been eroded from rock outcrops and worked by the winds into its present condition and position in Quaternary time.

As shown by the tables on page 9, gypsum is produced in 17 States and Territories, besides Alaska; and in connection with the mining of the material, mills for grinding and burning it are operated at nearly all the places of production. Newly observed deposits in Alaska and New Mexico have been described in Bulletins 314 and 315 of the United States Geological Survey.[a]

USES OF GYPSUM.

The bulk of the gypsum produced in the United States as well as in foreign countries is manufactured into the various plasters, such as plaster of Paris, stucco, cement plaster, flooring plaster, hard-finish plaster, etc. A steadily increasing quantity is being used as a retarder in Portland cement. Refined grades of plaster are used in dental work, also as cement for plate glass during grinding, and as an ingredient in various patent cements. Considerable quantities are ground without burning and are then used as land plaster, or low-grade fertilizer, while smaller quantities are used in the manufacture of paint and paper, imitation meerschaum and ivory, and as an adulterant. The pure white massive form, known as alabaster, is much used by sculptors for interior ornamentation. An interesting use to which gypsum is put, especially in England, is the Burtonization of beer. The reputed excellence of certain British beers, notably those of Burton and Newark, is attributed to the presence of calcium sulphate in the natural water used in their preparation. According to analyses reported by Metcalfe[b] the Burton water contains 24.499 grains of calcium to the imperial gallon (349 parts per million), combined mainly as calcium sulphate, and water from one of the deep brewery wells at Newark carries 28.555 grains of calcium per imperial gallon (407 parts per million), combined in the same manner. Other salts present in minor proportions are calcium carbonate, magnesium sulphate, and sodium chloride. It has been calculated that 350,000 pounds of gypsum are annually imbibed in potations of Burton beer, and since gypsum is soluble to a certain extent (1 part in 372 parts water at 26° C.), attempts have been made with varied success to add analogous artificial salts to water not derived from gypsum-bearing beds, and large quantities of gypsum are purchased by brewers in England for this purpose. This addition, though advantageous, does not produce

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[a] Wright, C. W., Nonmetallic mineral resources of southeastern Alaska: Bull. U. S. Geol. Survey No. 314, 1907, pp. 79-80; Shaler, M. K., Gypsum in northwestern New Mexico; Bull. U. S. Geol. Survey No. 315, 1907, pp. 260-266.

[b] Metcalfe, A. F., The gypsum deposits of Nottinghamshire and Derbyshire: Trans. Fed. Inst. Min. Eng., vol. 12, 1897, p. 112.

so perfect a combination of salts as that existing in the natural waters of Burton upon Trent.

CHEMISTRY AND PRACTICE OF GYPSUM BURNING.

In addition to the combined water shown in the outline of composition on p. 1069, the rock may contain as much as 25 per cent of absorbed moisture. If pure gypsum is heated to a temperature of more than 212° F. and less than 400° F., all the moisture and a certain definite portion of the combined water 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:

$CaSO_4.1/2H_2O$	Lime sulphate ($CaSO_4$)	93.8
	Water (H_2O)	6.2

Three-fourths of the original combined water 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.; it is found, however, most economical of fuel and time to carry on the process at the highest allowable temperature.

A general plan of calcining plaster—the size and weight of machinery depending upon the capacity desired—is as follows:[a]

The gypsum rock is crushed first in a jaw crusher; second, in a pot crusher; and then it goes to a rotary kiln drier. This drier is erected in brickwork like a boiler, and is equipped with an automatic feeder. If soft coal or wood is used as fuel, care must be taken that the products of combustion do not come in contact with the materials being dried, on account of the danger of discoloration. Fuel of any kind—oil, gas, coke, wood, or coal—is suitable. This drying process eliminates 10 per cent of moisture. Next, the crushed rock is sieved in a trommel, generally to 24 mesh. The material that does not pass the sieve is ground in buhr mills, and this product, with the screenings from the trommel, is ready for boiling. The boiling is done in a large kettle with wrought-steel sides and cast-iron or very heavy steel convex bottom. Flues pass through the kettle near the bottom and distribute the heat, which is applied below the kettle and passes around the lower part of the sides, through the flues, and then around the upper part of the sides and out at the stack. Inside the kettle is a shaft, which propels stirrers below the flues and mixing paddles above. The kettles are heavy and rest on brickwork. The ground gypsum is fed from bins into the kettle, and is constantly stirred and boiled until the remainder of the free moisture is expelled. The temperature of this preliminary boiling should not exceed 265° F., for at a higher temperature the water of crystallization, or combined water, begins to separate, and then the separation must be completed or the calcination will be a failure. To remove the necessary three-fourths of the combined water the material is then heated steadily to a temperature of 390° to 395° F. Care must be taken not to allow the temperature of this second boiling to exceed 400°, or all the combined water will be expelled and the plaster will lose its setting properties. When properly boiled the gypsum settles and may then be discharged through a gate on the side near the bottom of the kettle. After boiling, the plaster should be screened again through 40-mesh wire cloth, and the oversize should be reduced in a finishing buhr mill.

[a] Bartlett, C. O., Manufacture of plaster of Paris: Eng. and Min. Jour., vol. 82, No. 23, Dec. 8, 1906, pp. 1063–1064.

To manufacture 100 tons of plaster a day the following machinery is required:

1. A crusher; estimated cost, $1,000. 2. One direct-heat drier, 48 inches in diameter and 27 feet long, together with one dust room; estimated cost, $2,500. 3. One pot or bowl crusher for fine grinding the material after drying; estimated cost, $300. 4. Four French buhrstones for grinding; cost, about $300 each. 5. Two calcining kettles, $200 each. In addition to the above-mentioned machinery the necessary elevators, conveyers, shafting, belting, and bins are required. On account of the nature of the process and material, the bins, elevators, and conveyers should be made of steel, and the entire plant should be as nearly fireproof as practicable.

CONDITION OF THE TRADE.

An active demand for gypsum products has continued throughout the year 1906. Additional deposits of gypsite are reported to have been recently discovered in Riverside County, Cal., and many newly developed deposits are reported from the country at large. Alaska becomes a producer through the beginning of operations by the Pacific Coast Gypsum Company late in 1906. The completion of a railroad 1 mile long enables the gypsum to be loaded on barges and shipped to the mill at Tacoma, Wash. In California one new mill has been started and another finished successfully its first year of business. Others report a doubling of trade. Three new mills have been built in the Fort Dodge district, Iowa, and will be producers during 1907, while the old companies report increased trade. Reports from Kansas indicate that the demand for 1906 was slightly better than in previous years, as was the condition in Michigan, where one new plant finished its first year of business successfully. In Nevada trade appears to have largely increased. In New Mexico a new plant at Acme began producing burned plaster in October, 1906, and the plant at Ancho reports improvement in business. One new plant not in operation in 1906 was built at Fayetteville, N. Y., one plant at Mumford was run for the first time in 1906, and at Akron a new shaft 87 feet deep was sunk to a 6-foot bed of gypsum. Established concerns generally report improved conditions, some being unable to fill all orders. In Oklahoma the Romanose Company has just opened a plant; at Wautonga a plant has been operated one year; at Alva a new plant was opened in July; and several other plants report very satisfactory business. The trade in South Dakota, as well as in Texas, averaged better than in former years. In Virginia the properties of the Southern Gypsum Company at Broadford are being developed and production will begin during 1907. Increasing trade is noted at other plants. The market for Wyoming gypsum shows improvement, and a new plant has just been started at Sheridan.

At Mabon, Nova Scotia, a new mine has been opened, the output of which will be shipped by water to New York points.

PRODUCTION AND DISPOSITION.[a]

The gypsum mined in the United States in 1906 amounted to 1,540,585 short tons, valued at $1,147,129. This production repre-

[a] The collection and compilation of statistics in this report is the work of Miss J. B. Clagett, of this office.

sents an increase in quantity of more than 47 per cent, and in value of nearly 40 per cent, as compared with that of 1905. This largely increased production, which surpasses by far that of any previous year, is accounted for partly by the rapid increase in new producers, the total number of whom at the close of 1906 amounted to 74, as against 46 in 1905, a gain of 61 per cent. Since few of these, however, operated the whole year, they can not be credited with a proportionate share of the increase in production. As to relative rank among the States producing gypsum, Michigan still holds first place. New York regains second place, with Iowa a close third. The remaining States show few changes in relative position since 1905, their present rank being as follows: (4) Texas; (5) Ohio; (6) Oklahoma; (7) Kansas; (8) California; (9) Wyoming; (10) Virginia; (11) Nevada; (12) Oregon; (13) Utah; (14) New Mexico; (15) Colorado; (16) South Dakota; (17) Alaska; (18) Montana.

The following tables show the quantity of crude gypsum mined in the United States, the marketed output, by States and uses, and the disposition of this marketed product:

Crude gypsum mined in the United States, 1905–6, by States.

State.	1905.				1906.			
	Number of producers reporting.	Quantity (short tons).	Value.	Average price per ton.	Number of producers reporting.	Quantity (short tons).	Value.	Average price per ton.
California, Nevada and Oregon	4	29,155	$39,947	$1.37	11	69,571	$102,064	$1.47
Iowa	6	179,016	114,354	.64	8	286,857	199,222	.69
Kansas	4	47,276	32,946	.70	5	105,091	59,086	.56
Michigan	7	299,585	143,597	.48	7	341,716	195,892	57
Montana, New Mexico, South Dakota, and Utah	4	24,700	29,500	1.19	8	[a]30,830	27,417	.89
New York	10	153,367	151,272	.99	17	288,631	350,593	1.21
Ohio and Virginia	4	134,276	134,474	1.00	5	132,805	115,211	.87
Oklahoma and Texas	4	148,947	148,947	1.00	9	247,937	88,808	.36
Wyoming	3	26,880	26,930	1.00	4	37,147	8,836	.24
Total	46	1,043,202	821,967	.79	74	1,540,585	1,147,129	.74

[a] Includes also the production of Alaska and Colorado.

Crude gypsum mined in the United States, 1880–1906.

	Short tons.		Short tons.
1880	90,000	1894	239,312
1881	85,000	1895	265,503
1882	100,000	1896	224,254
1883	90,000	1897	288,982
1884	90,000	1898	291,638
1885	90,405	1899	486,235
1886	95,250	1900	594,462
1887	95,000	1901	633,791
1888	110,000	1902	816,478
1889	267,769	1903	1,041,704
1890	182,995	1904	940,917
1891	208,126	1905	1,043,202
1992	256,259	1906	1,540,585
1893	253,615		

Production (short tons) of gypsum in the United States in 1905 and 1906, by States and uses.

1905.

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
Montana, New Mexico, South Dakota, and Utah	500	1,000	1,300	4,700	18,365	93,575	99,275
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
Wyoming					21,505	71,560	71,560
Total	67,105	106,041	40,196	74,280	736,708	2,848,906	3,029,227

1906.

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	3,811	$7,622	2,893	$10,360	42,847	$217,988	$235,970
Iowa	9,862	15,414	3,751	6,922	146,526	551,162	573,498
Kansas	18,048	19,858	2,046	3,052	64,351	224,662	247,572
Michigan	27,517	39,679	30,220	71,340	208,715	642,859	753,878
Montana, New Mexico, South Dakota, and Utah	[a] 30,906	121,729	(b)	(b)	[a] 25,658	129,344	251,073
New York	72,658	161,344	7,858	14,938	161,218	573,614	749,896
Ohio and Virginia			[c] 15,903	50,680	70,916	250,290	300,970
Oklahoma and Texas	24,197	94,899			179,350	630,219	725,118
Wyoming	(d)	(d)			(d)	(d)	(d)
Total	186,999	460,545	62,671	157,292	899,581	3,220,138	3,837,975

[a] Includes also the production of Alaska, Colorado, and Wyoming.
[b] Included in Ohio and Virginia.
[c] Includes also the production of Utah and a small quantity of unground material from Ohio.
[d] Included in Montana, New Mexico, South Dakota, and Utah.

Production of gypsum in the United States, 1902–1906, classified as to uses.

Year.	Sold crude.			Sold crude, ground, as land plaster.		
	Quantity in short tons.	Value.	Average price per ton.	Quantity in short tons.	Value.	Average price per ton.
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
1906	186,999	460,545	2.46	62,671	157,292	2.50

Year.	Sold as calcined plaster.			Total value.
	Quantity in short tons.	Value.	Average price per ton.	
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
1906	899,581	3,220,138	3.58	3,837,975

Disposition of gypsum in the United States in 1906, by uses.

	Quantity.	Value.
	Short tons.	
Sold crude:		
For Portland cement	168,326	$400,669
For plaster material	13,863	39,458
As land plaster	62,281	156,652
For other purposes	[a] 5,200	21,058
Sold calcined:		
As plaster of Paris, wall plaster, etc	880,538	3,142,098
For Portland cement, and other purposes	[b] 19,043	78,040
Total	1,149,251	3,837,975

[a] Including paint material. [b] Including dental plaster.

IMPORTS.

The gypsum which is imported into the United States comes, except a few hundred tons annually from France and the United Kingdom, almost wholly from Nova Scotia and New Brunswick, 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 table, based upon reports of the Bureau of Statistics of the Department of Commerce and Labor, shows the imports for the calendar years from 1902 to 1906, inclusive:

Gypsum (short tons) imported and entered for consumption in the United States, 1902–1906.

Year.	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.	Total value.
	Quantity.	Value.	Quantity.	Value.		
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	22,948	446,152
1906	3,587	22,821	436,999	464,725	21,183	508,729

FOREIGN GYPSUM DEPOSITS.

CANADA.

As stated in greater detail in Mineral Resources for 1905, gypsum occurs in New Brunswick, near Hillsboro, Albert County, and in Ontario, where it is exploited principally along the valley of Grand River from Paris in Grant County to near Cayuga in Haldimand County. Extensive but undeveloped gypsum beds occur also along Moose and French rivers, near James Bay; and in Nova Scotia thick beds of gypsum occur near St. John Harbor, Port Bevis, and Baddeck Bay. A large deposit of gypsum occurs on Manitoba Lake. Formerly it was utilized by a plaster mill near by; but since the destruction of this mill by fire last July, a mill has been built at Winnipeg, to which the raw material is now shipped from Manitoba Lake.

Of the Canadian gypsum deposits, those of New Brunswick and Nova Scotia are of most 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 seaboard cities, but a considerable quantity of it is calcined as far inland as Syracuse, N. Y.

ENGLAND.

In England gypsum is found abundantly in the marls overlying the salt deposits in the counties of Chester, Worcester, Durham, and Stafford. In Nottingham and Derby counties they lie also in marls, but not associated with salt, as well as in Cumberland, Westmoreland, and Sussex counties. The marls of the northern and middle counties belong, for the most part, to the New Red Marl, or upper Keuper division of the Triassic. In Sussex the gypsum occurs in the Purbeck beds.

The workable deposits in England lie near a northwest-southeast line drawn from Carlisle, in Cumberland County, near the Scottish border, to Battle, in Sussex County, on the English Channel. The presence of bodies of anhydrite of considerable proportions constitutes a troublesome feature in many places, as no use has as yet been devised for this material.

In the Nottingham-Derby district, from which is produced more than half the tonnage of English gypsum, the workable mineral generally runs from 6 to 12 feet thick, mostly in a single bed. The material is of such excellent quality that the value of the product from this district exceeds two-thirds the total value of the gypsum produced in England. Much of it is a tough, massive, white alabaster, suitable for ornaments and church decorations; and thousands of tons are raised annually for the manufacture of plaster of Paris and as ingredients in Keene's and other hardened cements.

The deposits of Eden River Valley support a considerable industry in the manufacture of plaster of Paris and allied cements. Here the deposits occur in two beds, totaling 20 to 30 feet of workable material.

In the Dove Valley the gypsum is mined rather than quarried, and the seam attains a thickness in places of 20 feet. An irregular pillar-and-stall method is here employed in mining the ordinary gypsum. The rock is soft and easily bored by hand-auger drills and blasted by powder. Where the rock is of the alabaster quality, it is of the utmost importance that this material shall not be shattered; therefore all heavy blasting near it is stopped. The method then involves undercutting the roof above the alabaster and blowing it down with lightly charged shots until the rock is cleared for 4½ to 5 feet back, and 2½ to 3 feet above the block. Workmen then enter the space above the block, cut a gutter about 10 inches wide along the back of the block for the desired length, and other gutters at each end, so that the block, generally 4½ feet wide and from 4 to 20 feet long, is entirely separated except at the bottom. To cut the block horizontally, a line of auger holes is bored through the block, which is then broken by wedges. The smaller blocks are then sawed and prepared for the artisan.

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 1901 is set forth:

World's production of gypsum (short tons), 1901–1905.

Year.	France.		United States.		Canada.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	2,182,229	$3,449,747	633,791	$1,506,641	293,799	$340,148
1902	1,975,513	3,318,070	816,478	2,089,341	332,045	359,277
1903	1,798,508	3,134,891	1,041,704	3,792,943	314,489	388,459
1904	1,749,875	2,916,483	940,917	2,784,325	340,761	372,924
1905	1,414,596	2,343,943	1,043,202	3,029,227	435,789	581,543

Year.	Great Britain.		German Empire.		Algeria.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	224,919	$344,650	[a] 35,013	[a] $23,139	38,955	$132,286	7,784	$17,041
1902	251,629	384,263	34,944	12,732	[b] 6,889	52,253	7,874	17,443
1903	246,282	337,391	34,054	19,145	31,967	105,040	11,591	28,796
1904	262,086	354,138	25,095	17,307	33,951	93,287	12,449	31,721
1905	286,169	605,002	....	....	38,297	98,420	....	....

[a] Includes Baden. [b] Includes Tunis.

RECENT LITERATURE.

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PHOSPHATE ROCK AND PHOSPHORUS.

PHOSPHATE ROCK.

By Myron L. Fuller.

OCCURRENCE.

A bed of blue phosphate rock,[a] which bids fair to be of commercial importance, has been recently discovered in western Putnam County, Tenn., on the eastern flanks of the Nashville dome, or on the side opposite the older phosphate fields. The bed appears to be from 18 to 38 inches in thickness. It lies immediately above and rests upon the Devonian shale and is overlain by the siliceous St. Louis limestone, the contact with which is generally marked by a thin layer of flint or a layer of soft shale containing phosphate nodules. The phosphate rock averages from 65 to 75 per cent of tricalcic phosphate and carries only 1½ per cent of iron and alumina.

The Arkansas phosphates[b] are found along Lafferty Creek in western Independence County, and, although worked only at a single point, they extend for some distance in an east-west direction, reaching from Hickory Valley, 10 miles northeast of Batesville, westward to St. Joe, in Searcy County, or beyond. In its purer form it is a bluish-gray conglomeratic bed from 4½ to 6 feet in thickness and composed of pebbles the size of a pea or smaller. The impure deposits, which have an aggregate thickness of about 4 feet, are brown and sandy. The phosphate occurs near the base of the Cason shale near the top of the Ordovician series and between the overlying St. Clair limestone (Silurian) and the underlying Polk Bayou limestone (Ordovician). It is apparently of sedimentary origin, and is formed largely of tests of crustacea or possibly of bones or droppings of marine animals.

Recent prospecting has brought to light a number of phosphate deposits in Utah, Wyoming, and Idaho, several of which have been described in a recent Survey report.[c] The phosphatic series, which in places is nearly 90 feet thick, consists of alternating layers of shale, black or brown phosphate rock, and hard, compact blue or gray limestone, the main phosphate bed being 5 or 6 feet thick. Mining on a considerable scale has been begun in the vicinity of Montpelier, Idaho, the ore being shipped to Martinez, Cal., where it is used in the manufacture of fertilizers.

USES.

Phosphate rock is used altogether in the manufacture of artificial fertilizers and chemicals containing phosphoric acid.

[a] For a discussion of the term "phosphate rock" and of the well-known deposits of Florida, South Carolina, and Tennessee, the reader is referred to Mineral Resources of the United States for 1905, p. 1117-1118.
[b] Purdue, A. H., Bull. U. S. Geol. Survey No. 315, 1907, pp. 463-473.
[c] Weeks, F. B., and Ferrier, W. F., Bull. U. S. Geol. Survey No. 315, 1907, pp. 449-462.

PRODUCTION.

The following table gives the production of phosphate rock in the United States in 1905 and 1906, inclusive, based on the marketed product, classified by kinds or grades:

Production of phosphate rock in the United States, 1905–6, based on the quantity marketed.

State.	1905.		Average value per ton.	1906.		Average value per ton.
	Quantity (long tons).	Value.		Quantity (long tons).	Value.	
Florida:						
Hard rock	577,672	$2,993,732	$5.18	587,598	$3,440,276	$5.85
Land pebble	528,587	1,045,113	1.98	675,444	2,029,202	3.00
River pebble	87,847	213,000	2.42	41,463	116,100	2.80
Total	1,194,106	4,251,845	3.56	1,304,505	5,585,578	4.28
South Carolina:						
Land rock	234,676	774,447	3.30	190,180	711,447	3.74
River rock	35,549	103,722	2.92	33,495	105,621	3.15
Total	270,225	878,169	3.25	223,675	817,068	3.65
Tennessee:						
Brown rock	438,139	1,509,748	3.45	510,705	2,027,917	3.97
Blue rock	44,031	121,486	2.76	35,669	114,997	3.22
White rock	689	2,155	3.13	1,303	5,077	3.90
Total	482,859	1,633,389	3.38	547,677	2,147,991	3.92
Other States [a]	....	....	....	5,100	28,800	5.65
Grand total	1,947,190	6,763,403	3.47	2,080,957	8,579,437	4.12

[a] Includes Arkansas and Idaho.

This table shows that the marketed output in 1906 was 2,080,957 long tons, valued at $8,579,437, as against 1,947,190 long tons, valued at $6,763,403, in 1905. A comparison of the figures of late years indicates that although the output has usually increased each year, the demand has made even more rapid strides, and that the tendency of the price per ton has been upward. The new western fields will probably help to supply the increasing demand, but as their market is somewhat local they will not materially affect the general trade conditions throughout the country, and the demand will be likely to continue in excess of the supply unless the new Tennessee field proves to be more extensive than is anticipated. The outlook for the younger field is therefore bright, and will become even more promising as the older fields become exhausted. It is not improbable that the increasing demand and higher prices will make it possible to operate many low-grade deposits which it has hitherto been impracticable to utilize.

In the older fields the tendency toward concentration of operation into a few hands continues to be marked, and has resulted in the more systematic and economic development of the properties. The history in this particular of the hard-rock industry in Florida is indicated by the statement that there were 70 hard-rock plants reported to the Survey in 1902, 60 in 1903, 19 in 1904, 14 in 1905, and 16 in 1906. Of the plants reported in 1906, 10 were in operation, 3 were idle, and 3 were under construction.

The total quantity of phosphate rock mined in 1906 was 2,001,394 long tons, as against 2,138,309 tons mined in 1905 and 1,991,169 tons in 1904.

Since 1880 the quantity and the value of the phosphate rock produced (marketed) in the United States have been as follows:

Marketed production (long tons) of phosphate rock in the United States, 1880–1906.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	211,377	$1,123,823	1894	996,949	$3,479,547
1881	266,734	1,980,259	1895	1,038,551	3,006,094
1882	332,077	1,992,462	1896	930,779	2,803,372
1883	378,380	2,270,280	1897	1,039,345	2,673,202
1884	431,779	2,374,784	1898	1,308,885	3,453,460
1885	437,856	2,846,064	1899	1,515,702	5,084,076
1886	430,549	1,872,936	1900	1,491,216	5,359,248
1887	480,558	1,836,818	1901	1,483,723	5,316,403
1888	448,567	2,018,552	1902	1,490,314	4,693,444
1889	550,245	2,937,776	1903	1,581,576	5,319,294
1890	510,499	3,213,795	1904	1,874,428	6,580,875
1891	587,988	3,651,150	1905	1,947,190	6,763,403
1892	681,571	3,296,227	1906	2,080,957	8,579,437
1893	941,368	4,136,070			

PRODUCTION BY STATES.

FLORIDA.

Florida continues to be the largest producer of phosphate rock in the United States. The output of the State for 1906 was 1,304,505 long tons, valued at $5,585,578, against 1,194,106 long tons, valued at $4,251,845, in 1905, and the percentage of the total production increased from 61.3 per cent in 1905 to 62.4 per cent in 1906, notwithstanding that the year was a wet one and much trouble was experienced in the mines owing to the high ground-water level. The increase was confined to the hard rock and the land pebble, which increased in price, respectively, from $5.18 and $1.98 per long ton in 1905 to $5.85 and $3 per long ton in 1906. There was a falling off of more than 50 per cent in the production of river pebble, although it increased in price per ton from $2.42 in 1905 to $2.80 in 1906. The average price per ton of Florida phosphate rock in 1906 was $4.28, as against $3.56 in 1905.

The reports made to the United States Geological Survey indicate that 72,236 long tons of stock carried over from previous years were marketed in 1906. Hence the quantity mined in 1906 was 1,232,269 long tons.

The relative proportions of the different kinds marketed were approximately hard rock 45 per cent, land pebble 51.8 per cent, river pebble 3.2 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 of variety of phosphate rock produced in Florida from 1902 to 1906, based upon the reports of marketed material:

Phosphate rock marketed in Florida, 1902–1906, classified by grades, in long tons.

Year.	Hard rock.		Land pebble.		River pebble.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	587,598	3,440,276	675,444	2,029,202	41,463	116,100	1,304,505	5,585,578

The total quantity of phosphate rock produced (marketed) in Florida since 1888, when the first was exploited, is 11,038,366 long tons, valued at $41,465,650.

As reported by Messrs. Auchincloss Brothers, the shipments of Florida hard-rock phosphate from 1901 to 1906, inclusive, have been as follows:

Shipments of Florida hard-rock phosphate, 1901–1906, in long tons.

1901	424,130	1904	494,044
1902	492,610	1905	595,491
1903	467,872	1906	565,953

The bulk of these shipments has gone, in order of importance, to Germany, Holland, England, Belgium, Norway and Sweden, and Austria. A large part of the shipments to Rotterdam are forwarded to the interior of Germany.

As reported by the same authority, the shipments of Florida land-pebble phosphate in the last four years have been 308,776 long tons in 1903, 352,294 tons in 1904, 385,915 tons in 1905, and 482,232 tons in 1906. These shipments have been almost evenly divided between domestic and European ports.

No foreign shipments of Florida river pebble phosphate were reported in either 1905 or 1906.

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 slight increases over the years immediately preceding. During 1906 the output was 223,675 long tons, valued at $817,068, against 270,225 long tons, valued at $878,169, in 1905, a decrease from 1905 of 44,496 long tons of land rock and of 2,054 long tons of river rock. This decrease, however, was partly counterbalanced by a rise in the average price of the land rock from $3.30 to $3.74 per ton, and of the river rock from $2.92 to $3.15 per ton. The total average price per ton in 1906 was $3.65 against $3.25 in 1905.

The returns indicate that the output of rock mined exceeded the sales by 7,762 long tons, the latter figure representing the net increase of stock carried over at the end of the year.

The relative proportions of the two classes of rock are, land rock 85 per cent and river rock 15 per cent.

The quantity and value of the different kinds of phosphate rock produced and marketed in the State since 1902 are shown in the following table:

Phosphate rock marketed in South Carolina, 1902–1906, classified by grades, in long tons.

Year.	Land rock.		River rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	190,180	711,447	33,495	105,621	223,675	817,068

There has been produced and marketed in South Carolina since the industry first began in 1867 a total of 11,655,747 long tons of phosphate rock, valued at $25,730,401.

TENNESSEE.

The year 1906 showed a larger total production than any other year since the discovery of the deposits, the quantity put on the market, 547,677 long tons, exceeding even that of the previous banner year, 1904. The value likewise increased, the average price per long ton of brown rock increasing over 1905 from $3.45 to $3.97; of blue rock from $2.76 to $3.22; of white rock from $3.13 to $3.90; and the total average price from $3.38 to $3.92. The total value increased from $1,633,389 to $2,147,991. With the development which may be expected in the newly discovered field, still further increase may be looked for.

The returns indicate that 18,789 long tons of stock carried over from previous years were marketed in 1906, hence the total quantity mined in that year was 528,888 tons.

The relative proportions of the different kinds marketed were, approximately, brown rock, 93.2 per cent; blue rock, 6.5 per cent; and white rock, 0.3 per cent.

The output and value of the phosphate rock produced in Tennessee since 1901 are shown in the following table:

Production of phosphate rock in Tennessee, 1901–1906, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1901	409,653	$1,192,090	1904	530,571	$1,745,054
1902	390,799	1,206,647	1905	482,859	1,633,389
1903	460,530	1,543,567	1906	547,677	2,147,991

According to the reports of Messrs. Auchincloss Brothers the shipments of Tennessee phosphate rock by water from Pensacola, Norfolk, and Newport News during the last four years have been 111,915 long tons in 1903, 122,964 long tons in 1904, 99,925 long tons in 1905, and 98,846 long tons in 1906. Nine-tenths of these shipments have gone to foreign ports.

OTHER STATES.

Among the other States which have produced phosphate rock within the last five years may be mentioned North Carolina, Pennsylvania, Arkansas, and Idaho. The production in all of them, except Idaho, has been very small. The last reported production from North Carolina was in 1903, when 45 long tons were reported, and of Pennsylvania in 1904, when 100 tons were sold. Arkansas is still producing steadily, although in small quantities. Idaho began actively producing in October, 1906, and bids fair to become a producer of importance in the next year or two.

IMPORTS.

The following table shows the imports of fertilizers of all kinds into the United States for the years 1903–1906, inclusive:

Fertilizers imported and entered for consumption in the United States, 1903–1906, in long tons.

Year.	Guano.		Kieserite and kainite.		Apatite, bone dust, crude phosphates, and other substances used only for manure.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
1903	21,985	$252,132	158,313	$773,758	246,042	$2,231,575	$3,257,465
1904	37,127	498,702	218,957	1,050,082	243,130	2,455,618	4,004,402
1905	27,104	379,667	351,053	1,850,622	197,115	2,450,835	4,681,124
1906	23,222	322,766	334,843	1,790,969	211,274	2,598,451	4,712,186

WORLD'S PRODUCTION.

In the following table will be found a statement of the world's production of phosphate rock from 1903 to 1905, inclusive:

World's production of phosphate rock, 1903–1905, by countries, in metric tons.

Country.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	320,843	$1,238,454	343,317	$1,325,104	334,784	$1,225,126
Aruba (Dutch West Indies)	15,749	(a)	23,128	(a)	23,307	(a)
Belgium	184,120	332,250	202,480	252,263	193,305	332,292
Canada	1,251	8,214	832	4,590	1,179	8,425
Christmas Island (Straits Settlements)	71,218	(a)	72,905	(a)	99,519	(a)
France	475,783	2,115,647	423,521	1,909,859	476,720	2,093,118
French Guiana	7,893	60,023	(b)	....	(b)	....
Norway	1,795	24,120	1,456	19,564	2,522	33,768
Redonda (British West Indies)	1,102	7,207	1,729	10,498	....	....
Russia	14,635	47,580	(b)	....	(b)	....
Spain	1,124	5,968	3,305	19,136	1,370	7,295
Sweden	3,219	8,627	2,929	6,279	(b)	....
Tunis	352,088	1,260,137	455,197	1,582,165	521,731	1,812,493
United Kingdom	71	423	59	423	....	....
United States	1,606,881	5,319,294	1,904,418	6,580,875	1,978,345	6,763,403

a Value not reported. b Statistics not yet available.

PHOSPHORUS.

By George W. Stose.

INTRODUCTION.

The production of phosphorus has not been heretofore reported as a mineral industry because it was formerly an organic industry—that is, phosphorus was produced from bones and other organic substances. It is only recently that it has been extracted from mineral deposits. The mineral from which phosphorus was first obtained was phosphorite or rock phosphate, an impure fluophosphate of calcium, from which soluble phosphate fertilizer is generally made. Apatite, a fluophosphate or chlorophosphate of calcium, has been used in Europe and Canada to a small extent, but wavellite (aluminum phosphate) has not been heretofore used commercially, so far as known, in the manufacture of phosphorus, as the mineral does not generally occur in minable quantity. A deposit of wavellite at Mount Holly Springs, Pa., has recently been mined for this purpose and has been successfully reduced in the company's plant by a secret process.

MANUFACTURE OF PHOSPHORUS.

Old method.—The method of making phosphorus that has been in use since the beginning of the nineteenth century is as follows: Bones are roasted and crushed, and the powdered bone ash (calcium phosphate) is treated with sufficient sulphuric acid to convert all or part of the calcium into calcium sulphate and the phosphorus into calcium metaphosphate, or even into phosphoric acid. This is partially evaporated, mixed with powdered charcoal, and reduced in a furnace in a clay retort. Phosphorus vapor and carbon monoxide distill off, and the phosphorus is condensed under water in a yellow waxy form. Theoretically the reaction would be:

$$2Ca_3(PO_4)_2+6H_2SO_4+12C=6CaSO_4+12CO+2H_2+P_4+4H_2O.$$

It is found in practice, however, that the following is more nearly what takes place:

$$3Ca_3(PO_4)_2+6H_2SO_4+10C=6CaSO_4+Ca_3(PO_4)_2+10CO+6H_2O+P_4.$$

In this process much loss is occasioned by the destruction of the retorts by the acid and the intense heat, and only about one-half of the phosphorus in the charge is recovered. There is also danger of igniting the phosphorus when removing it, and great delicacy is required to prevent the vapor from condensing in the tubes and clogging them. Many improvements and modifications of this process have been patented in recent years. Wöhler early suggested that calcium phosphate, either burnt bones or rock phosphate, be heated with sand and carbon without the sulphuric-acid treatment, and the Wing patent, 1891, followed the same general method.

Wing process.—In the Wing process the charge of bone ash, or pulverized rock phosphate, and silica is moistened and made into balls and is placed in layers in the cupola with coke or coal between, which furnish incandescent carbon to reduce the phosphoric-acid fumes. The silica releases the phosphoric acid from the phosphate in the form of the anhydride P_2O_5, which is reduced by the incandescent carbon and a reducing flame to phosphorus. The fumes pass off to depositing chambers kept at a temperature of 500° F., where most of the phosphorus is deposited in the red form and the remainder is caught in a water chamber as yellow phosphorus. The process is made continuous by feeding the charge from the top, dumping the residuum from the grate below, and using two depositing chambers alternately

With only the ordinary furnace at command this method was found impracticable on account of the high degree of heat required to smelt so refractory a charge. Electricity as a powerful heating agent had been known for some time and was looked to as the solution of the problem, but the invention of the electric furnace has only recently made it commercially feasible. It has now been generally introduced throughout Europe and America in the production of phosphorus on a profitable basis.

Readman patent.—This is the process which, since its introduction in 1889, has come into commercial use in most countries. Bone ash or crude phosphoric acid is mixed with powdered coal or charcoal, or, if mineral calcium phosphate is used, it is roasted, crushed, and mixed with charcoal and silica or some basic salt. The mixture is reduced in a continuously operated electric furnace in a reducing atmosphere, by passing the current from carbon electrodes through the mass, which acts as a resistant conductor and is heated to incandescence. The silica combines with the calcium to form calcium silicate slag. The phosphorus and carbon monoxide distill off as before. Distillation begins at 1,150° C. and requires 1,400° to 1,500° C. to complete the process. The chemical reaction is $2Ca_3(PO_4)_2+6SiO_2+10C=6CaSiO_3+10CO+P_4$.

Harding process.—In Harding's patent, 1898, pulverized rock phosphate is boiled with sulphuric acid, and the phosphoric acid, free from lime, is filtered out and boiled down to a sirup. This is mixed with granulated carbon, heated in a reverberatory furnace, and then smelted in an electric furnace by electric arcs between the electrodes and the mass. A hydrogen atmosphere is obtained by spraying gasoline into the furnace.

Gibbs furnace.—In this furnace, which was devised especially for phosphorus manufacture, the electricity instead of discharging through the mass passes through a continuous high resistant medium, such as a carbon rod, placed above the charge. The rod becomes incandescent, and the roof, which is arched over the grate, reflects the heat as in a reverberatory furnace.

Irvine furnace.—The Readman process was modified by the Irvine patent in 1901. The charge is the same as in the earlier method, although either aluminum or calcium phosphate can be used with the silica or basic salt flux. The two carbon electrodes are suspended vertically from above and are connected below at the start by coal, through which the current passes. After the charge melts the slag forms on top, and thereafter the current passes through it as the conductor between the electrodes. Fusion is continuous, and the excess of slag is tapped off gradually so as not to expose the ends of the electrodes.

Duncan patent.—A process patented in 1903 by Duncan takes 77 parts of powdered phosphate, either organic or mineral, and 23 parts of powdered carbon, mixed with tar as a binder. This is dried, and after a preliminary heating as a matter of economy in a hydrogen flame, a by-product in the manufacture, it is placed in an electric furnace and calcium phosphide continuously produced. This is put into a chamber submerged in hydrogen; after adding water it forms phosphorus hydrides. Upon heating the hydrides are reduced to phosphorus in pure state, either red or yellow, depending upon the degree of heat at which it is allowed to deposit.

Parker patent.—In 1902 Parker patented a process in England for the reduction of aluminum phosphate. It is treated with sulphuric acid and then with an alum-forming sulphate, all the alumina being removed by the crystallization of the alum previous to the electric treatment. The residual liquor is mixed with coal and other carbonaceous material and reduced in an electric furnace.

Landis method.—The American Phosphorus Company of Philadelphia have a plant at Yorkhaven, Pa., where they extract phosphorus from wavellite by a method invented by Mr. G. C. Landis, chemist of the company. The process, which is kept a secret, is, so far as could be learned, similar to the Readman method, except for the ore and the furnace. Wavellite, aluminum phosphate, and calcium phosphate obtained from South Carolina, are roasted, mixed with silica and charcoal, and reduced in the patent electric furnace. In January, 1907, a patent was secured on certain improvements in the furnace designed to prevent the escape of fumes, vapors, and gases, or their absorption by the furnace lining. This is accomplished by an outer lining of nonabsorbent brick and by a sealing device for all openings into the furnace whereby the projecting flanges of the joints are inclosed in a moat of water. The furnace has an inner lining of carbon bricks which acts as one electrode, and one or more vertical carbon electrodes are used which may be adjusted either to furnish a continuous current through the charge or to produce with it an electric arc. The slag is drawn off every three or four hours and the phosphorus fumes condensed under water. Probably some additional treatment is required to remove the alumina in the batch similar to the Parker patent, and this is what is kept secret.

METHODS OF REFINING.

The phosphorus obtained by most commercial processes is a crude form of the white or yellowish waxy variety, and contains sand, carbon, clay, and other impurities. These are removed in various ways—by filtering while molten through powdered charcoal or canvas submerged in water, by forcing the molten mass through porous pottery by means of steam, and by redistillation in iron retorts. The best method of purification, however, is to treat the crude phosphorus, when molten, with a mixture of potassium dichromate and sulphuric acid, or sodium hypobromite, some of the impurities being dissolved, others rising to the surface as scum.

VARIETIES OF PHOSPHORUS.

Because ordinary white phosphorus is very poisonous and injurious to handle, other forms of the element have been sought. Red amorphous phosphorus, which is not poisonous, is readily prepared by heating the ordinary variety to 250° C. in a closed vessel under pressure or excluded from air aud water. It has not the same qualities, however, as the white crystalline variety. A red crystalline form, recently discovered in Germany, is made by heating to boiling a 10 per cent solution of white phosphorus in phosphorus tribromide. This is not poisonous and is an efficient substitute for white phosphorus in making matches.

WAVELLITE MINE AT MOORES MILL, PENNSYLVANIA.

Since aluminum phosphate has not been heretofore used in the manufacture of phosphorus because it has not been found in minable quantities, as was stated in the introduction, the American Phosphorus Company's mine at Moores Mill, Pennsylvania, is somewhat unique and will therefore be described in some detail.

Discovery.—The wavellite occurs in white clay associated with manganese and iron ores at the foot of the northern slope of South Mountain, in the vicinity of Mount Holly Springs, Pa., 25 miles southwest of Harrisburg. For many years iron mining was a prosperous industry along the foot of the mountain in this region, but in competition with the great deposits of the West and South it has ceased to be profitable and the mines have long been idle. The iron is a secondary product, having been leached from iron-bearing beds in the vicinity and deposited in the residual sand, gravels, and clays near the contact of the limestones of the valley and the mountain sandstones. Associated with the iron, usually underlying it or on the side toward the mountain, is a body of clay, in places highly colored and plastic, elsewhere pure white or cream colored, siliceous, and less plastic. The extensive use of pure white clay as a filler for wall paper and for other commercial purposes has created an increasing demand for the clay of this region, and it is extensively mined in the vicinity of Mount Holly Springs and prospected for everywhere along the mountain front.

It was in one of these prospect pits, on the property of Mr. T. J. Spangler, in the vicinity of Moores Mill, 4 miles west of Mount Holly

Springs, that peculiar round white nodules, usually in aggregates and botryoidal masses, were found in the white clay. The less weathered of these when broken open showed a beautiful, radiate, silky, fibrous structure. The mineral proved to be a pure form of wavellite, aluminum phosphate.

Development.—The American Phosphorus Company was organized by Philadelphia capital to develop the deposit, and a mill for the extraction of the phosphorus from the ore was built near the mine. Mr. T. J. Spangler, superintendent of the mine and owner of the land, is paid a royalty on the ore extracted. The mine was opened in 1900, the first years being devoted to prospecting and experimenting with the reduction of the ore. During 1905 the mine was in active operation, and 400 tons of ore were reported to have been extracted and reduced in the company's furnaces.

The mine is operated by open cut. The phosphate is scattered through the white clay and appears to lie between a manganese deposit in reddish clay and the mountain. The open cut, after reaching a depth of about 30 feet, was stopped because of the water. A shaft near by was said to have passed through clay with phosphate ore from a depth of 12 feet to 52 feet, at which point 16 feet of manganese ore was encountered. When examined in August, 1906, both the shaft and the open cut were filled with water and the workmen were stripping for an enlargement of the pit. A tunnel is to be dug from a ravine below to drain it so that mining can be continued to greater depth. The deposit is apparently limited in width to 40 or 50 feet, with a depth ranging from a few feet on the valley side to 50 feet on the mountain side, as indicated by the shaft, and is of undetermined length along the mountain.

Other deposits of wavellite.—The only other deposit of phosphorus ore found in this vicinity is on the other side of Mount Holly in the small valley east of Upper Mill, 1 mile above Mount Holly Springs. In the clay prospects of Mr. J. L. Musser, small, bean-shaped fragments and nodules of the phosphate are associated with manganese ore, but their quantity and extent have not been determined. Wavellite was also observed by Mr. T. C. Hopkins[a] in the white clay deposits of North Valley Hill, on the north side of Chester Valley.

Origin.—The wavellite and the manganese and iron ores are secondary deposits in the surface gravels, sands, and clays which cover the rock outcrops at the foot of the mountain. These surface deposits are in part residual, in part transported. White sands are followed by beds of pure white siliceous clays, and these by colored plastic clays. The sand is derived from sandstones which have been leached of their calcareous cement, and in the quarries the loose sand merges into the unaltered rock. The white clay is a decomposed hydromica slate, transition into which has been described in the reports of the Second Geological Survey of Pennsylvania, and by Hopkins,[b] and similar relations were observed in the clay mines by the writer,[c] but the exposures are not so clear and definite as they were when the iron mines were in active operation. The colored plastic clay is apparently derived from impure limestone. Generally these beds are steeply inclined, or vertical, like the undecomposed rocks, but in places they have moved down the slope, and lie flat, and have become covered over by and mixed with the quartzite débris from the mountain above.

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[a] Ann. Report Pennsylvania State College, 1889–1900, Appendix III, p. 13.
[b] Loc. cit., pp. 11–13.
[c] Bull. U. S. Geol. Survey No. 315, 1907, pp. 325–326.

It is in this heterogeneous mass that the mineral deposits occur. Throughout the South Mountain district the iron ore that is associated with the basal part of the limestone is at the horizon of the hydromica slate at the contact with the sandstone, and is usually found in the highly colored clay, the limestone residuum, overlying the white clay derived from the hydromica slate. The ore often dips steeply into the hill parallel to the bedding and appears to be interbedded with the rocks.

It seems reasonable to conclude, therefore, that the original deposition of iron was in some way a feature of the change of sedimentation from shore detritus to calcareous silt, probably not occurring originally as a massive bed of iron ore, but as ferruginous sediments. The solution of the limestone and the decomposition of the other rocks has left the iron and clay residuum, and the iron has been further concentrated in the clay by solution and redeposition.

The wavellite undoubtedly had a similar history, for it is a common constituent of the iron and manganese ores. Analyses show its presence to a greater or less extent in all the iron ores of the region, amounting in many cases to one-half of 1 per cent, and occasionally reaching $1\frac{1}{2}$ per cent. At Mount Holly Springs the wavellite occurs chiefly in nodular form, with radiate structure, inclosed in the white clay, but it is also found coating pieces of quartzite and manganese ore. The phosphorus was probably associated with the iron in its original occurrence and in the process of redeposition combined with the alumina, but it is possible that it may have been in part derived from the phosphatic animal remains in the sediments. It is known that trilobites and other fossils with phosphatic skeletons once existed in these beds in considerable abundance. They are still found in the limestones, and their casts are occasionally observed in the sandstones, but the phosphatic material has all been removed from the porous beds by solution, and may have been deposited in the white clay adjacent to the iron and manganese.

USES OF PHOSPHORUS.

Phosphorus is used chiefly for making matches. The first matches on a commercial scale were made in 1833. Parlor matches were invented in 1848, and safety matches in 1855. The white variety of phosphorus is used for ordinary matches, whereas the red amorphous form is used in the manufacture of safety matches.

On account of the injury to health in making and handling the ordinary phosphorus, and the danger from fire in using parlor matches, certain European countries have forbidden the manufacture and sale of the white variety, so that amorphous phosphorus and safety matches are coming into general use. The newly-discovered, crystalline, red phosphorus is not only not poisonous but is suitable for ordinary matches.

Phosphorus is sold in the market in round sticks molded through glass tubes, and is usually stored under water. Its uses other than for matches are: For fuse compositions, rat and insect poison, phosphoric acid, and other compounds used in medicine and the arts. It it is also used in the precipitation of precious metals, electrotyping, and in phosphor-bronze.

PRODUCTION.

The industry in this country is so young that statistics are difficult to obtain; in fact, general information on the subject is lacking. The world's production of phosphorus has been variously estimated to be from 1,000 to 3,000 tons a year, and until very recently this was almost entirely a foreign industry. The greater part of the world's supply is made in the Albright & Wilson factory, Wednesfield (Oldbury), England, where the Readman process originated. The output is said to be 500 tons a year. Other large factories are located at Lyon, France; and at Griesheim and Frankfort, Germany. There is also a plant in Sweden, and numerous smaller ones in Russia, six of which, located near Perm, had an output of about 140 tons in 1890.

In the United States the first phosphorus works were built about forty years ago in Philadelphia by Mr. Moro Phillips, and this factory has continued in operation until very recently. The J. J. Allen's Son's plant was established in Philadelphia in 1891, and it supplied the Diamond Match Company, the largest match factory in the United States, in competition with imported phosphorus. In 1897 the English firm of Albright & Wilson, under the firm name of the Oldbury Electro-Chemical Company, built a 300-horsepower factory of the Readman type at Niagara Falls, which thereafter supplied the Diamond Match Company and the greater part of the domestic product. This firm has recently made a further improvement in its plant by introducing the Irvine patent furnace, by which method 80 to 90 per cent of the phosphorus is reported to be extracted from the raw material, a high-grade phosphate rock. This is similar to the results obtained in the English works, where 86 per cent is recovered. They have 6 furnaces of 50-horsepower each with a capacity of 170 pounds of phosphorus a day, a total of 1,000 pounds a day. Their production varies according to the demand, but they furnish at present over 50 per cent of the domestic product.

The General Chemical Company, a small domestic manufacturer and the successor of Mr. Phillips in Philadelphia, recently acquired the Duncan patent. Another company was established at Long Island, where it operated furnaces by electricity from city supply.

The American Phosphorus Company built its first plant in 1902 at Moores Mill, near Mount Holly Springs, Pa., where its wavellite mine is located. The old method of heating by gas was employed. This mill burned down, and another was built and put in operation by 1905. Electric furnaces were installed in the new plant and operated during 1905; but the production of electricity by steam was too expensive, and in 1906 the mill was moved to Yorkhaven, Pa., where electricity generated by water power could be had. This company reports a production of about 500 pounds a day and a capacity of about 1,200 pounds.

At the census of 1900, three establishments were reported in operation, but at the 1904–5 census only the Oldbury Electro-Chemical Company of Niagara Falls reported.

In addition to the domestic production, the United States imports annually from 30,000 to 40,000 pounds of phosphorus, on which a duty of 18 cents a pound is paid. The price in the New York market ranges, according to quality, from 45 to 70 cents a pound.

SALT AND BROMINE.

By A. T. Coons.

SALT.

PRODUCTION.

In 1906 the quantity of salt produced in the United States was 28,172,380 barrels of 280 pounds, valued at $6,658,350; in 1905 the production reported was 25,966,122 barrels, valued at $6,095,922, showing an increased output for 1906 of 2,206,258 barrels in quantity and $562,428 in value.

These quantities expressed on a tonnage basis represent an output of 3,635,257 short tons in 1905 and of 3,944,133 short tons in 1906, an increase in 1906 of 308,876 short tons.

In 1905 the average net value was 23.476 cents per barrel, or $1.68 per short ton; in 1906 the average net value was 23.634 cents per barrel, or $1.69 per short ton, an increase for 1906 of 0.158 cent per barrel, or $0.01 per ton.

This increase in value is small when the fact is considered that many of the producers report increased cost of production on account of high price of labor and increased cost of supplies. However, the small average price for 1906, as for 1905, is accounted for by the increase in the quantity of brine used in chemical works without concentration into salt, the average value of the dry salt obtained from this brine being, according to the principal producers, about 5 cents a barrel. In 1905 there was the equivalent of 7,869,931 barrels of dry salt contained in the brine reported as produced, and 9,573,680 barrels in 1906, an increase of 1,703,749 barrels. In 1905 the increase of this product over the quantity reported for 1904 (4,006,950 barrels) was 3,862,981 barrels, indicating a great expansion of this branch of the chemical industry during 1905, an expansion not so obvious in 1906. Deducting the quantity and value of the brine from the total output for 1906 it will be seen that the quantity of dry salt reported for 1906 was 18,598,700 barrels, or 2,603,818 short tons, valued at $6,179,666, an average value of 33.226 cents per barrel and of $2.37 per ton. The corresponding figures for 1905 were 18,096,191 barrels, or 2,533,467 short tons, valued at $5,702,425, an average value of 31.512 cents per barrel, or $2.25 per short ton. These figures show an increase for 1906 in the reported production of dry salt of 502,509 barrels, or 70,351 short tons in quantity; of $477,241 in value; and of 1.714 cents per barrel, or 12 cents per short ton, in average price.

For convenience, salt is classified according to the grades by which it is sold by the producer, the different grades depending upon the amount of refining, the methods employed in refining, and the purpose for which the salt is used. These grades are "table and dairy," "common fine," "common coarse," "packers," "solar," "rock," "milling," "brine," and "other grades."

The "table and dairy" salt includes all extra fine and fancy grades prepared for family use, and all grades artificially dried, used for butter and cheese making, and such special brands.

The "common fine" salt includes all other grades of fine salt of first quality, not artificially dried, such as those known to the trade as "C. F.," "No. 1 F.," "anthracite," etc.

The "common coarse" salt includes all grades coarser than "common fine" made by artificial heat, such as "steam coarse," "No. 1 coarse," " pan solar," "G. A.," "Liverpool ground," "C. C.," etc.

The "packers" salt includes all grades prepared for the purpose of curing fish, meats, etc.

The "coarse solar" salt includes all coarse salt made by solar evaporation.

The "rock" salt includes all rock salt mined and shipped without special preparation.

The "milling" salt is that used in gold and silver mills.

The "other grades" should include all low-grade or No. 2 salt used for salting cattle and horses, and for fertilizers, track purposes, etc.

"Brine" includes all salt liquor used in the manufacture of soda ash, sodium bicarbonate, sodium hydrate (caustic soda), and other sodium salts or brine sold without being evaporated to dryness.

The following table shows the quantity and value of salt reported as produced in the United States from 1893 to 1906:

Production and value of salt in the United States, 1893–1906.

1893..barrels..	11,897,208	$4,154,668	1900..barrels..	20,869,342	$6,944,603
1894....do....	12,968,417	4,739,285	1901....do....	20,566,661	6,617,449
1895....do....	13,669,649	4,423,084	1902....do....	23,849,231	5,668,636
1896....do....	13,850,726	4,040,839	1903....do....	18,968,089	5,286,988
1897....do....	15,973,202	4,920,020	1904....do....	22,030,002	6,021,222
1898....do....	17,612,634	6,212,554	1905....do....	25,966,122	6,095,922
1899....do....	19,708,614	6,867,467	1906....do....	28,172,380	6,658,350

From this table it will be seen that the output reported for 1906 shows a greater value than has been reported since 1900, the year of maximum value. The quantity reported in 1906, however, is much greater than for any previous year on record. This increased production not followed by a corresponding increase in value is due in large measure to overproduction and close competition for trade rendering the business in very many cases not especially lucrative. The tendency to combination in the salt trade, as well as in other industries, which has marked the last ten years of this country's history, has been keenly felt by the very small producers and has extended over the chief producing States of New York, Ohio, Michigan, Kansas, Utah, and California.

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, 1902–1906, in barrels.

Year.	Table and dairy.	Common fine.	Common coarse.	Packers.	Solar.
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	2,724,769	327,192	903,143
1906	2,923,044	6,483,937	2,550,209	452,490	1,080,591

Year.	Rock.	Milling.	Other grades.	Brine.	Total production.	Total value.
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
1906	4,873,526	....	234,903	9,573,680	28,172,380	6,658,350

a Included under "Other grades."

From this table it will be seen that while table and dairy, packers salt, solar salt, rock salt, brine, and salt of other grades increased in quantity, common fine and common coarse decreased.

The following table gives the production and value of the salt produced in the United States from 1903 to 1906, inclusive, by States:

Production and value of salt, 1903–1906, by States, in barrels.

State.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	8,170,648	$2,007,807	8,600,656	$2,101,568	8,359,121	$2,167,931	8,978,630	$2,098,686
Michigan	4,297,542	1,119,984	5,425,904	1,579,206	9,492,173	1,851,332	9,936,802	2,018,760
Ohio	2,798,899	795,897	2,455,829	478,523	2,526,558	565,946	3,236,785	789,237
Kansas	1,555,934	564,232	2,161,819	717,101	2,098,585	576,139	2,198,837	681,022
Louisiana	568,936	178,342	1,095,850	320,000	1,055,186	303,507	1,179,528	268,005
California	629,701	198,630	821,557	205,435	664,099	188,330	806,788	291,528
West Virginia	244,236	35,797	575,000	66,470	202,151	74,063	200,055	57,584
Texas	314,000	117,647	376,695	149,246	444,832	142,993	360,733	170,559
Utah	212,955	181,710	253,829	321,301	177,342	135,465	262,212	169,635
Idaho	(a)	(a)	(a)	(a)	(a)	(a)	1,574	1,867
Nevada	(a)	(a)	(a)	(a)	(a)	(a)	11,249	6,420
Oklahoma	(a)	(a)	(a)	(a)	(a)	(a)	9,893	4,965
Other States	175,238	86,942	262,863	82,372	b 946,075	90,216	c 989,294	100,082
Total	18,968,089	5,286,988	22,030,002	6,021,222	25,966,122	6,095,922	28,172,380	6,658,350

a Included in Other States.
b Virginia, Pennsylvania, Oklahoma, Nevada, New Mexico, Massachusetts, and Idaho.
c Includes Virginia, Pennsylvania, New Mexico, and Massachusetts.

New York leads in value of output, closely followed by Michigan. The output of Michigan, however, is considerably greater than that of New York. The average net price per barrel in New York in 1906 was 23.4 cents; in Michigan, 20.3 cents. Ohio ranks next, followed by Kansas. In 1905 Kansas exceeded Ohio in value of output; each shows an increase for 1906. California, Texas, and Utah show an increase and Louisiana and West Virginia a decrease in value of output.

Michigan and New York combined contributed more than two-thirds (67.14 per cent) of the total production of the United States. Of the five leading salt-producing States during 1906, Michigan produced 9,936,802 barrels (35.27 per cent), New York 8,978,630 barrels (31.87 per cent), Ohio 3,236,785 barrels (11.49 per cent), Kansas 2,198,837 barrels (7.8 per cent), and Louisiana 1,179,528 barrels (4.19 per cent). These five States contributed 90.62 per cent of the total quantity of salt produced in the country during the year.

The following table is of interest as showing the grades of salt produced in the different States. Brine and other grades are combined in order to conceal individual productions of dry salt obtained from brine; Michigan, New York, Ohio, West Virginia, Pennsylvania, and Virginia are the States producing the brine. Michigan, New York, and Ohio are the largest producers of table and dairy salt; Michigan, New York, Kansas, and Ohio of common fine salt; Michigan, of common coarse salt; Ohio, of packers; New York and California, of coarse solar salt; and Louisiana, Michigan, and New York, of rock salt.

Production of salt, by States and grades, in the United States in 1906, in barrels.

State.	Table and dairy.		Common fine.		Common coarse.		Packers.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	177,177	$117,118	50,030	$23,020	28,571	$6,000	122,182	$36,205
Idaho	45	95	43	65	558	737		
Kansas	97,046	80,623	992,304	390,215	1,129	208		
Louisiana								
Michigan	509,905	362,368	2,927,478	757,470	2,021,287	618,727	91,089	33,733
Nevada	357	850						
New York	1,097,655	557,034	1,143,665	401,377	239,103	77,668	86,376	28,345
Ohio	905,107	363,145	896,613	259,599	211,507	59,222	147,229	51,600
Oklahoma			1,500	1,490	8,000	3,225		
Texas	65,572	41,796	252,103	111,511	31,036	12,653	2,000	840
Utah	65,180	98,932	24,164	14,082			3,614	2,284
West Virginia	5,000	3,000	106,037	47,428	9,018	3,156		
Other States[a]			90,000	54,000				
Total	2,923,044	1,624,961	6,483,937	2,060,257	2,550,209	781,596	452,490	153,007

State.	Solar.		Rock.		Other and brine.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	427,925	$108,807			903	$378	806,788	$291,528
Idaho			893	$925	35	45	1,574	1,867
Kansas			1,108,358	209,976			2,198,837	681,022
Louisiana			1,179,528	268,005			1,179,528	268,005
Michigan					4,387,043	246,462	9,936,802	2,018,760
Nevada	10,892	5,570					11,249	6,420
New York	510,811	191,551	2,547,629	663,594	3,353,391	179,117	8,978,630	2,098,686
Ohio					1,076,329	55,671	3,236,785	789,237
Oklahoma					393	250	9,893	4,965
Texas	6,429	2,250			3,593	1,509	360,733	170,559
Utah	122,686	30,407	37,118	12,927	9,450	11,003	262,212	169,635
West Virginia					80,000	4,000	200,055	57,584
Other States[a]	1,848	1,210			897,446	44,872	989,294	100,082
Total	1,080,591	339,795	4,873,526	1,155,427	9,808,583	543,307	28,172,380	6,658,350

[a] Includes Virginia, Pennsylvania, New Mexico, and Massachusetts.

THE SALT INDUSTRY, BY STATES.

The tables show that salt is produced in the United States on a commercial scale in fourteen States and two Territories—California, Idaho, Kansas, Louisiana, Massachusetts, Michigan, Nevada, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Texas, Utah, Virginia, and West Virginia—and a statement of the conditions of trade in these States and Territories follows:

California.—California ranks sixth as a salt-producing State, with an output of 806,788 barrels, or 112,950 short tons, valued at $291,528, an average value of 36.1 cents per barrel, or $2.58 per ton. This is an increase of 142,689 barrels, or 19,976 short tons, in quantity, and of $103,198 in value over the output for 1905, which was 664,099 barrels, or 92,974 short tons, valued at $188,330, an average value of 28.4 cents per barrel and of $2.03 per ton.

In 1906 the salt industry of this State was disturbed by excessive rains and floods. All of the salt in the State, with the exception of that produced by one company, is made by solar evaporation, which consists in taking the water from ocean or bay or tributary streams and changing it from one vat to another until sufficient water is evaporated and the salt is crystallized out, when it is drained and put into piles containing from 100 to 2,000 tons. During 1906 there were excessive storms and abnormally high tides, which swept over the levees into the ponds, breaking the levees; the creeks also overflowed their banks where the salt works were located, entailing heavy loss. This was especially a condition near Alvarado, but much damage was also done in southern California, where a large quantity of salt was lost.

Tendency to combination has been a feature of the California salt industry for some time, and in 1906 a number of the smaller plants were absorbed by the larger companies. Producers report that for a year or so the selling prices were in some cases less than the cost of manufacture, but that recently the conditions have so changed that the trade is very satisfactory, especially where abundant capital is put into the enterprise and the firms have enough business to reduce their expenses to a minimum. As with other industries, increase of wages and advanced price of material used are factors to be overcome by the successful operator.

The localities of output in California in 1906 were Newark, Alvarado, Mount Eden, and Russells (Haywards), Alameda County; Redwood City and Leslie, San Mateo County; Long Beach, Los Angeles County; near San Diego, San Diego County, and in Marin County. The salt works at Salton, Riverside County, which at one time were extensive, were flooded and destroyed in 1905–6 by the diversion of Colorado River into the Salton Sink. In 1906 the building of salt works was begun near Amboy, San Bernardino County, but no salt was marketed.

Idaho.—The commercial salt deposits in Idaho are in Bannock County, near the Wyoming line. The salt is produced by about half a dozen small operators, and is won by the open-pan process, with heat applied directly.

Kansas.—Kansas ranked fourth in value of salt production in 1906, the production for this year being 2,198,837 barrels, or 307,837 short tons, valued at $681,022. This in comparison with the output in 1905 of 2,098,585 barrels, or 293,802 short tons, valued at $576,139, shows an increase in 1906 of 100,252 barrels, or 14,035 short tons, in output and $104,883 in value. The average price in 1906 was 31 cents per barrel, or $2.21 per ton; in 1905 this average price was 27.4 cents per barrel, or $1.96 per ton.

The localities of commercial output were at Hutchinson, Reno County; Ellsworth and Kanopolis, Ellsworth County; Anthony, Harper County; Sterling and Lyons, Rice County; Kingman, Kingman County. At Hutchinson, Ellsworth, Anthony, and Sterling the open-pan and grainer processes are employed, using steam, while at Kanopolis, Lyons, and Kingman the salt is sold as rock salt.

Louisiana.—The rock salt mined in Louisiana is from Iberia Parish, the output in 1906 being 1,179,528 barrels or 165,134 short tons, valued at $268,005, as compared with 1,055,186 barrels or 147,726 tons, valued at $303,507, an increase of 124,342 barrels or 17,408 short tons in quantity, but a decrease of $35,502 in value.

Massachusetts.—The small quantity of salt produced in Massachusetts is obtained by evaporation of sea water near Buzzards Bay.

Michigan.—Michigan, for the last two years, has produced a greater quantity of salt than any other State, but the value of the output has been smaller than the value of the somewhat smaller quantity produced in New York. In 1906 the output of Michigan was 9,936,802 barrels or 1,391,522 short tons, valued at $2,018,760. In 1905 the quantity was 9,492,173 barrels or 1,328,904 short tons, valued at $1,851,332, an increase in quantity of 444,629 barrels or 62,248 short tons, and in value of $167,428.

The deposits of this State are beds of rock salt, exploited by means of wells; the artificial brine is converted into salt mostly by use of steam in the vacuum-pan and grainer processes, or is used directly by chemical works in the making of sodium salts.

The commercial localities are Ludington, Mason County; Saginaw and St. Charles, Saginaw County; Manistee, Filer City, and Eastlake, Manistee County; Marine City and Port Huron, St. Clair County; Delray (near Detroit), Wyandotte, and Ecorse, Wayne County; Midland, Midland County, and Bay City, Bay County.

Nevada.—The commercial output of salt in Nevada is from Washoe and Churchill counties, and is won from brine by solar evaporation.

New Mexico.—Torrance County furnishes the only commercial salt output reported from this Territory, the salt being evaporated from brine by solar evaporation.

New York.—This State ranks first in value of salt production and second in quantity of output, being exceeded in this respect, for the last two years, by Michigan. The output was 8,978,630 barrels or 1,257,008 short tons, valued at $2,098,686, in 1906, and 8,359,121 barrels or 1,170,277 short tons, valued at $2,167,931, in 1905, an increase in 1906 of 619,509 barrels or 86,731 short tons in quantity, and a decrease of $69,245 in value.

The salt in this State occurs as natural brine and as rock salt, both the rock salt and the salt wells being of great depth. The rock salt is sold as such, or is dissolved and recrystallized for culinary and other purposes. The brine, either in natural solution or artificial solution made by water led to the deposits through wells, is pumped into covered vats, where it is evaporated, or it is piped directly to chemical works for the manufacture of sodium salts.

The localities producing in 1906 were the Onondaga district in Onondaga County, near Syracuse; at Cayuga and Ithaca, Tompkins County; Watkins Glen, Schuyler County; Perry, Rock Glen, and Silver Springs, Wyoming County; Le Roy, Genesee County; Geneseo, Retsof, Cuylerville, and Piffard, Livingston County.

Ohio.—Ohio is the third State in rank of salt production in 1906. The production for 1906 was 3,236,785 barrels, or 453,150 short tons, valued at $789,237, the largest production reported since 1903. This output, compared with 2,526,558 barrels, or 353,718 short tons, valued at $565,946, in 1905, shows an increase of 710,227 barrels, or 99,432 short tons, in quantity, and of $223,291 in value.

The brine of this State is treated mostly by the vacuum pan and grainer processes, with direct application of heat or by steam. Some of the brine is used as such by the chemical works.

The commercial output in 1906 was reported from Pomeroy, Meigs County; near Cleveland, Cuyahoga County; Akron and Barberton, Summit County; Durant, Morgan County; Rittman, Wayne County, and Wadsworth, Medina County.

Oklahoma.—The commercial output from this State is from near Ferguson, Blaine County.

Pennsylvania.—The Pennsylvania output was from Allegheny City, Allegheny County.

Texas.—The output of salt reported from Texas in 1906 increased in value but decreased in quantity. In 1905 the output was 444,832 barrels, or 62,276 short tons, valued at $142,993, while in 1906 it was 360,733 barrels, or 50,502 short tons, valued at $170,559, a decrease for 1906 of 84,099 barrels, or 11,774 short tons, in quantity, and an increase of $27,566 in value. The average price was 47 cents per barrel, or $3.38 per ton, in 1906, as compared with 32 cents per barrel, or $2.30 per ton, in 1905.

The commercially producing localities are Grand Saline, Van Zandt County; Colorado, Mitchell County; and Palestine, Anderson County. The entire output for 1906 was won from brine by simple solar or by grainer process.

There are also many salt lakes or salines throughout Texas, from which much salt is taken annually by ranchmen, who drive or ride many miles for it. Some of this salt yields the owner of the lake a certain sum, and much of it is to be had for the getting out. While no report of this output reaches the United States Geological Survey, it is known that from one lake in Crane and Ector counties there is taken out annually over 1,500,000 pounds of stock salt, which is worth about $1.50 per 100 pounds. These salt lakes dry up after rains and leave a crust of salt from one-fourth to 1½ inches thick, which is raked up, loaded on wagons, and carted away.

Utah.—There was an increase in both quantity and value of the salt produced in Utah in 1906. The output in 1905 was 177,342 barrels, or 24,828 short tons, valued at $135,465; in 1906 the output was 262,212 barrels, or 36,710 short tons, valued at $169,635, an increase of 84,870 barrels, or 11,882 short tons, in quantity, and of $34,170 in value.

The commercial source is chiefly the neighborhood of Great Salt Lake, Salt Lake County, where salt is won from the brine by solar evaporation. Other brine is obtained at Nephi City, Juab County. Rock salt is obtained near Gunnison, Sanpete County; in Sevier County; and in Salt Lake County.

Virginia.—The brine produced in this State is used entirely for chemical purposes and is obtained at Saltville, Smyth County.

West Virginia.—The brine output from this State in 1906 was from near Malden, Kanawha County, and Hartford, Mason County.

DOMESTIC CONSUMPTION.

The following table shows the increase in the proportion of salt produced in the United States entering 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 1906. The consumption of salt imported into the United States, however, decreased from 36.5 per cent of the total in 1880 to 4.3 per cent in 1906, this per cent being the same as in 1905. The actual consumption in 1906 was 29,176,973 barrels, in 1880 9,384,263 barrels. The production for the United States in 1880 was 5,961,060 barrels and the imports amounted to 3,427,639 barrels; in 1906 the production had increased to 28,172,380 barrels and the imports had decreased to 1,247,367 barrels, which importation was somewhat greater than that for 1905.

Supply of salt for domestic consumption, 1880–1906, in barrels.

Source.	1880.	1890.	1900.	1905.	1906.
Domestic production	5,961,060	8,876,991	20,869,342	25,966,122	28,172,380
Imports	3,427,639	1,838,024	1,427,921	1,151,133	1,247,367
Total	9,388,699	10,715,015	22,297,263	27,117,255	29,419,747
Exports	4,436	17,597	53,650	244,555	242,774
Domestic consumption	9,384,263	10,697,418	22,243,613	26,872,700	29,176,973
Increase over preceding year		877,610	1,274,634	3,755,729	2,304,273
Percentage of imports to total consumption.	36.5	17.2	6.4	4.3	4.3

IMPORTS AND EXPORTS.

In 1894, salt, by the tariff act, was placed on the free list, and importations increased to 434,155,708 pounds in 1894 and to 520,411,-822 pounds in 1896. In 1897 salt was again made dutiable, and salt in bags, barrels, or other packages is subject to a duty of 12 cents per 100 pounds (33.6 cents per barrel) and salt in bulk is taxed 8 cents per 100 pounds (22.4 cents per barrel). The duty on imported salt in bond used in curing fish taken by licensed vessels engaged in fishing and in curing fish on the navigable waters of the United States or on salt used in curing meats for export may be remitted.

According to figures obtained from the Bureau of Statistics of the Department of Commerce and Labor the quantity and value of the salt imported and entered for consumption in the United States in the last five years is as follows:

Salt imported and entered for consumption in the United States, 1902–1906, in 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.		
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
1906	74,228,878	257,592	159,674,675	149,944	115,359,107	101,326	349,262,660	508,862

The exports of salt of domestic production from the United States from 1902 to 1906 is shown as follows:

Salt of domestic production exported from the United States, 1902–1906.

1902....pounds..	10, 188, 771	$55, 432
1903.......do....	25, 499, 630	95, 570
1904.......do....	27, 928, 090	113, 625
1905....pounds..	68, 475, 356	$239, 223
1906.......do....	67, 976, 581	274, 627

The export trade has increased considerably in the last five years, rising from 10,188,771 pounds, valued at $55,432 in 1902, to 67,976,-581 pounds, valued at $274,627 in 1906. An increased exportation to Russia and Cuba accounts for this.

The imports of salt are chiefly from the United Kingdom, the West Indies, Italy, and Canada; the exports are chiefly to Cuba, Asiatic Russia, the Dominion of Canada, and Mexico.

During the fiscal year ending June 30, 1906, out of 329,000,000 pounds of salt imported, 120,000,000 pounds came from the United Kingdom, nearly 93,000,000 pounds from the West Indies, and over 82,000,000 pounds from Italy; during the same period out of a total of 72,000,000 pounds exported, about 29,000,000 pounds went to Cuba 25,000,000 pounds to Asiatic Russia, over 12,000,000 pounds to the Dominion of Canada, and nearly 2,400,000 pounds to Mexico. These proportions of import and export are approximately true for several years past, except that the imports from the West Indies fell off about one-half from 1903 to 1905 and rose again considerably in 1906, and that the exports to Japan fell off from over 5,000,000 pounds in 1903 to a few thousand pounds in 1906, while during the same period the exports to Cuba rose from a few thousand pounds in 1903 to nearly 29,000,000 pounds in 1906, and in like manner the exports to Asiatic Russia increased from about 200,000 pounds in 1903 to nearly 25,000,000 pounds in 1906.

WORLD'S PRODUCTION.

In the following table the statistics of salt production in the principal salt producing countries of the world from 1900 to 1905 are shown as far as statistics are available. The production of Turkey is not included. The industry in that country, as in Austria-Hungary, is a Government monopoly, with no statistics of production published. On account of the unsettled condition in Russia no statistics are available since 1903.

The world's salt production, 1901–1905, in short tons.

Year.	United States.		United Kingdom.		France.[a]		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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, 809	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
1905..........	3, 635, 257	6, 095, 922	2, 116, 699	2, 707, 622	1, 275, 361	3, 594, 818	1, 959, 401	4, 829, 496

[a] Includes product of Algeria.

The world's salt production, 1901–1905, in short tons—Continued.

Year.	Japan.		Italy.		Austria-Hungary.[a]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	773,776	4,852,049	511,827	713,595	595,335	16,024,783
1905	(b)	(b)	482,475	714,859	609,572	17,115,539

Year.	Russia.		Spain.		India.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	1,828,646	3,652,074	471,116	670,247	1,002,221	2,420,260
1904	(c)	(c)	599,292	738,348	1,236,702	2,008,930
1905	(c)	(c)	543,931	736,074	1,336,682	198,090

Year.	Canada.		Other countries.[d]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	59,428	$262,328	541,613	$2,463,670	13,522,025	$45,989,867
1902	63,056	288,581	125,467	970,522	13,880,017	45,613,395
1903	62,452	297,517	477,000	1,106,000	13,674,341	45,858,300
1904	68,777	318,628	584,000	1,543,000	14,569,464	47,537,508
1905	67,340	320,858	442,086	1,841,926	15,071,226	46,659,327

[a] Government monopoly.
[b] Production and value in 1904 used in making up the total for the world's production in 1905.
[c] Production and value in 1903 used in making up total for world's production in 1904 and 1905.
[d] Probably 500,000 tons should be added annually for countries not furnishing statistics.

A bibliography of recent literature concerning the salt industry is contained in the report for 1905.

BROMINE.

The bromine produced in the United States in 1906 was derived from brine obtained at Midland and Mount Pleasant, Midland County, and St. Louis, Gratiot County, Mich.; Pomeroy, Meigs County, Ohio; Allegheny City, Allegheny County, Pa.; and Hartford, Mason County, and Malden, Kanawha County, W. Va. These four States produced in 1906 brine containing an equivalent of 1,283,250 pounds of bromine recovered as potassium bromide, valued at $165,204. In 1905 the production was 1,192,758 pounds, valued at $178,914. This shows an increase for 1906 of 90,492 pounds and a decrease in value of $13,710.

The average price per pound in 1906 was 12.8 cents, in 1905, 15 cents, a decrease of 2.2 cents for 1906. The prices reported by the producers varied from 8 cents to 20 cents, the higher values being based on old contracts and not on the price ruling for the year. Michigan furnished the greater part of this output, the production from the other States being nearly all by-product production from salt works.

The following table shows the production of bromine from 1880 to 1906, inclusive:

Production and value of bromine, 1880–1906.

1880.....pounds..	404, 690	....	1895.....pounds..	517, 421	$134, 343
1883........do....	301, 000	....	1896........do....	546, 580	144, 501
1884........do....	281, 100	$67, 464	1897........do....	487, 149	129, 094
1885........do....	310, 000	89, 900	1898........do....	486, 979	126, 614
1886........do....	428, 334	141, 350	1899........do....	433, 004	108, 251
1887........do....	199, 087	61, 717	1900........do....	521, 444	140, 790
1888........do....	307, 386	95, 290	1901........do....	552, 043	154, 572
1889........do....	418, 891	125, 667	1902........do....	513, 893	128, 472
1890........do....	387, 847	104, 719	1903........do....	598, 500	167, 580
1891........do....	343, 000	54, 880	1904........do....	897, 100	269, 130
1892........do....	379, 480	64, 502	1905........do....	1, 192, 758	178, 914
1893........do....	348, 399	104, 520	1906........do....	1, 283, 250	165, 204
1894........do....	379, 444	102, 450			

It will be seen that while there has been a gradual increase in the quantity of bromine produced, the value has decreased. This is accounted for to a large extent by the imports of this material from Germany, which have cut the prices of the United States material so much that there is not much profit in the production. Figures showing exports and imports are not available. A large quantity of the United States product was exported as the bromides of potassium, sodium, and ammonium.

Free bromine is used in the manufacture of some of the aniline dyes, as a disinfectant, and in metallurgical and chemical work.

The bromine products are various, but the usual salts are the alkaline bromides used in medicine and in photography.

Details in regard to the occurrence of bromine are given in the reports in Mineral Resources for 1904 and 1905.

SULPHUR AND PYRITE.

SULPHUR.

OCCURRENCE IN THE UNITED STATES.

The great production of sulphur in Louisiana has continued, and in addition the local demand for sulphur for sheep dip and for use in destroying vegetable parasites has been very well met by developments in Utah, fully described by Willis T. Lee in the Contributions to Economic Geology for 1906.[a] Sulphur is also developed near Cody, Wyo., and the methods of mining and refining it have been described by L. W. Trumbull, professor of mining in the University of Wyoming school of mines.[b] The sulphur deposits of Trout Creek, Mineral County, Colo., are being developed by the Colorado Sulphur Company.[c]

PRODUCTION.

The production of sulphur in the United States increased from 181,677 long tons in 1905 to 294,153 tons in 1906. This is substantial proof of the success of the Frasch sulphur process in Louisiana, a success further demonstrated by numerous photographs in trade papers of great blocks of sulphur solidified from the streams pumped from the Louisiana wells.[d] In value the product of 1905 was $3,706,560, and for 1906 it was $5,096,678.

The production of the United States since 1880 is as follows:

Production of sulphur in the United States, 1880–1906.

1880..long tons..	536	$21,000	1894..long tons..	446	$20,000
1881......do....	536	21,000	1895......do....	1,607	42,000
1882......do....	536	21,000	1896......do....	4,696	87,200
1883......do....	893	27,000	1897......do....	2,031	45,590
1884......do....	446	12,000	1898......do....	1,071	32,960
1885......do....	638	17,875	1899......do....	4,313	107,500
1886......do....	2,232	75,000	1900......do....	3,147	88,100
1887......do....	2,679	100,000	1901......do....	[e] 241,691	1,257,879
1888......do....			1902......do....	[e] 207,874	947,089
1889......do....	402	7,850	1903......do....	[e] 233,127	1,109,818
1890......do....			1904......do....	127,292	2,663,760
1891......do....	1,071	39,600	1905......do....	181,677	3,706,560
1892......do....	2,400	80,640	1906......do....	294,153	5,096,678
1893......do....	1,071	42,000			

[a] Lee, Willis T. Cove Creek sulphur beds, Utah: Contrib. to Econ. Geology for 1906, Bull. U. S. Geol. Survey No. 315, pt. 1, U. S. Geol. Survey, 1907, pp. 485-489.
[b] Mines and Minerals, February, 1907.
[c] Min. and Sci. Press, August 10, 1907.
[d] Manufacturers' Record, May 31, 1906.
[e] Includes the production of pyrite.

IMPORTS AND EXPORTS.

For the last few years the consumption of sulphur in the United States has increased quite regularly, along with the general industrial growth of the country. The imports, however, have decreased, in consequence of the development of the domestic resources.

Sulphur imported and entered for consumption in the United States, 1902–1906, in long tons.

Year.	Crude.		Flowers of sulphur.		Refined.		All other. [a]		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
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
1906	72,404	1,282,873	1,100	29,565	709	17,918	28	3,224	1,333,580

[a] Includes sulphur lac and other grades not otherwise provided for, but not pyrite.

In the following 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, for the years 1904–1906, inclusive.

Statement, by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each calendar year, 1904 to 1906, in long tons.

Countries whence exported and customs districts, through which imported.	1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRY.						
Canada			18	$472		
United Kingdom	4,214	$96,242	1,656	35,733	3,881	$76,068
Italy	106,358	2,042,467	69,135	1,274,014	47,629	868,453
Japan	17,207	301,938	12,307	210,191	20,848	337,323
Other countries	1,106	23,132	85	1,595	46	1,029
Total	128,885	2,463,779	83,201	1,522,005	72,404	1,282,873
CUSTOMS DISTRICT.						
Baltimore, Md	4,844	94,142				
Boston and Charlestown, Mass	17,988	375,799	8,585	171,235	7,552	150,244
New Orleans, La					185	4,437
New York, N. Y	54,665	1,033,661	44,062	805,041	35,798	631,959
Philadelphia, Pa	11,050	206,666	3,063	47,948	5,892	86,824
Portland, Me	23,660	459,250	15,150	286,378	7,050	139,581
San Francisco, Cal	11,601	198,437	9,145	131,795	12,192	198,010
Willamette, Oreg	3,398	64,642	2,994	75,558	3,530	67,362
All other	1,679	31,182	202	4,050	205	4,456
Total	128,885	2,463,779	83,201	1,522,005	72,404	1,282,873

In 1906 the United States exported 22,237 long tons of sulphur, valued at $460,435.

SICILY.

Course of trade.—The Italian Government entered the sulphur trade during the year 1906 in the effort to benefit the Sicilian industry, which had lost the American trade through the successful development of Louisiana deposits by the Frasch process.

For the past ten years the Anglo-Sicilian Company, a combination of English, French, and Italian capital, had controlled the output and sale of Sicilian sulphur. Not believing that it would be possible to develop a great product in Louisiana, the company invested a considerable portion of its profits in a stock of sulphur which finally exceeded 400,000 tons, for much of which no market could be found. This incubus caused the company to sell out to the Italian Government at a price reported in the press at $12 per ton in Sicily. This advent of the Italian Government directly into the trade under the title "Consorzio Obligatorio" is an extremely interesting commercial novelty, which the Government has not been slow to aid by such special legislation as would have probably been difficult for private interests to obtain, particularly the granting of a 50 per cent reduction in railroad rates on sulphur for export.[a]

The following table, obtained from information furnished by the official report Rivista del Servizio Minerario, gives the quantity and value of the sulphur produced in Italy since 1901:

Production of sulphur in Italy, 1901-1906.

1901..long tons..	554,096	$10,358,496	1904..long tons..	519,255	$9,740,776
1902......do....	530,938	10,068,811	1905......do....	559,967	10,269,363
1903......do....	545,030	10,278,193	1906......do....	491,942	8,882,163

Production of sulphur in Italy in 1906, by districts.

Bologna	long tons..	22,107	$433,498
Caltanissetta	do....	463,770	8,353,718
Florence	do....	279	5,481
Naples	do....	5,786	89,466
Total	do....	491,942	8,882,163

Exports.—The production of Sicily, the dominating factor of the world's supply, has fluctuated, as is shown by the following table of exports furnished by Mr. Alfred S. Malcomson, of New York:

Total exports of sulphur from Sicily, 1903-1906, by countries, in long tons.

Country.	1903.	1904.	1905.	1906.
Austria	17,926	23,374	25,111	22,756
Belgium	15,233	13,627	14,442	13,940
France	74,342	103,042	96,170	67,536
Germany	32,553	31,613	28,319	34,967
Greece and Turkey	22,133	25,376	25,069	26,560
Holland	5,157	8,122	4,425	5,539
Italy	45,572	79,619	99,633	79,519
Portugal	14,064	8,373	13,196	12,302
Russia	15,068	15,141	16,673	16,181
Scandinavia	28,292	20,120	18,288	21,608
Spain	4,099	4,063	2,478	3,120
United Kingdom	19,210	18,108	18,847	20,883
United States	155,996	100,680	70,332	41,283
Other countries	25,833	24,487	23,277	21,238
Total	475,478	475,745	456,260	387,432

[a] Daily Cons. Reps. No. 2671, September 20, 1906.

The following table shows the quantity of Sicilian sulphur received at the different ports of the United States in 1906:

Sicilian sulphur received at the different ports of the United States in 1906, in long tons.

New York	35,798	Portland, Me	7,050
Philadelphia	850	Other ports	74
Boston	3,672		
New Orleans	185	Total	47,629

The stocks of sulphur on hand in Sicily, according to Mr. Malcomson, during the years from 1901 to 1906, inclusive, are shown in the following table:

Stocks of sulphur on hand in Sicily, 1901–1906, in long tons.

1901	310,123	1904	396,541
1902	339,143	1905	462,437
1903	361,220	1906	525,115

WORLD'S PRODUCTION OF SULPHUR.

The following table shows the estimated quantity of sulphur produced by all countries for the years 1904 to 1906, inclusive:

World's production of sulphur, 1904–1906, in metric tons.

Country.	1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	129,329	$2,663,760	184,584	$3,706,560	298,859	$5,096,678
Austria	a 2,141	42,815	1,700	32,292	b 1,579	b 30,000
Chile	3,595	131,214	3,510	123,647	b 4,000	b 125,000
France	a 834	16,673	740	14,057	b 789	b 15,000
Greece	1,225	25,613	1,126	23,353	b 1,200	b 24,000
Hungary	143	4,405	135	4,060	b 140	b 4,200
Italy	527,563	9,740,776	568,927	10,269,363	499,814	8,882,163
Japan	25,587	278,063	24,419	259,650	b 24,000	b 250,000
Spain	a 2,232	44,632	2,285	43,421	b 2,263	b 43,000
Sweden	35	748				
Total	692,684	10,733,318	787,426	14,476,403	832,644	14,470,041

a Estimated sulphur content of ores. b Estimated.

PYRITE.

PRODUCTION BY STATES.

Pyrite production increased from 253,000 long tons in 1905 to 261,422 long tons in 1906. The price, however, showed the strained condition of the sulphur industry and declined from an average for the year 1905 of $3.71 per ton to $3.56, causing the total value to decrease slightly, from $938,492 in 1905 to $931,305 in 1906.

Pyrite burning entered significantly into the sulphuric acid business in 1882, when the product was 12,000 tons. In the next year the Davis mine in Massachusetts was opened and effected a large increase. In 1885 the product had increased fourfold; five years later it nearly doubled again, and has rapidly increased since. The growth has been due not only to the cheapness of this source of sulphur but to the use of the cinder in the blast furnace.

After the celebrated Davis mine in Massachusetts, Virginia developed the dominant position in the supply and even increased its product in 1906, as is shown in the following table:

Production of pyrite in the United States, 1904–1906, by States, in long tons.

State.	1904.			1905.			1906.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Alabama and Georgia	18,369	$76,101	$4.14	19,928	$71,863	$3.61	26,173	$78,817	$3.01
California	26,902	132,905	4.94	61,748	247,712	4.01	52,926	236,867	4.48
Indiana	4,465	16,242	3.64	3,107	11,491	3.70	2,579	7,179	2.78
Massachusetts and New Jersey	26,552	115,184	4.34	[a] 24,155	108,765	4.50	([b])	([b])	....
New York	5,285	17,705	3.35	11,935	39,883	3.34	[c] 46,218	[c] 162,615	3.52
Ohio	4,837	15,918	3.29	8,944	32,770	3.66	4,732	14,439	3.05
Virginia	120,671	440,753	3.65	123,183	426,008	3.46	128,794	431,388	3.35
Total	207,081	814,808	3.93	253,000	938,492	3.71	261,422	931,305	3.56

[a] Includes the production of South Dakota.
[b] Included in New York.
[c] Includes the production of Massachusetts.

Production of pyrite in the United States, 1882–1906.

1882..long tons..	12,000	$72,000	1895..long tons..	99,549	$322,845
1883......do....	25,000	137,500	1896......do....	115,483	320,163
1884......do....	35,000	175,000	1897......do....	143,201	391,541
1885......do....	49,000	220,500	1898......do....	193,364	593,801
1886......do....	55,000	220,000	1899......do....	174,734	543,249
1887......do....	52,000	210,000	1900......do....	204,615	749,991
1888......do....	54,331	167,658	1901......do....	[a] 241,691	1,257,879
1889......do....	93,705	202,119	1902......do....	[a] 207,874	947,089
1890......do....	99,854	273,745	1903......do....	[a] 233,127	1,109,818
1891......do....	106,536	338,880	1904......do....	207,081	814,808
1892......do....	109,788	305,191	1905......do....	253,000	938,492
1893......do....	75,777	256,552	1906......do....	261,422	931,305
1894......do....	105,940	363,134			

The more careful attention paid to waste products in copper, lead, and precious metal smelting will lead in the near future to the production of much sulphuric acid, and these sources must be taken into account.

IMPORTS.

The same utilization of the residues from pyrite burning which has given stability to production in the United States has also upheld the imports, for the large importing concerns profit by the small percentage of copper in the Spanish ores.

Imports of pyrite containing not more than 3.5 per cent of copper, 1901–1906.

1901..long tons..	403,706	$1,415,149	1904..long tons..	422,720	$1,533,997
1902......do....	440,363	1,650,852	1905......do....	511,946	1,774,379
1903......do....	420,410	1,636,450	1906......do....	598,078	2,148,558

[a] Includes production of natural sulphur.

WORLD'S PRODUCTION OF PYRITE.

Taking the whole world into consideration the trade in pyrite shows the following position: In 1904 the product actually marketed as pyrite (that is, chiefly for its sulphur content, which was reckoned at 45 per cent) amounted to 1,693,492 long tons, displacing 762,071 long tons of sulphur. In 1905 the corresponding figures were, pyrite 1,742,686 long tons, equivalent to 784,209 long tons of sulphur displaced.

World's production of iron pyrite and quantity of sulphur displaced, 1901–1905, in long tons.

Country	1901.	1902.	1903.	1904.	1905.
Spain	393,397	142,708	153,543	159,292	176,258
France [a]	302,605	313,204	[a] 324,212	267,268	262,907
Portugal	331,641	407,173	370,253	377,540	346,928
United States	234,825	207,874	233,137	253,000	261,422
Germany	154,954	162,613	168,307	172,030	182,448
Norway	100,283	101,016	127,887	131,499	159,461
Hungary	92,428	104,806	95,560	95,618	105,165
Italy	87,969	91,704	99,857	110,240	115,814
Canada	31,483	31,800	33,039	29,499	29,236
Newfoundland	7,532	26,000	42,000	60,200	50,720
Russia	30,248	26,048	22,420	([b])	([b])
United Kingdom	10,241	9,168	9,639	10,287	12,186
Bosnia and Herzegovina	4,498	5,088	6,484	10,256	18,745
Belgium	([b])	699	709	1,058	961
Sweden	Nil.	([b])	7,670	15,705	20,435
Total	1,782,104	1,629,901	1,694,717	1,693,492	1,742,686
Sulphur displaced [c]	801,947	733,455	762,623	762,071	784,209

[a] Includes Algeria.
[b] Statistics not available.
[c] Based on estimated 45 per cent of sulphur content.

CONSUMPTION OF SULPHUR IN THE UNITED STATES.

The consumption of domestic and imported sulphur and of 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, 1904–1906, in long tons.

Source.	1904	1905.	1906.
Domestic sulphur and sulphur content of pyrite	220,478	295,527	411,793
Imported sulphur	129,532	84,339	74,441
Sulphur content of imported pyrite [a]	190,224	230,376	269,135
Total domestic consumption	540,234	610,242	755,369

[a] Based on average sulphur content of 45 per cent.

BARYTES.

By Ernest F. Burchard.

CHARACTER.

Barytes or heavy spar is barium sulphate, the chemical formula of which is $BaSO_4$. The mineral is composed of barium monoxide (baryta, BaO), 65.7 per cent; sulphur trioxide (SO_3), 34.3 per cent. The specific gravity is 4.3 to 4.6; the hardness, 2.5 to 3.5. Barytes is usually a white, opaque to translucent crystalline material, about as hard as calcite, but differing from the latter by its greater weight and the fact that it does not effervesce with acids. A common form of the mineral is that of an aggregate of straight or slightly curved plates. It also occurs in granular, fibrous, and earthy masses, and in stalactitic forms, as well as in single and clustered crystals. In nature the material is rarely pure, the most common impurities being silica, lime, magnesia, and the oxides of iron and aluminum. Commercial grades as mined carry 95 to 98 per cent barium sulphate and 1 to 3 per cent silica.

DISTRIBUTION.

Barytes occurs commonly in veins as a gangue of metallic ores, and also in veins in sandstone and limestone, or as a replacement of limestone. Differential weathering of the limestone and barytes has given rise to deposits of barytes embedded in residual clay. It thus may have a wide range in geologic age and an extensive distribution. The principal sources, however, are limited to two districts—that of Missouri and the Appalachians. In Missouri the counties of Washington, St. Francois, Crawford, Cole, and Miller are producers, Washington County furnishing three-fourths of the output of the State. The Appalachian district includes contiguous portions of Virginia, Tennessee, and North Carolina. Considerable barytes has been found also in the Cumberland Valley in southern Pennsylvania, although but little has been produced there.

USES AND REQUIREMENTS.

One of the principal uses of barytes is as a white pigment; and, in order that the material may be suitable for such use, it must, when cleaned, be free from calcium carbonate, silica, iron oxide, or manganese oxide. Other uses are in the manufacture of paper, cloth, rubber, barium salts, and as an adulterant.

PREPARATION.

The principal steps in the preparation of barytes for market are hand cobbing, sorting, crushing, washing or jigging, bleaching, grinding, and pulverizing. Such associated minerals as galena, quartz, calcite, and limonite, when occurring massive or as surface stains on the barytes, can be removed largely by hand cobbing during mining; but when galena or iron stains are scattered through the material, crushing and washing may serve to clean the barytes completely. The greater portion of the material that is mined is bleached.

DEVELOPMENT AND TRADE CONDITIONS.

Deposits of barytes in general are so scattered and so small that the problems connected with their exploitation are those of handling the material and getting it to market rather than of mining. The problem that confronts the manufacturer at times is the difficulty of accumulating sufficient barytes to keep a mill running continuously. Where barytes occurs in residual clay and soil the best way to handle it would be with steam shovel and log washer; but since few, if any, deposits are large enough to warrant the installation of such a plant, and water is not everywhere plentiful, the slower hand methods of mining, cobbing, and rocking must be employed. The workings in the Appalachian district usually consist of open cuts, and in Missouri of "gopher holes." The deposits at present worked in the Appalachain district lie in valleys within a short wagon haul of a railroad, but good and abundant deposits still exist too remote from railroads to be worked. In some instances deposits are worked where the cost of teaming is greater than the cost of mining. Mills are situated at Bristol, Honaker, Lynchburg, Pounding Mill, and Richmond (a new mill), Va., at Knoxville and Sweetwater, Tenn., and at Stackhouse, N. C.

The mill at Sweetwater, Tenn., together with the general processes for milling barytes and converting part of it into barium sulphide has been described.[a]

The ore is mined in the Sweetwater district on royalty from openings about 3½ miles south-southwest of the town, near the border of Monroe County, where it is found in pockets of clay overlying Knox magnesian limestone. The clay cover is very deep, 40 feet or more in places. The barytes occurs in nuggets, lumps, and bowlders, from the size of an egg to that of a flour barrel. The material is stained on outside surfaces and in cracks by iron oxide and is mixed with a small proportion of chert and limonite. The Sweetwater barytes yields readily to grinding and improves in whiteness with depth of workings, which have reached about 100 feet.

Developments are reported to be particularly active in southern Virginia, and production has been begun in Alabama. Without exception the producers of barytes in the Appalachian district have found trade conditions better in 1906 than in the preceding year. The demand increased during the year until it exceeded the supply, and consequently prices became higher. The inability of supply to meet demand was due to a scarcity of available ore in some places which had formerly been steady producers and to failure of transportation facilities at critical times. A further result of the exhaustion of old

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[a] Min. Industry during 1905, vol. 14, 1906, pp. 44-45.

deposits has been the development of others not so favorably located for cheap mining and transportation. In Cocke County a fissure vein carrying 7 feet of crystalline, high-grade barytes has been reported opened at a depth of 150 feet. From other localities, particularly Gaston County, N. C., quantities of good ore are reported as available.

Although but a comparatively small quantity of barytes was produced in Kentucky in 1906, preparations have been made that will insure a larger output in 1907. The localities thus affected are in Caldwell, Bourbon, Boyle, Garrard, Hubbell, Jessamine, and Lincoln counties. A 50-ton mill is planned to be built at Nicholasville.

The barytes or "tiff" industry in Missouri is operated on a principle similar to that in the Appalachian district. Mills are located at St. Louis and at Mineral Point, and materials mined in a small way from shallow holes are brought by the mill agents, who make weekly rounds through the "tiff" district, which is mainly in Washington County. Here mining is done largely under lease, royalties running from 25 to 50 cents per ton, the price paid the miner being regulated by the market. The barytes occurs in scattered deposits in Washington and adjacent counties. The country rock is principally cherty magnesian limestone of Ordovician age, associated with strata of sandstone and chert. The barytes occurs massive, filling veins and mixed with other minerals, particularly lead. It occurs also in lenticular sheets, forming large bodies with red clay between the layers and suggesting that the barytes has replaced a series of thin beds of limestone. Over the surface of this district weathering has reduced the limestone to red clay to great depths, and the barytes, being more resistant than the limestone, remains in the clay. It is thus found from the grass roots down to solid rock, in masses of more or less richness, mixed with clay, chert, and galena. The barytes occurs in loose lumps from the size of an egg to that of a bushel measure. The associated iron-oxide scale and galena cubes are chipped off by hand, and the latter are saved to be sold as a by-product, since surface lead mining has ceased to be of primary importance in this district.

The conditions of trade in Missouri during 1906 were highly satisfactory to the majority of producers. Increased demand, with prices trending steadily higher, is the general record.

PRODUCTION.

In 1906 the quantity of crude barytes mined in the United States amounted to 50,231 short tons, valued at $160,367. This value is that of the crude barytes at the mines, hand cobbed, and ready for shipment to the mill. This production shows an increase in quantity of 1,996 tons, and in value of $11,564, over that of 1905, which was 48,235 short tons, valued at $148,803. The value per ton shows the following steadily increased averages since 1904: 1904, $2.66; 1905, $3.08; and 1906, $3.19.

Of the States producing barytes Missouri still ranks first, and shows an increased production for 1906. Virginia reports a largely increased production, and Alabama enters the field as a producer.

In addition to the quantity of crude barytes reported as mined in the United States there has been reported as refined by mills in Missouri, North Carolina, and Tennessee together a total of 26,261 short tons, valued at $343,675, and from Virginia alone 14,388 short tons, valued at $175,432. This gives an average value for refined barytes of $12.77 per short ton throughout the country, and this average is a very representative figure. From 50 to 88 per cent of the refined barytes was floated for pigment at the various mills, while the remainder was sold for other purposes, including manufacture of cloth, paper, and barium salts.

The following tables give the quantity, total value, and average price per ton of the barytes produced in the United States in 1904, 1905, and 1906, by States, and the annual output since 1882:

Production of crude barytes in the United States, 1904–1906, by States, in short tons.

State.	1904.			1905.			1906.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Missouri	25,498	$75,552	$2.96	26,761	$84,095	$3.14	28,869	$93,479	$3.24
North Carolina	13,413	33,930	2.53	5,519	21,545	3.90	(a)	(a)	....
Tennessee	[b]15,602	34,024	2.18	[b]9,487	15,325	1.62	5,247	8,782	1.67
Virginia	11,214	31,452	2.80	6,468	27,838	4.30	11,775	45,336	3.85
Other States	....	....	....	....	....	....	[c]4,340	12,770	2.94
Total	65,727	174,958	2.66	48,235	148,803	3.08	50,231	160,367	3.19

[a] Included in Other States.
[b] Includes a small production from Kentucky.
[c] Includes the production of Alabama, Kentucky, and North Carolina.

Production of crude barytes, 1882–1906.

Year	Short tons.	Year	Short tons.
1882	22,400	1895	21,529
1883	30,240	1896	17,068
1884	28,000	1897	26,042
1885	16,800	1898	31,306
1886	11,200	1899	41,894
1887	16,800	1900	67,680
1888	22,400	1901	49,070
1889	21,460	1902	61,668
1890	21,911	1903	50,397
1891	31,069	1904	65,727
1892	32,108	1905	48,235
1893	28,970	1906	50,231
1894	23,335		

IMPORTS.

A ruling of interest and importance to manufacturers of barium compounds is the decision of the Treasury Department of July 26, 1906. By the terms of this decision precipitated barium carbonate became dutiable at the rate of 25 per cent ad valorem under the provisions of paragraph 3 of the tariff act of 1897. Up to November, 1901, barium carbonate, or witherite, had been on the free list; at that time it was made dutiable, but the duty was soon set aside. Thus for several years previous to 1906 the material was imported duty free under the name witherite, or native carbonate. This gave opportunity for large quantities of precipitated carbonate to be brought into the country under an erroneous designation. The addition of the duty to precipitated carbonate has permitted a revival of its manufacture in this country, and at present at least one plant, that of the W. D. Gilman

Company, at Sweetwater, Tenn., is engaged in its production. This plant has an output of 2 tons daily and is producing an excellent grade of material, testing 98.5 per cent $BaCO_3$.

In the following table are given the quantity and value of the manufactured and crude barytes imported into the United States since 1902:

Barytes imported and entered for consumption in the United States, 1902–1906, in short tons.

Year.	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
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
1906	4,807	37,296	9,190	27,584

The table below gives the kind and value of the imports of various other barium compounds in 1904, 1905, and 1906:

Value of the imports of barium compounds in 1904, 1905, and 1906.

Barium compound.	1904.	1905.	1906.
Witherite, barium carbonate	$46,133	$45,073	$55,405
Barium binoxide	102,076	111,856	152,403
Barium chloride	43,694	47,386	65,242
Blanc fixe, or artificial barium sulphate	50,901	53,112	61,961
Total	242,804	257,427	335,011

CANADIAN PRODUCTION.

According to the Geological Survey of Canada there were produced in 1906 in the Dominion 4,000 short tons of barytes, valued at $12,000, as against 3,360 short tons, valued at $7,500, in 1905.

STRONTIUM.

The most common ores of strontium are celestite, the sulphate of strontium ($SrSO_4$), and strontianite, the carbonate of strontium ($SrCO_3$). Celestite occurs associated with limestones, and also with beds of clay, rock, salt, gypsum, and deposits of sulphur. Localities where it has been observed in the United States are on Drummond Island, Lake Huron; Put-in-Bay, Lake Erie, Blair County, Pa.; Brown County, Kans.; and about 5 miles north of Austin, Tex. The latter deposit was described by Dr. J. H. Pratt[a] in 1905, and in 1907 it was visited by Mr. F. L. Hess, of the United States Geological Survey, who reports the presence of strontianite in the deposit as an alteration product of the celestite.

No strontium ore was shipped from the Texas deposit in 1906, and no production has been reported from the United States. Limited quantities of the material are converted in Germany into the soluble salt strontium nitrate, which is used chiefly to produce red fire in pyrotechnic displays.

[a] Pratt, J. H., Mineral Resources United States for 1904, U. S. Geol. Survey, 1905, pp. 1101-1102.

Imports.—Strontium salts valued at only $108 were reported by the Bureau of Statistics for 1906. This does not represent the total value of this material imported, since a single firm manufacturing pyrotechnic goods has reported an annual consumption of $5,000 worth of strontium nitrate, which it imports from Germany. Evidently the importation has been reported as some other substance, or else it has been grouped with other materials.

RECENT LITERATURE.

The following papers represent the important articles of recent date pertaining to the occurrence and technology of barytes:

Engineering and Mining Journal. Barytes: Mineral industry during 1905, New York, 1906, pp. 42–45.

Higgins, Edwin. Barytes and its preparation for the market: Eng. News, vol. 53, February 23, 1905, pp. 196–198.

Judd, Edward K. The barytes industry of the South: Eng. and Min. Jour., April 20, 1907, pp. 751–753.

Lakes, Arthur. A new and large deposit of barytes in Idaho: Min. Reporter, August 16, 1906.

Miller, A. M. The lead and zinc bearing rocks of central Kentucky, with notes on the mineral veins: Kentucky Geol. Survey Bull. No. 2, 1905, pp. 24–35.

Pratt, Joseph Hyde. Production of barytes in 1904: Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, pp. 1095–1101.

Stose, George W. Barite in southern Pennsylvania: Bull. U. S. Geol. Survey, No. 225, 1904, pp. 515–516.

MINERAL PAINTS.

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 oxide, 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, talc, asbestos, barytes, 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 matallurgical processes.

PRODUCTION.

In 1906 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 124,601 short tons, valued at $6,521,104, as against 125,202 short tons, valued at $6,245,173, in 1905, a decrease of 601 short tons in quantity in 1906, but an increase of $275,931 in value.

The decrease in quantity is due chiefly to greater care in eliminating from the statistical returns such pigments as are not directly manufactured from mineral raw materials. On examining the table it will be seen that the decrease fell almost entirely in the undefined class of "other pigments," while all of the true mineral paints showed a decided increase, except umber and sienna and mortar color, which decreased slightly.

The following table shows the production of the various mineral paints from 1903 to 1906, inclusive:

Production of mineral paints, 1903–1906, in short tons.

Kind.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ocher	12,524	$111,625	16,826	$110,602	13,402	$126,351	15,482	$148,049
Umber, Sienna	666	15,367	522	12,960	689	17,004	657	17,394
Metallic paint	25,103	213,109	19,357	204,377	[a] 16,489	176,722	17,992	204,026
Mortar color	10,863	101,792	7,525	84,426	10,494	120,430	10,309	111,720
Zinc white	62,962	4,801,718	63,363	4,808,482	68,603	5,520,240	74,680	5,999,375
Slate [b]	7,106	59,029	5,370	53,709	5,181	44,108	5,481	40,540
Other pigments	....	....	2,736	27,360	10,344	240,318	....	....
Total	119,224	5,302,640	115,699	5,301,916	125,202	6,245,173	124,601	6,521,104

[a] Includes a small quantity of unground material. [b] Slate and shale ground for pigments.

OCHER, UMBER, AND SIENNA.

PRODUCTION.

The quantity of ocher mined in the United States in 1906 amounted to 15,482 short tons, valued at $148,049, as against 13,402 short tons, valued at $126,351, in 1905, an increase in 1906 of 2,080 tons in quantity and of $21,698 in value. The bulk of the ocher now produced in the Cartersville district of Georgia is not used directly as a mineral paint but in the manufacture of linoleum and allied products. Pennsylvania continues to rank first in quantity of ocher produced in the several States. Virginia shows a considerably increased production, and for the first time ocher is reported from Kentucky.

In 1906 the combined production of umber and sienna amounted to 657 tons, valued at $17,394, as compared with 689 tons, valued at $17,004 in 1905, a decrease of 32 tons in quantity in 1906, but an increase of $390 in value.

Production of ocher, 1903–1906, by States, in short tons.

State.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	(a)	(a)	412	$4,750	780	$5,900	500	$4,470
Georgia	5,212	$47,908	4,752	44,142	4,209	43,481	5,550	58,350
Pennsylvania	4,937	34,782	4,077	29,355	7,789	72,360	8,597	79,244
Vermont	(a)	(a)	2,176	5,200	(a)	(a)	(a)	(a)
Other States	b 2,375	b 28,935	c 5,409	c 27,155	d 624	d 4,610	e 835	e 5,985
Total	12,524	111,625	16,826	110,602	13,402	126,351	15,482	148,049

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.
e Including Alabama, Iowa, Kentucky, Vermont, and Virginia.

Production of ocher, umber, and sienna, 1902–1906, in short tons.

Year.	Ocher.		Umber.		Sienna.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	15,482	148,049	a 657	17,394			16,139	165,443

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, 1902–1906, in pounds.

Year.	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	11,316,868	97,830	113,049	2,233	11,429,917	100,063

Imports of umber, 1903–1906, in pounds.

Year.	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	2,159,914	$17,685	9,656	$587	2,169,570	$18,272
1904	2,261,793	19,727	13,133	784	2,274,926	20,511
1905	2,580,501	20,763	6,783	461	2,587,284	21,224
1906	2,948,539	23,732	6,028	418	2,954,567	24,150

Imports of sienna, 1903–1906, in pounds.

Year.	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	1,873,532	$28,447	1,387	$123	1,874,919	$28,570
1904	1,286,301	22,118	5,770	396	1,292,071	22,514
1905	1,737,909	26,097	2,886	227	1,740,795	26,324
1906	1,941,664	32,673			1,941,664	32,673

WORLD'S PRODUCTION OF OCHER.

In the following table is given the output of ocher in the principal producing countries of the world for the years 1901 to 1905, inclusive, as far as the statistics are available:

World's production of ocher, 1901–1905, in 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
1905	13,402	126,351	18,185	75,238	41,667	655,003	20,175	40,369

Year.	Canada.		Belgium.		Japan.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	2,233	$16,735	2,315	$8,400			[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	192	$764	[a] 2,540	5,531
1905	5,105	34,675	683	2,084	23	243	[a] 3,092	6,817

[a] Umber exports.

METALLIC PAINT.

PRODUCTION.

The production of metallic paint and mortar colors in 1906 amounted to 28,301 short tons, valued at $315,746, a fair increase over the 1905 production, 26,983 short tons, valued at $297,152.

Pennsylvania is the largest producer of metallic paint, with New York second, the other States given in the order of their production being Tennessee, Wisconsin, Ohio, California, Maryland, Connecticut, and Vermont.

The following table gives the production of metallic paint and mortar colors from 1903 to 1906, inclusive:

Production of metallic paint and mortar colors, 1903–1906, by States, in short tons.

State.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Maryland and Tennessee			[a] 5,292	$36,071	6,209	$40,192	5,625	$51,800
New York	11,022	$95,799	4,550	53,150	[b] 7,159	76,990	7,106	79,060
Ohio	771	12,020	1,750	21,300	1,589	20,360	[c] 1,929	19,360
Pennsylvania	12,920	135,010	7,710	107,609	8,596	123,570	11,021	136,086
Other States	11,253	72,072	[d] 7,580	70,673	[e] 3,430	36,040	[f] 2,620	29,440
Total	35,966	314,901	26,882	288,803	26,983	297,152	28,301	315,746

[a] Includes the production of Tennessee only.
[b] Includes a small quantity of unground material.
[c] Includes also a very small quantity from Connecticut and Vermont.
[d] Alabama, New Jersey, and Wisconsin.
[e] California, New Jersey, Virginia, and Wisconsin.
[f] California and Wisconsin.

SLATE AND SHALE.

PRODUCTION.

The principal States producing slate and shale, ground and used as pigments, are Pennsylvania and New York, small quantities also being reported from Arkansas and Iowa. The quantity reported in 1906 was 5,481 short tons, valued at $40,540.

In the table following is given the production of slate and shale ground for pigment from 1903 to 1906, inclusive:

Quantity and value of slate and shale ground for pigment, 1903–1906.

1903	short tons	7,106	$59,029	1905	short tons	5,181	$44,108
1904	do	[a] 5,370	53,709	1906	do	5,481	40,540

[a] Includes mineral and carbon black.

ZINC WHITE.

PRODUCTION.

The production of zinc white, or zinc oxide, continues to increase, the output for 1906, 74,680 short tons, valued at $5,999,375, showing a gain of more than 41 per cent over the production reported five years ago.

The following table gives the production of zinc white from 1903 to 1906, inclusive:

Production of zinc white, 1903–1906.

1903	short tons	62,962	$4,801,718	1905	short tons	68,603	$5,520,240
1904	do	63,363	4,808,482	1906	do	74,680	5,999,375

IMPORTS.

The following table shows the quantity of zinc white, dry and in oil, imported into the United States in the last four years:

Imports of zinc white, 1903–1906, in pounds.

Year.	Dry.		In oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	3,487,042	$171,932	166,034	$16,562	3,653,076	$188,494
1904	2,585,661	138,674	224,244	26,436	2,809,905	165,110
1905	3,436,367	196,220	342,944	40,542	3,779,311	236,762
1906	4,191,476	251,609	292,538	36,457	4,484,014	288,066

LEAD PAINTS, LITHOPHONE, AND VENETIAN RED.

PRODUCTION.

Under this head are included white lead, red lead, Venetian red, etc., which can not properly be classed as mineral paints, as they are secondary products and are not made from crude minerals.

On examining the table it will be seen at once that there are serious discrepancies between the relative quantities of white lead reported "dry" and "in oil" for 1905 and 1906, respectively. Similar discrepancies have occurred in past years, but it is hoped that the use of the revised statistical card, as arranged and sent out for the 1907 production, will insure greater accuracy in the future. The relative quantities of white lead "dry" and "in oil" shown in the 1906 figures are probably close to the truth, while the 1905 figures show entirely too high an output of white lead "dry" and a correspondingly too low output of white lead "in oil."

Production of white lead, sublimed white lead, zinc lead, red lead, litharge, orange mineral, lithophone, and Venetian red, 1903–1906, in short tons.

	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
White lead:								
In oil	62,674	$7,482,487	58,332	$6,935,620	62,767	$7,577,437	93,763	$12,357,632
Dry	51,212	5,355,160	65,014	6,821,309	73,909	8,261,212	38,318	4,571,618
Sublimed white lead	4,296	386,640	6,477	550,587	6,977	732,585	7,988	958,440
Zinc lead	4,500	247,500	5,779	404,530	6,779	474,530	8,124	681,292
Red lead	8,832	1,022,754	10,271	1,206,073	16,378	2,049,888	13,808	1,924,288
Litharge	10,321	1,116,361	} 9,839	1,084,093	19,878	2,307,233	18,910	2,551,346
Orange mineral	651	100,693						
Lithophone	.....	.....	.....	.....	.....	.....	4,300	311,500
Venetian red	7,425	134,635	7,449	137,737	6,879	137,541	13,526	198,394

IMPORTS.

The following table gives the quantity and value of the imports of white lead, red lead, litharge, orange mineral, and Venetian red from 1903 to 1906, inclusive:

White lead, red lead, litharge, orange mineral, and Venetian red imported, 1903–1906, in pounds.

Year.	White lead.		Red lead.		Litharge.		Orange mineral.		Venetian red.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	453,284	$24,595	1,152,715	$40,846	42,756	$1,464	756,742	$36,407	4,867,156	$43,769
1904	587,338	33,788	836,077	30,115	44,541	1,500	766,469	37,178	4,937,397	40,270
1905	597,510	34,722	704,402	26,553	117,757	4,139	628,003	31,106	4,558,998	39,585
1906	647,636	41,233	1,093,639	50,741	87,230	3,737	770,342	42,519	5,432,732	43,091

GEOLOGY AND TECHNOLOGY.

By Edwin C. Eckel.

METALLIC PAINTS OF THE LEHIGH GAP DISTRICT, PENNSYLVANIA.

During the summer of 1906, while the writer was in southeastern Pennsylvania examining the brown iron-ore deposits of that region, advantage was taken of a favorable opportunity to examine the well-known "paint-ore" mines and works near Lehigh Gap, in Carbon County, Pa.

A typical geologic section in this district would be about as follows, from above downward:

Geologic section containing paint ore, Lehigh Gap district, Pennsylvania.

	Feet.
Black slates (Marcellus).	
Clayey limestone ("Upper Helderberg")	0– 6
Clay	0– 1
Paint ore	0– 6
Clay	2–20
Sandstone (Oriskany).	

The paint ore is an impure iron carbonate containing considerable clayey matter and some lime carbonate. Near the surface it weathers into brown oxide of iron. The "bed" of paint ore is not continuous, but thickens or thins, and in places disappears entirely. As to its continuity in depth no definite data are available, but at several mines the ore is said to thin markedly in depth, while the limestone bed thickens. These conditions can perhaps be interpreted best by assuming that the "paint-ore" deposit is the result of a replacement of the "Upper Helderberg" limestone.

The typical paint ore is light blue in color and rather distinctly laminated. Except for weight, it might readily be mistaken for a sandy shale. Occasionally fossils are present in the ore, in which case it looks still less like an iron ore. Grains and nodules of iron pyrite are scattered through the ore, but not to any considerable extent. The larger nodules of pyrite are picked out before the ore is sent to the kiln, and some sulphur is roasted off, but a sufficient number of small grains remain to give the paint a sulphur content of from one-half to 1 per cent.

Analysis of crude paint ore, Lehigh Gap district, Pennsylvania.

Silica (SiO_2)	16.21
Alumina (Al_2O_3)	5.49
Iron oxide (FeO)	44.50
Manganese oxide (MnO)	1.19
Lime (CaO)	3.51
Magnesia (MgO)	1.08
Sulphur (S)	.67
Phosphorus (P)	.02
Carbon dioxide and organic matter Water	24.35

The analysis given above was made by A. S. McCreath.[a] The sample analyzed is evidently far richer in iron than the average material used in the manufacture of paint, as can be seen in comparing this analysis with the analyses of finished paint given later.

Two firms are now operating in the district. Prince's Manufacturing Company is operating 2 kilns (one west of Millport, the other at Bowmans) and 3 mills, all at Bowmans. The Prince Metallic Paint Works operates kilns and a mill about half a mile east of Lehigh Gap.

The kilns used in the district are circular internally, with an interior section about 5 feet in diameter and about 16 feet in height. The fuel used is wood, burned in two furnaces, the heat being conveyed to the charge by a checkerwork of brick.

The ore is charged at the top of the kiln at the rate of 8 to 10 long tons a day. As the kiln holds about 16 tons, the ore is roasted for about two days. One cord of wood will roast 8 to 10 tons of ore. During the roasting the ore loses from 10 to 20 per cent in weight, and the lumps assume a brownish-yellow color on the outside. When broken open and pulverized, the powder is a deep brownish red.

The roasted ore is crushed to about quarter-inch size in a Mosser pot crusher and then pulverized by millstones. The latter are of several types. At a plant at Bowmans 5 of the 6 stones in use were French buhrs. The other was a vertical rock-emery mill. At the Lehigh Gap plant all of the 7 mills were rock-emery. Four of them were horizontal under-runner stones. The other 3 were vertical. It is generally assumed that six sets of stones will handle the product from one kiln.

The composition of the metallic paint from this district is fairly indicated by the following analyses:

Analyses of finished metallic paint, Lehigh Gap district, Pennsylvania.

	1.	2.	3.	4.
Silica (SiO_2)	37.20	37.20	35.30	37.79
Alumina (Al_2O_3)	9.60	9.40	10.70	10.61
Iron oxide (Fe_2O_3)	43.30	42.70	43.30	41.28
Manganese oxide (MnO)	.35	1.40	1.83	1.27
Lime (CaO)	.10	1.70	2.00	3.00
Magnesia (MgO)	3.35	1.70	1.91	2.03
Sulphur trioxide (SO_3)	2.38	1.88	1.95	1.94
Phosphorus pentoxide (P_2O_5)	.17	.14	.15	.14
Carbon dioxide and organic matter (CO_2)	2.40	2.60	1.50	2.68
Water	.60	.60	.90	....
Metallic iron (Fe)	30.30	29.90	30.30	28.90
Sulphur (S)	.95	.75	.78	.77

Analyses 1, 2, 3 furnished by Mr. Thompson, president Prince Metallic Paint Company; analysis 4 quoted from Ann. Rept. Pennsylvania Geol. Survey for 1886.

The paint made in this district is a browner red than that made from the oolitic red hematites at Franklin, N. Y., and Chattanooga, Tenn. It is used mostly for car and other structural work, very little being used as mortar color.

Until quite recently the standard package for this paint was a 300-pound barrel, but now the larger consumers (car shops, etc.) prefer a 500-pound barrel. A portion of the product is packed in 100-pound kegs.

[a] Ann. Rept. Pennsylvania Geol. Survey for 1886, pt. 4, p. 1404.

METALLIC PAINT IN TENNESSEE AND GEORGIA.

In a recent publication Ernest F. Burchard has summarized certain facts relative to the metallic-paint industry of these States. The following extracts from his report[a] are of interest here:

At certain localities in northwestern Georgia and southeastern Tennessee the Clinton oolitic hematite occurs in beds too thin to be profitably mined as iron ore under present conditions. Much of this red ore is of the "soft" variety and contains an unusually high percentage of ferric oxide, with but little silica and alumina and practically no lime. Its chemical composition renders it an ideal red-paint material, and, owing to its physical condition, it is easily crushed and ground. With the rapid increase of building in the South, together with the manufacture of railroad cars and structural iron, has come a demand for metallic paint that has given these beds of ore an unexpected importance.

The reasons why this ore can be profitably mined for paint material and not for iron making are briefly these: In order to bring the cost of production within the limits of market prices of smelting ores, mining must be conducted on a scale involving the use of power, cables, and general mine equipment, and usually a railroad spur a mile or more in length would have to be built. The total amount of ore in sight indicates that the beds would be exhausted too soon to warrant this outlay. Furthermore, the nature of the deposits is likely to be such that a larger quantity of shale than ore would have to be removed either to win the ore or to provide the head room necessary for regular mine work, thereby rendering it doubtful whether the ore could profitably be worked for iron, even if the quantity in sight were assuredly greater.

When the right kind of ore occurs under these conditions, it is sufficiently valuable to paint manufacturers to bear the cost of mining by hand and of haulage by wagon to the nearest railroad. Ordinary grades of iron ore, such as are smelted in the district, are not suitable for paint manufacture, and therefore they can not compete with the more expensive material here considered, although a small amount of high-grade ore that would otherwise be smelted is sold by the iron producers to paint makers on account of the good price it commands.

Most of this ore that is used for paint is ground by mills at Chattanooga, but part of it goes to Birmingham. The paints made are the reds and dark browns, and a considerable quantity of the ground oxide is sold for coloring sand-lime bricks and mortars for pressed-brick work.

Analyses of representative paint ores from northwestern Georgia and southeastern Tennessee.

	1 (Estelle, Ga.).	2 (Ooltewah, Tenn.).	3 (Hinch's Switch, Tenn.).
Iron oxide (Fe_2O_3)	72.86	83.14	80.00
Silica	21.00	11.90	16.45
Phosphorus	0.40	....	0.28
Manganese	0.30	....	....

[a] Burchard, Ernest F. Southern red hematite as an ingredient of metallic paint: Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, pp. 430–434.

ASBESTOS.

J. S. Diller.[a]

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 make 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[b] 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 become less silky and their strength is impaired.

OCCURRENCE.

UNITED STATES.

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, South Carolina, North Carolina, Virginia, Connecticut,

[a] Much of this report concerning the properties and occurrence of asbestos is taken from the report by Dr. George Otis Smith for 1905: Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, pp. 1155–1159.

[b] Proc. U. S. Nat. Mus., vol. 18, 1895, p. 281.

and Massachusetts. Georgia, South Carolina, Virginia, and Massachusetts 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, but it is expected that this subject will be given more attention in the near future.

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, pryoxenite, 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 department of the interior of Canada.[a]

Asbestos fiber, aside from its variation in mineral composition and the rocks with which it is associated, has two modes of occurrence, according to which it is designated either "cross fiber" or "slip fiber."[b] Cross-fiber asbestos forms veins in which the fiber in most cases extends directly across the vein, perpendicular to the vein walls. It is often silky and of high grade, ranging in size from a small fraction of an inch to 3 inches in length.

On the other hand, slip fiber occurs in slickenside fault planes, produced by the slipping of one portion of serpentine or amphibole rock along its contact with another portion, generally of the same rock. The fibers produced as a result of the slipping lie in the slipping plane, hence the name slip fiber. The mass of slip fiber in each slip ranges from a mere film to 4 or 5 inches in thickness, and varies greatly in quality from long, smooth, flexible, tough fiber, excellent for textile purposes, to short, harsh, brittle fiber, of small tensile strength.

Cross fiber is generally, if not always, chrysotile. As far as yet known definitely, amphibole does not occur in distinct cross-fiber veins. Cross fiber is for the most part of good quality, but slip fiber, though often of chrysotile, varies greatly in its properties. The brittle, splintery form appears to be amphibole. It is important to note that in serpentine, where the cross-fiber asbestos is all chrysotile, the slip fiber is frequently in part amphibole. In some of the Canadian mines much of the slip fiber is rejected on the ground that it does not work well with cross fiber of higher grade. In other mines by far the greater part of the fiber mined is slip fiber, and its quality may be excellent, though generally somewhat inferior to the cross fiber.

In both the Quebec and the Vermont localities the chrysotile forms irregular veins of cross fiber and sheets of slip fiber in the serpentine rock. These thin cross-fiber 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 igenous 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

[a] Cirkel, F., Asbestos: Mines Branch, Dept. of Interior, Canada, 1905.
[b] Bull Geol. Soc. America, vol. 16, 1905, p. 433.

only in regions of crystalline siliceous rocks that have been subject 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."[a]

Georgia.—The Sall Mountain district of Georgia is one of the oldest and most active producers in this country, a fact which is due in large measure to cheap mining and convenient transportation.

Virginia.—Virginia has been one of the principal producers for several years, the chief activity being in Bedford City, where special fiberizing machinery has been devised and successfully used. Rocky Mount, in Franklin County, has recently furnished some excellent specimens of high-grade amphibole asbestos 18 inches in length. The fibers are remarkably uniform, free from cross fractures and impurities, and promise well for some purposes. With convenient railroad transportation, if the material is abundant and can be cheaply mined, Virginia may be expected to become a producer of greater importance.

Massachusetts.—Massachusetts has been a producer for a number of years at Dalton, but the output in 1906 was considerably less than in 1905. This is due simply to the inequality of the deposit. The asbestos is mined in connection with talc, in which the asbestos forms pockets ranging in quantity from a few pounds to several tons, and the output varies according to the number and size of the asbestos pockets encountered. The asbestos is wholly in the form of slip fiber, and, according to Dr. F. E. Wright, who kindly determined the material for me, is anthophyllite, and not chrysotile, as is generally supposed. The method of milling is remarkably simple. The material is first put through a rotary crusher and then through a small buhrstone mill, and is then sold without separating any portion of the fiber whatever.

Vermont.—The discovery of asbestos (chrysotile) in Vermont in the same belt of rock which contains the valuable asbestos mines of Canada, gave rise some years ago to considerable activity in prospecting, which resulted in the construction of a mill for the treatment of asbestos ore. The mill, in its machinery, was fashioned after those of Canada, and failed, it is claimed, in not saving the finer fiber. Since 1903 matters have been practically at a standstill until recently, when a new impetus was given to the business by the formation of two new companies and the beginning of two new mills, now in course of construction on the slope of Belvedere Mountain.

The asbestos district of Vermont may be conveniently referred to as the Lowell region, from the name of the principal village and stopping place; it is situated 18 miles southwest of Newport, or 13 miles by stage south of North Troy, on the Canadian Pacific Railway. There are three important localities. One is 2 miles northeast of Lowell; the other two are southwest of Lowell, one 5 miles, on the eastern slope of Belvedere Mountain, and in Lowell Township, and the other 6 miles, on the southeastern slope of Belvedere Mountain, in the town of Eden.

The region was first studied by Prof. J. F. Kemp,[b] and later with more detail by Mr. V. F. Marsters,[c] and both regarded the locality as

[a] Min. World, March 24, 1906.
[b] Mineral Resources U. S. for 1900, U. S. Geol. Survey, 1901, pp. 862–866.
[c] Bull. Geol. Soc. America, vol. 16, 1903, p. 419.

bidding fair to yield commercial asbestos. The most promising locality, as pointed out by the authors noted, is that opened by Judge Tucker on the east slope of Belvedere Mountain, where, at the time of the present writer's examination, a considerable number of $\frac{3}{4}$-inch veins and many smaller ones of good quality of silky cross fiber were seen traversing the mass of serpentine, in which slickensides containing much slip fiber are a prominent feature. Much of the rock is permeated by slip fiber of distributed faulting; and a large portion of the slip fiber is white, flexible, and tough, but lacks the silky luster of the cross fiber and locally becomes brittle.

Though no material belonging to class No. 1 crude was seen, there is certainly a considerable portion of No. 2 crude, which could be obtained by hand cobbing, and much of the rock is similar to that furnished to the mills of Thetford, Canada. While it is true, on the whole, that the rock is not as rich as the average of the Canadian mines, it appears sufficiently rich to warrant the expectation that, with proper management, it can be successfully mined. The method of milling which it is preferred to use at Belvedere Mountain is similar to that successfully applied for a number of years at Sall Mountain, Georgia, and Bedford City, Va.

The failure of the earlier endeavor at this place is attributed by some to the fact that cyclone fiberizers were employed and much of the fiber was lost in dust.

Wyoming.—Natrona County reports an increase in production of chrysotile, with an estimated value of $150 per ton. The specimens of cross fiber exhibited are fine and silky and from one-sixteenth to three-fourths of an inch in length. Several companies are active in the region, and they report that the chrysotile occurs in a large serpentine dike 150 to 600 feet wide and 6,000 feet long. The principal determining factors in the development of this deposit will be the quantity of good fiber present in proportion to the inclosing serpentine rock and the distance to market. A manufacturing firm has tried this material and regards it with favor for making pipe covering.

Arizona.—An increased production of chrysotile is reported from the mine in the Grand Canyon, Arizona, though none has been sold. The fine quality of the fiber, as well as the regularity of the seams, was considered by Dr. J. H. Pratt, who examined the deposit and reported on it in 1904, as favoring the operation of the deposit.

California.—One of the direct consequences of the earthquake and fire of San Francisco is a greatly increased demand for asbestos on the Pacific coast. Prospecting for asbestos has been stimulated. The large masses of serpentine in the Klamath Mountains and in portions of the Sierra Nevada afford promising fields. Several new finds have been reported from California, near the western border of the great belt of serpentine which extends from Plumas County south through Sierra, Nevada, Placer, Amador, and Calaveras counties. Persistent mines have not yet been established, though productive prospects occur at several points, and a manufacturing plant is said to be in course of construction at Long Beach.

Oregon and Texas.—In Oregon a new and attractive discovery has been reported[a] 10 miles west of Kerby and another is announced from Taylor, Tex., but no detailed information concerning them is available.

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[a] Oregon Min. Jour., January 19, 1907.

CANADA.

The eastern townships of the Province of Quebec furnish the greater part, 85 per cent, of the world's production of asbestos. In 1906[a] Canada exported 59,864 tons of asbestos, valued at $1,689,257, most of which came to the United States. The output is increasing; and in 1906 there were observable improvements in plant and machinery in some of the older mines, the opening up of new and promising properties, and a tendency toward the consolidation, under one management and ownership, of a number of mines formerly separately owned.

URAL MOUNTAINS.

Renewed attention is being given to the deposits in the Ural Mountains, but their possible development can not yet be foretold. The ground is said to carry more asbestos to a given area than the Canadian mines, but the veins are not so thick nor is the color very white. A large force of cheap labor is employed, with primitive methods and as yet no proper milling plant.

INDIA AND WESTERN AUSTRALIA.

Extensive deposits of asbestos have recently been reported from Northwest India, and in the vicinity of Perth, in western Australia, but little information concerning these discoveries has been published.

USES.

The uses of asbestos are many and constantly increasing. They depend primarily upon its fibrous character, but largely also upon its slow conduction of heat and electricity. As amphibole asbestos is less strong than chrysotile, the latter is the more valuable and useful, especially for products involving spinning. The amphibole asbestos is chiefly used in the manufacture of boiler lagging, steam-pipe covering, and insulating cements for general application. 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 in which heat-insulation is required rather than fireproof qualities.

It is extensively used for plastering and for making lumber that is employed throughout buildings and especially on the roof, where insulation against fire and electricity are desired. Being a slow conductor of heat, its use contributes greatly to comfort and protection against extremes of heat and cold. Its application in fireproof structures, and especially to envelop electrical conductors, is rapidly increasing, and the demand is said to be much greater than the supply.

PRODUCTION AND IMPORTS.

The output of asbestos in the United States for 1906 was 1,695 tons, valued at $28,565. This is a decrease of nearly one-half from the reported output for 1905. Approximately 1,540 tons of the output

[a] Mineral Production of Canada for 1906, Canada Geol. Survey, 1907, p. 13.

came from Georgia, Virginia, and Massachusetts, and is fibrous amphibole. The remainder, from Wyoming and Arizona, is chrysotile, as is probably also that of California.

The following table includes the statistics of asbestos in the United States and of asbestos imported into this country since 1890. Both the quantity and the value of the United States output 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, 1890–1906.

Year.	Production.		Imports.		
	Quantity (short tons).	Value.	Unmanufactured.	Manufactured.	Total.
1890	71	$4,560	$252,557	$5,342	$257,899
1891	66	3,960	353,589	4,872	358,461
1892	104	6,416	262,433	7,209	269,642
1893	50	2,500	175,602	9,403	185,005
1894	325	4,463	240,029	15,989	256,018
1895	795	13,525	225,147	19,731	244,878
1896	504	6,100	229,084	5,773	234,857
1897	580	6,450	263,640	4,624	268,264
1898	605	10,300	287,636	12,897	300,533
1899	681	11,740	303,119	8,949	312,068
1900	1,054	16,310	331,796	24,155	355,951
1901	747	13,498	667,087	24,741	691,828
1902	1,005	16,200	729,421	33,011	762,432
1903	887	16,760	657,269	32,058	689,327
1904	1,480	25,740	700,572	51,290	751,862
1905	3,109	42,975	776,362	70,117	846,479
1906	1,695	28,565	1,010,454	65,716	1,076,170

While it is true that Canada in a measure controls our asbestos industry, the advance in the price and the increasing demand should greatly stimulate prospecting for asbestos in the United States.

It is stated on good authority [a] that "those familiar with the asbestos market are aware that the present supply of asbestos is not sufficient to meet the world's demand. This is principally due to the increasing uses and applications of the mineral for industrial purposes. It may be affirmed that the output of all the existing asbestos mines is insufficient to supply two-thirds of the demand for this product, and the leading manufacturing firms interested in the industry are diligently searching for new deposits."

CANADIAN PRODUCTION.

The production of asbestos in Canada in 1906 is reported as 59,283 short tons, valued at $1,970,878, as against 50,670 short tons, valued at $1,486,359, in 1905. The production of asbestic in 1906 was 20,127 short tons, valued $17,230, as against 17,594 short tons, valued at $16,900, in 1905.

PRICES.

The average price per ton of sales reported in 1906 is $16.86. This represents an increase of $3.04 per ton over the average price for 1905. The lowest price for actinolite was $8 per ton; the lowest price

[a] Cirkel, Fritz, Canadian Min. Jour., April 1 and May 15, 1907.

for amphibole asbestos was $17.61; and the highest price for chrysotile was $30, though some as yet unsold was estimated at $150 per ton.

The Canadian production[a] of asbestos, wholly chrysotile, was 59,283 tons, valued at an average of $33.25 per ton, an advance of 23 per cent on the average price for 1905. Of this product, one-fifteenth classed as crude was valued at $165 per ton, and the remainder, called mill stock, at $24 per ton. The lowest grade of asbestos mine product is the "asbestic"[b] of commerce. It is the rock which has been reduced to sand in the mill, contains some asbestos, and is used extensively for fireproof wall plaster. The production of asbestic from the Canadian mines in 1906 was valued at 85 cents per ton.

These prices afford data in estimating the value of asbestos deposits, but of greater importance is the relative proportion of asbestos in the rock mined. Cirkel[c] states that an average of from 30 to 60 per cent of all the rock mined is suitable for milling. In the majority of the mills 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 usually 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.

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[a] Mineral Production of Canada, 1906: Canadian Geol. Survey, 1907, p. 13.

[b] Cirkel, F., Asbestos, its occurrence, exploitation, and uses: Mines Branch, Dept. of Interior, Canada, 1905, p. 136.

[c] Op. cit., pp. 77–81.

ASPHALT AND BITUMINOUS ROCK.

By Joseph A. Taff.

INTRODUCTION.

The term asphalt is used here in its broader sense as commonly applied and is made to include both the natural and the refined forms of viscous or semisolid bitumen, which is perhaps properly termed asphaltum, a similar but usually more liquid hydrocarbon termed mastic, derived from bituminous rock, and a refined by-product, an almost pure bitumen, obtained in the distillation of certain crude asphaltic oils. The last-named class is termed oil asphalt and is now refined in large quantity on the Pacific and Gulf coasts of the United States. In addition to these the term asphalt is made to include the series of solid hydrocarbons or asphaltites specifically named wurtzilite, gilsonite, grahamite, etc. Ozokerite, a true hydrocarbon, a mineral wax, is a natural paraffin and has been classed statistically with asphalts. No production of ozokerite during 1906 was reported.

It appears that there are gradations between the various species of the solid asphalts depending upon the composition or relative quantities of the more volatile constituents. In fact, it is found that there are often variations within single veins and large masses of gilsonite or other asphalts sufficient to separate them into grades.

OCCURRENCE.

The asphaltic hydrocarbons considered in this report occur naturally in three principal forms: (1) In the viscous semiliquid state, filling interstices and cavities in rock of almost every class, but found most abundantly in sand as asphaltic sand and in sandstone and limestone strata, as a rule, because of their greater porosity; (2) as viscous and semisolid tenacious exudations from the earth, either directly from the exposed bituminous rock or from subterranean passages; (3) as solids in the form of veins or bodies cutting across or extending between beds or masses of rock. The asphalts are found in commercial quantity in or associated with sedimentary rocks of almost all kinds and of all ages from the Ordovician to the Pleistocene. They are found in smaller quantity impregnating schists, and sparingly even in igneous rocks.

Very extensive deposits of asphaltic shale and sandstone are found in California in and contiguous to the oil fields from the vicinity of Santa Cruz southeastward, generally parallel with the coast line. The bitumen permeates porous sandy strata and exudes at the surface from highly bituminous oil-bearing deposits. The asphalt in this region appears, for the most part, to be a natural residue from the same crude oil from which oil asphalt is recovered by distillation in the California oil fields at the present time.

Indian Territory, Texas, Kentucky, and Utah contain also extensive deposits of bituminous rock. The bituminous rock in Indian Territory is found chiefly in the Chickasaw Nation. The bitumen here occurs in Ordovician, Carboniferous, and Cretaceous sandstones and in Ordovician limestones. The market product in this field has been in the form of bituminous rock and mastic. The bituminous rock in Texas is an asphaltic sand and limestone occurring in the basal Cretaceous of Montague and Burnet counties, an asphaltic limestone of upper Cretaceous age in Nueces County, and the asphaltic limestone of Uvalde County, which appears to be of greater importance at the present time than the bituminous sandstone. This limestone is very porous, the interstices and cavities containing a semisolid asphalt equal to 14 or 15 per cent of the whole rock. The asphalts of Kentucky occur as bituminous impregnations of Carboniferous sandstone in the western part of the State, principally near Garfield, Leitchfield, Beespring, and Russellville. They occur in beds of flat-lying rock and have been interpreted as residues in what were once subterranean oil pools. The bituminous rock of Utah is confined chiefly to Tertiary strata and is found for the most part in the Roan Cliffs in northeastern Carbon County and in the north end of the Wasatch Plateau east of Thistle Junction. In the Roan Cliffs there appear to be extensive deposits of asphaltic sandstone and limestone of considerable thickness, and the deposits east of Thistle Junction are considerably enriched bituminous limestones.

The development of bituminous rock deposits has decreased recently, as may be seen by reference to the table of production. The larger output has been from California, and is at present in a measure replaced by the increased production of oil asphalt.

Of the solid hydrocarbons, ozokerite is relatively the most valuable, and it is at the present time the rarest of the commercially valuable hydrocarbons. In order of value follow wurtzilite (in trade elaterite), gilsonite, grahamite, etc. Ozokerite[a] occurs in narrow fissures and zones of crushed rock cutting Tertiary strata near Midway, Soldier Summit, and Colton station, on the Rio Grande Western Railroad in Utah. During 1906 operations were inactive on account of litigation. Exploitation of ozokerite has been recently resumed at Midway.

Wurtzilite (elaterite) occurs in vertical vein deposits cutting flat-lying Tertiary sediments in the western part of the Uinta basin, Utah, about 50 miles south of Fort Duchesne. Uintaite (in trade gilsonite) occurs like wurtzilite, but in greater quantity. The veins are larger as a rule, and at places attain widths of several feet. In some instances they are known to extend for many miles in length and to an unknown depth. They are found from the vicinity of Fort Duchesne southeastward to the edge of Colorado. Similar deposits also occur southwest of Fort Duchesne in the vicinity of the wurtzilite veins. One difficulty in the development of the asphalt deposits of the Uinta region has been poor transportation facilities. Recently a railroad has been built across Roan Cliffs from the Rio Grande Western Railroad to the

[a] For further information see Ozokerite deposits in Utah: Bull. U. S. Geol. Survey No. 285, 1906, pp. 369-372.

gilsonite fields along the Utah-Colorado line, and there is a probability of the early construction of a railroad into the region from the east.

An asphaltite closely related to albertite or grahamite occurs at several localities in Indian Territory, and is known in the trade as grahamite. One of these localities is in the central part of the Choctaw Nation between the St. Louis and San Francisco and the Missouri, Kansas and Texas railroads. It occurs in vertical veins through highly folded sandstone and shale of Carboniferous age. The veins vary in width from thin stringers to bodies several feet thick. An asphaltite of similar nature is found in the western Chickasaw Nation near Loco. It occurs filling vertical fissures through flat-lying shale and sandstone strata of probable Carboniferous age. Similar but more highly carbonaceous products are found as fissure fillings in the district east of Page, in the eastern part of the Choctaw Nation, and in western Arkansas. It is reported, however, that the last-named deposits are not convertible into products of commercial use. These grahamite deposits are characterized by perfect blackness, high luster, brittleness, and a high grade of purity. One other and the original locality for grahamite in the United States is in Ritchie County, W. Va., 25 miles east of Parkersburg. It occurred here filling a vertical fissure across Carboniferous strata. The available supply was exhausted, and mining has long since been abandoned.

USES.

Bituminous rock, like any other rock, is obtained by quarrying or excavating, and is a natural mixture of bitumen and the including rock, usually consisting of sandstone or limestone. For paving or roofing it must be crushed, and for successful use the bituminous or asphaltic content must be brought to the proper consistency and quantity with respect to the stone matrix. The mastic extracted from the bituminous rock in the presence of heat and moisture naturally carries a percentage of earthy impurities, as do the malthas and viscous asphalts that occur exuding at the surface of the earth. The extracted and the natural asphalts are used largely for street paving. The natural asphalt imported from Trinidad and Venezuela supplies a large part of the eastern United States for street paving. They are refined and utilized also for roof and other metal paints.

The oil asphalt produced in various stages of refinement in California and Texas seems to meet all demands made of an asphalt. In the more liquid state it is a road dressing and a coating as paint for wood or iron substances, and it is used in the manufacture of building papers. In the refined state it is a practically pure asphalt, being free from earthy silts commonly carried by the natural product. It seems to be growing in favor in the trade as street-paving material, as roof tiling, and for all other uses to which an asphalt is commonly applied. Although hampered in its use by long freight haulage, yet large quantities are introduced into the markets of eastern United States for paving purposes.

The natural ozokerite in Utah contains a small but variable percentage of harder varieties of bitumen that give it shades of dark brown to black and hardness ranging between that of beeswax and a brittle solid approaching the consistency of wurtzilite. It is the most valuable of the solid hydrocarbon products and is rated in the market at between $200 and $300 per ton. It is used as a leather polish, in sealing wax, pencils, etc., and when refined it is light yellow to white and is manufactured into candles for special purposes. It is used also as an insulator, and is said to make a good acid-proof coating.

Wurtzilite (in the trade elaterite), uintaite (gilsonite), and grahamite in the refined state are of notable use as varnish or paint for metal and other surfaces. They are said to be excellent for acid-proof coating and for marine paint. Gilsonite and grahamite are used extensively as roofing and metal paint for exterior work; the paint presents a solid, glassy surface, and resists the heat and moisture of the weather.

Manjack, an asphaltite resembling wurtzilite and high-grade gilsonite, is imported from Barbados, and is used in the manufacture of a black varnish of superior quality.

PRODUCTION.

The following table presents the output of all classes of asphalt, both natural and refined, including bituminous rock, that enter the market from quarries and refineries in the United States. The production in 1906 was 138,059 short tons, valued at $1,290,340, as against 115,267 short tons, valued at $758,153, in 1905, an increase in 1906 of nearly 20 per cent in quantity and of 70 per cent in value.

Production of asphalt and bituminous rock, 1882–1906, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1882	3,000	$10,500	1895	68,163	$348,281
1883	3,000	10,500	1896	80,503	577,563
1884	3,000	10,500	1897	75,945	664,632
1885	3,000	10,500	1898	76,337	675,649
1886	3,500	14,000	1899	75,085	553,904
1887	4,000	16,000	1900	54,389	415,958
1888	50,450	187,500	1901	63,134	555,335
1889	51,735	171,537	1902	105,458	765,048
1890	40,841	190,416	1903	101,255	1,005,446
1891	45,054	242,264	1904	108,572	879,836
1892	87,680	445,375	1905	115,267	758,153
1893	47,779	372,232	1906	138,059	1,290,340
1894	60,570	353,400			

PRODUCTION OF ASPHALT, BY VARIETIES AND BY STATES.

The total production, by varieties, for four years is given in the next table, and the production in 1906, by States as well as by varieties, in the succeeding table. Reports from producers for 1906 have not distinguished between bituminous sandstone and bituminous limestone. The localities from which the reports of production come induce the belief that almost the entire output of this class is bituminous sandstone. The record shows a continued decrease in the production of bituminous rock. California is by far the largest producer, and the decline in output is doubtless due to the growing production of oil asphalt in that State. Kentucky stands second in the production of bituminous rock, and is the only producer of mastic, the extracted bitumen.

The great increase in 1906 in the production of hard and refined, or gum, asphalt is due chiefly to the new refinery development in Texas, though the production in California for 1906 is more than 100 per cent in advance of the total for 1905. Likewise, the great increase in the production of maltha, more than twice the total output for 1905, is due to the Texas industry.

California stands almost alone in the output of oil asphalt, with a large increase over the production of 1905. A very small production is reported from Texas.

In certain reports of the production of wurtzilite and uintaite by single operators the two classes were not distinguished, and hence the production of the two is included together in the table. There are reasons to believe that the production of wurtzilite was small as compared with that of uintaite.

Production of asphalt, 1903–1906, by varieties, in short tons.

Variety.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	38,633	$118,001	46,641	$138,465	39,273	$94,972	24,085	$70,686
Bituminous limestone	2,520	8,800	1,798	4,495	6,029	42,000	....	....
Mastic	961	11,532	1,200	10,800	2,200	22,000	2,543	24,158
Hard and refined, or gum	12,896	343,799	6,637	141,446	3,036	41,438	24,178	341,106
Liquid, or maltha	58	1,150	3,363	36,320	3,139	34,292	9,900	86,750
Wurtzilite[a]	....	....	550	50,000	500	44,000	} 12,947	159,960
Gilsonite	....	....	2,978	14,175	10,916	47,040		
Grahamite	....	....	1,000	25,000	....	....	1,952	16,432
Ozokerite	....	....	....	....	5	1,500	....	....
Oil asphalt	46,187	522,164	44,405	459,135	50,169	430,911	62,454	591,248
Total	101,255	1,005,446	108,572	879,836	115,267	758,153	138,059	1,290,340

[a] Erroneously entered as "elaterite" (trade name) in the report for 1904. Prior to 1904 included under "Hard and refined, or gum."

Production of asphalt in 1906 by varieties and by States, in short tons.

Variety.	California.		Utah.		Indian Territory.	
	Quantity.	Value.	Quantity,	Value.	Quantity.	Value.
Bituminous sandstone	20,418	$47,427	....	....	738	$2,029
Mastic	....	....	....	....	....	....
Gum	8,178	101,106	....	....	....	....
Maltha	1,000	20,000	....	....	....	....
Uintaite (gilsonite) and wurtzilite (elaterite)	....	....	12,947	$159,960	....	....
Grahamite	....	....	....	....	1,952	16,432
Oil asphalt	62,361	590,046	....	....	....	....
Total	91,957	758,579	12,947	159,960	2,690	18,461

Variety.	Kentucky.		Arkansas.		Texas.		Georgia.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	1,629	$7,330	900	$5,400	....	....	400	$8,500
Mastic	2,543	24,158	......	......	......	......	......	......
Gum	......	......	......	......	16,000	$240,000	......	......
Maltha	......	......	......	......	8,900	66,750	......	......
Oil asphalt	......	......	......	......	93	1,202	......	......
Total	4,172	31,488	900	5,400	24,993	307,952	400	8,500

IMPORTS.

The following table shows the imports of asphalt by calendar years from 1903 to 1906 inclusive:

Asphalt imported for consumption into the United States, 1903–1906, in short tons.

Year.	Crude.		Dried or advanced.		Bituminous limestone.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	186,169	$509,755	17,200	$83,591	10,230	$35,010	213,599	$628,356
1904	117,184	490,809	16,766	100,081	6,496	20,236	140,446	611,126
1905	85,014	381,474	9,688	78,639	5,895	19,183	100,597	479,296
1906	100,818	355,493	14,178	114,076	5,086	15,110	120,082	484,679

About two-thirds of the asphalt 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.

EXPORTS.

During the fiscal year ending June 30, 1906, domestic asphalt and manufactures of asphaltic material to the total value of $299,091 were exported from the United States to other countries, as against similar exports valued at $291,120 in the fiscal year ending June 30, 1905.

The most important receivers of these exports were, in the order named: Canada, Mexico, United Kingdom, Argentina, Brazil, and Germany.

EXPORTS FROM TRINIDAD.

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 asphalt 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 time long enough 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 asphalt is coming into the lake from subterranean sources. Excavations in the lake pitch and in the land pitch also, fill again with asphalt in a short time.

The exports of asphalt from the island of Trinidad increased somewhat during 1906, as compared with 1905. According to the report of the New Trinidad Lake Asphalt Company (Limited), through whose courtesy this statistical information regarding the asphalt of Trinidad has been received, the total quantity of asphalt exported from the island for the year ending January 31, 1907, was 145,932 short tons, as against 128,685 short tons in the year ending January 31, 1906, and 151,122 short tons in the year ending January 31, 1905.

About 96 per cent of the material exported in 1906 was obtained from the pitch lake, which is under the control of the New Trinidad Lake Asphalt Company (Limited) under a long-term lease. The lake constantly receives fresh supplies of asphalt 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 2,679,372 short tons of asphalt have been removed from the pitch lake and exported to foreign countries since the records have been kept.

Total exports of asphalt from Trinidad, 1905–1906, in short tons.

Year.	To United States.			To Europe.			To other countries.			Grand total.
	Lake.	Land.	Total.	Lake.	Land.	Total.	Lake.	Land.	Total.	
1905 [a]	53,701	13,581	67,282	54,640	577	55,217	5,900	286	6,186	128,685
1906 [b]	71,902	5,292	77,194	68,284	454	68,738	....	....	....	145,932

[a] Year ending January 31, 1906.

[b] Year ending January 31, 1907.

GRAPHITE.

By George Otis Smith.

INTRODUCTION.

Graphite is one of the minerals of economic value which attract attention because the domestic product supplies so small a part of the demand. In the better grades of graphite the value of imports is over six 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 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 molybdenite is a sulphide and graphite is pure carbon, the two may be readily distinguished by simple blowpipe tests.

OCCURRENCE.

Graphite occurs in the crystalline schists, in which it is found in three general types of occurrence—beds, dikes, and 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.

The bedded deposits of graphite appear to represent sedimentary beds rich in carbonaceous matter which by metamorphism has been converted into graphite. This metamorphism can, in many cases, be attributed to the action of intrusive granitic rock, the development of graphite in the metamorphosed strata being 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.

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 the older 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.

A newly discovered occurrence of graphite belonging to the first type is in the Haystack Hill, Laramie County, Wyo., where pre-Cambrian schist of sedimentary origin has been metamorphosed by large intrusive masses of granite. The graphite occurs rather abundantly as a thinly disseminated constituent of the schist. The richest specimens run between 10 and 16 per cent graphite, and it is estimated that a 10-foot bed would run from 6 to 8 per cent graphite. The close association of this fine and largely amorphous graphite and the mica in the schist might be expected to prohibit a clean separation of the graphite; so that even if this deposit could be worked at a profit, the product would be a low-grade graphite.

Other occurrences of graphite are reported in Washington, Virginia, and Idaho. In Virginia the graphite is reported as occurring in well-defined veins from 1 to 8 feet in width in the crystalline rocks near the Albermarle-Orange county line.

USES.

The characters already mentioned as possessed by graphite make it a mineral of much industrial importance. Its chemical composition constitutes 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 the flake graphite make it especially adapted for use as a lubricant. The high electro-conductivity of the mineral also gives it value for certain electrical supplies.

The largest use that is made of graphite is in the manufacture of crucibles, muffles, brazing boxes, stirrers, 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; 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. 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 paint and for foundry facings. The impure and cheap graphitic material mined in Georgia is used to color fertilizers.

PRODUCTION AND CONSUMPTION.

The total value of the graphite produced in the United States in 1906 was $340,239, an increase of $22,028 over the value of the 1905 output, but with a considerable decrease in quantity. Fourteen operators report production.

The production of crystalline graphite in the States of Pennsylvania and New York in 1906 was 5,887,982 pounds, with a reported value of $238,064, a decrease in quantity of 148,585 pounds, but an increase in value of $492, as compared with the figures for 1905. This brings the average price per pound again slightly above 4 cents, the range of reported values being less than $3\frac{1}{2}$ and over 7 cents. The statistics of production fail to indicate fully the activity of the crystalline graphite industry. Four companies in Pennsylvania have reported development and construction work, which is expected largely to increase the output of that State in 1907. Specimens of high-grade crystalline graphite from Virginia give some promise of that State being added to the list of producers of crystalline graphite.

The graphite produced in the States of Alabama, Georgia, Michigan, Wisconsin, Colorado, Rhode Island, Nevada, and North Carolina 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 some of 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 16,853 short tons, valued at $102,175, as against 21,953 tons, valued at $80,639 for 1905. 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 Pennsylvania leads, with New York second in rank, and Alabama third. The most noteworthy change in the output of 1906 was the large decrease in New York's production, of about one-third in both quantity and value. Pennsylvania and Alabama showed increases for the year, with prospects of further improvement, while Virginia and Montana may become new producers.

The following table includes the statistics of graphite produced in the United States and of graphite imported into this country in the last five years. 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, 1902–1906.

Production.				Imports.		
Year.		Quantity.	Value.	Year.	Quantity.	Value.
					Short tons.	
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	1906	25,487	1,554,212
	short tons	16,927				
1905	pounds	6,036,567	318,211			
	short tons	21,953				
1906	pounds	5,887,982	340,239			
	short tons	16,853				

This composite table shows the annual consumption of natural graphite in the United States. It is noteworthy that, while it produces only about one-fifth of the graphite of the world, this country consumes over 35 per cent of the world's production. A small quantity is exported, but probably mostly in the manufactured form. To this consumption of natural graphite, to the value of over a million and a half dollars, must be added the output of artificial graphite, which is largely consumed in this country. The imports of graphite are mostly from Ceylon. Canada promises to become a larger producer of graphite, as American capital is becoming interested in developing new properties there.

ARTIFICIAL GRAPHITE.

The production of artificial graphite has steadily increased since its introduction in 1897. The quantity manufactured in 1906 amounted to 5,074,757 pounds, valued at $337,204, which is the largest quantity produced in any year since its first introduction on the market. Of the total output, 2,766,000 pounds were ground to a fine powder, and this product was valued at $94,578.

In the following table are given the quantities and value of the graphite manufactured for the last five years:

Production and value of artificial graphite, 1902–1906.

Year.	Quantity (pounds).	Value.	Price per pound (cents).
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	6.83
1906	5,074,757	337,204	6.64

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. A process has been developed during 1906 for treating artificial graphite with tannin. The resulting deflocculated graphite is claimed to be adapted especially for use in lubrication, with either water or oil as a vehicle. 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, 1904, and 1905:

World's production of graphite, 1903, 1904, and 1905, in short tons.

Country.	1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	18,860	$225,554	19,768	$321,372	24,971	$318,211
Austria	32,616	382,148	31,548	386,082	37,937	274,154
Canada	728	23,745	452	11,760	541	17,033
Ceylon	[a] 26,998	1,952,529	[a] 29,187	2,110,873	[a] 34,319	2,307,042
France	139	689	17	130	110	1,351
Germany	4,099	35,411	4,171	40,122	5,424	49,742
India	3,801	82,474	3,647	81,288	2,603	82,085
Italy	8,730	28,855	10,764	44,542	11,654	52,104
Japan	126	10,950	238	18,026	206	15,022
Mexico	1,548	41,635	1,069	47,436	1,069	42,916
Sweden	28	988	61	1,755	44	1,276
Total	97,673	2,784,978	100,922	3,063,386	118,878	3,160,936

[a] Exports.

MAGNESITE.

By Charles G. Yale.

PRODUCTION.

All the magnesite produced in the United States continues to come from California, but the quantity is not large, since the consumption is limited on the Pacific coast, and the native product can not compete at points of greatest consumption east of the Missouri River with that imported from Greece and Austria, owing to prohibitory freight rates from California. The Porterville, Tulare County, deposits yield most of the crude and calcined material, though a few thousand tons are derived from the Red Mountain deposits in Alameda County. Some calcined material is also sold by the manufacturers of carbonic acid gas, who, however, obtain their crude magnesite from the Porterville deposits. At this latter place there are kilns where the calcining is done. The calcined material is mainly used as a digester for wood pulp in paper manufacture, but less is used than formerly, as the manufacturers found they were using more than was really necessary to accomplish the object. For carbonic acid gas manufacture about 800 tons yearly are consumed. The crude magnesite costs in the San Joaquin Valley about \$3 per ton, and the freight to San Francisco Bay is \$3 per ton. The calcined sells for a lower price than formerly, and that sold in San Francisco is \$14 per ton free on board at factory. The prices for labor and mining are now higher than formerly and add about \$1 per ton to the cost of the crude. In the matter of the calcined the variation in the price depends on the amount of roasting given it. That resulting from the work of manufacturing carbonic acid gas does not bring so high a price as that which is specially calcined and given a longer roast at a higher heat.

The total domestic output of crude magnesite in 1906 was 7,805 short tons, valued at \$23,415, an average of \$3 per ton, as against 3,933 short tons, valued at \$15,221, in 1905. Most of this was roasted, resulting in 2,864 tons of calcined material for use as a digester for wood pulp and for making brick and building material. It usually requires 2.4 tons of raw ($MgCO_3$) to make 1 ton of calcined (MgO) magnesite. This 2,864 tons of calcined material was valued at \$40,000, or between \$13 and \$14 per ton. Some small lots were, however, sold for less prices.

Quantity and value of crude magnesite produced in the United States, 1891–1906.

1891	short tons..	439	\$4,390	1899	short tons..	1,280	\$18,480
1892	do....	1,004	10,040	1900	do....	2,252	19,333
1893	do....	704	7,040	1901	do....	3,500	10,500
1894	do....	1,440	10,240	1902	do....	2,830	8,490
1895	do....	2,220	17,000	1903	do....	3,744	10,595
1896	do....	1,500	11,000	1904	do....	2,850	9,298
1897	do....	1,143	13,671	1905	do....	3,933	15,221
1898	do....	1,263	19,075	1906	do....	7,805	23,415

The plant at Sessions Basin, East Oakland, owned by the American Magnesite Company, was badly damaged by the earthquake of April, 1906, though the machinery was not much injured. The buildings were not restored much before the close of the year. For this reason little was done in the way of manufacturing magnesite bricks or building material in 1906 in California.

Since the close of the year a new deposit near Cloverdale, Sonoma County, has been opened, and a few hundred tons of crude material have been shipped. A road is being built to another deposit near Guerneville, Sonoma County, which is being opened. Also since the close of the year a deposit has become productive near Exeter, in Tulare County, about 20 miles from the Porterville deposits. The California Magnesite Company has been organized to develop magnesite deposits near Winchester, in Riverside County; the headquarters of the company are in Los Angeles. Thus far no output has been made. With these exceptions there is nothing new to record as to magnesite mining operations in California. Many other deposits are known—some of them of considerable value—but the small local demand and the impossibility of shipping eastward and in competition with the cheap imported article prevents any extensive mining operations being inaugurated.

Somewhat extensive experiments are being conducted in California in the manufacture of tiles partly formed of calcined magnesite. The producers are in hopes that their experiments will prove successful, as the manufacture of these tiles will cause a more decided demand for magnesite. It is also the hope of the producers that the increasing use of open-hearth furnaces will cause a large demand for the mineral, which is used in the form of ground calcined plaster for lining.

IMPORTS.

The imports of magnesite into the United States for 1905 and 1906 were as follows:

Imports of magnesite into the United States in 1905 and 1906, in pounds.

	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Magnesia:				
Calcined, medicinal	13,554	$2,778	30,788	$5,689
Carbonate of, medicinal	21,901	1,360	39,487	5,844
Sulphate of, or Epsom salts	9,039,099	38,084	5,830,224	22,471
Magnesite:				
Calcined, not purified	134,595,334	575,355	141,314,682	740,585
Crude	14,152,466	63,264	39,477,766	122,908

In addition magnesium not made up into articles was imported to the value of $22,205 in 1905 and to the value of $8,706 in 1906.

United States Consul W. A. Rublee, of Vienna, Austria, states that the export of calcined magnesite to the United States from the Vienna consular district alone amounted to 53,000 tons net weight. He says also that at present the Veitscher Magnesitwerke Actiengesellschaft is the principal company operating magnesite mines in Austria and is enjoying extraordinary prosperity.

His statement in part is as follows:

Magnesite was discovered in the province of Styria, Austria, in the early eighties by Carl Spaeter, of Coblenz, Germany, who had acquired some property near Veitsch, Styria, which was supposed to contain manganese ore. In the course of exploiting this property the yield of manganese was not found to be satisfactory, but another substance was discovered which turned out to be valuable for fireproofing purposes and was later called magnesite owing to its high percentage of magnesia.

Elaborate experiments were made with it by the Alpine Montangesellschaft, one of the principal iron and steel companies of Austria, and its uses were discovered.

The first magnesite was produced in small quantities in 1890, but its production on a large scale began in 1892, when shipments were first made to the United States. In 1897 the Veitsch property was organized into a stock company with 2,000,000 crowns ($406,000) in preferred shares and 6,000,000 crowns ($1,218,000) in common shares, the preferred shares to pay 7½ per cent interest guaranteed. This dividend was soon advanced to 10 per cent and has been paid on preferred and common shares alike for several years past. Carl Spaeter retains the controlling interest in the company, and a Vienna bank owns a large part of the remainder of the shares.

Magnesite mines were worked in competition with the Veitsch mines at Eichberg, lower Austria, for a number of years, but were acquired by the Veitsch company in March, 1905. There are also magnesite mines in Hungary, which operate under a cartel agreement with the Veitsch company. The Veitsch company is acquiring other mines in Styria and is desirous of maintaining a monopoly of the business in Austria. At present, however, there are two or three independent concerns opening up magnesite properties in Austria and in Hungary.

MICA.

By Douglas B. Sterrett.

INTRODUCTION.

Of the minerals composing the group called mica, practically only two are commercially valuable for their physical properties. These are muscovites, or potash mica, and phlogopite, or magnesia mica. The interesting properties of mica are its perfect cleavage and the toughness, flexibility, and elasticity of its cleavage sheets. These properties, combined with transparency and nonconductivity of electricity, render the varieties mentioned valuable in the industrial world.

The crystallization of mica is monoclinic, approximating hexagonal symmetry. The crystals indicate this by the closeness with which they resemble hexagonal forms, while the molecular structure revealed by the percussion and pressure figures is also nearly hexagonal. Commercially mica is found in rough blocks, sometimes with crystal outlines; these crystals are often called "books."

The color of mica is somewhat variable and is generally much lighter in muscovite than in phlogopite. Muscovite may be white, gray, yellow inclining to amber, brown, red, and green. The brown and red when of the proper color are often called "rum" and "ruby" mica. Zonary banding of colors parallel to the crystal faces is not uncommon; thus a crystal may be a rich "rum" color inside with an exterior of light yellow, or the position of the two colors may be reversed. Phlogopite is generally some shade of yellow or brown to black, often possessing a coppery appearance, and is called "amber" mica from its color. Other colors observed in phlogopite are milky and silvery gray. The luster of muscovite is brilliant and glimmering on fresh surfaces, while that of phlogopite is less brilliant and more silvery or pearly. Iridescent colors are often produced on the surface of hard fresh sheets of mica by the presence of moisture, while Newton rings and rainbow colors are formed by thin films of air working in between the laminæ.

Muscovite often contains inclusions of other minerals, either between the laminæ or cutting across them. Common among these inclusions are magnetite, quartz, feldspar, garnet, and other mica crystals, with tourmaline, apatite, beryl, and rare minerals of less common occurrence. Inclusions of magnetite are in the form of minute crystals, often arranged in definite positions with respect to one another, forming patches or dendrites, which are themselves arranged in a definite order corresponding to structural lines in the crystal. Inclusions of other mica may be other small crystals of muscovite with their cleavage turned across that of the large crystal, or intergrowths of biotite possessing the same cleavage as the inclosing muscovite. The various minerals included in mica detract from its commercial value or ruin it commercially altogether.

Other more striking features that detract from the value of mica are the "wedge," the "A," and the "ruled" structure. In "wedge" mica the crystals are thicker on one side than on the other, due to an uneven development of the laminæ, some of which do not extend entirely across the width of the crystal. The "A" structure is due to two series of crumplings, or small folds in the laminæ, making angles of approximately 60° with each other. In some cases these corrugations or striations are not very pronounced and the mica splits across them, while in others there are small lath-shaped strips between the sheets and the laminæ do not extend across the striations. The "wedge" and the "A" structure often occur together in mica crystals. In "ruled" mica sharp parting planes or cleavage pass through the crystals, making angles of about 66½° with the regular cleavage. This is sometimes repeated many times in parallel position, cutting the mica crystals into narrow strips, called "ribbon" mica, and at other times it occurs in two or three directions, at about 60° to one another in the crystal.

Details of the crystal structure of mica are brought out by percussion and pressure figures. These have the shape of a six-rayed star, being made up of three lines or cracks crossing one another at angles of nearly 60°, and correspond to lines of molecular weakness in the crystal. The two differ from each other in having the rays of one inclined at about 30° to the direction of those of the other. Percussion figures are produced by striking a sheet of mica a sharp blow with a dull-pointed instrument. Pressure figures are more difficult to obtain and are formed by slow pressure with a blunt point. A beautiful example of a large percussion figure is sometimes seen in a block of mica which a miner has carelessly struck with a pick.

When percussion and pressure figures have been made in sheets of muscovite which show the "ruled" and the "A" structures, the rays of the pressure figure are found in each case to be parallel to the "ruled" and "A" lines, while the rays of the percussion figure are inclined at about 30° to them. When the crystal faces are present the traces of the percussion figures are found to be parallel to the edges of the clino-pinacoid and unit prism faces on the base.

OCCURRENCE.

Of the two varieties of mica used extensively in the industrial world, only one, muscovite, is found in deposits of commercial value in the United States. Muscovite occurs widely disseminated in small plates and crystals of no value in crystalline igneous and metamorphic rocks, as well as in the sediments derived from them. Commercially valuable valuable muscovite, however, is confined to pegmatite. The latter is closely allied to granite in composition, being composed of feldspar and quartz with more or less mica and other accessory minerals. Unlike granite, the constituent minerals of pegmatite are crystalized out in large masses, sometimes with an extremely coarse granitic texture, and at others in veinlike bands or irregular segregations. Among the coarser products of crystallization of pegmatite is mica, which is sometimes found in blocks more than a yard in diameter.

A large number of accessory minerals occur with mica and in pegmatite. Among the more common ones and those of commercial value are, quartz, massive, crystallized, smoky, and rose; feldspar, potash and others; kaolin; beryl, common and gem varieties, as colorless, yellow or golden, blue, aquamarine, and emerald; touraline gems, white, yellow, green, blue, red, and other colors; spodumene, kuntzite, and hiddenite; zircon; lepidolite; cassiterite; uraninite or pitchblende, and other rare minerals. A complete list of the associated minerals will be found in the report on mica for 1904 by Dr. Joseph Hyde Pratt.[a]

The mica crystals occupy various positions in pegmatite masses, and no positive rule can be made for finding them. Where the pegmatite has a typical granite texture the mica may be found evenly distributed through it. Often the larger crystals will be found either in clusters at intervals through the "vein," in places partly connected by streaks of small crystals, or along one or both walls of the pegmatite. Where there is a quartz streak within the pegmatite the mica occurs on either or both sides of it, being in places partly embedded in the quartz or occupying any of the positions noted above in the remaining portion of the pegmatite.

Pegmatites are common in regions of crystalline metamorphic and granitic rocks. Those more valuable for their mica contents are generally found in metamorphic gneisses and schists, in which they occupy various positions. Sometimes the pegmatites follow the bedding planes of the country rock for considerable distances; at others they cut the strike of the inclosing rock through part or all of their extent. They are often very irregular in shape and continuity, and sometimes exhibit the same structures as the country rock. The common forms of occurrence of pegmatite, commercially valuable for mica, are overlapping lenticular-shaped bodies and sheets of more persistent extent. They range from a fraction of an inch up to many yards in thickness, and the length of the lens-shaped masses may be from two or three times to twenty or more times their thickness. The limit of size below which a pegmatite body can not be profitably worked for mica might be arbitrarily placed at from 1 to 2 feet for rich and regular veins.

The origin of pegmatites is a debated question. Certain forms are generally conceded to be dikes, intruded into the formations in which they occur as highly aqueous magmas. Others possess such typical vein structures that they must be considered to have been formed by aqueous action. Between these two types are all gradations, and it is impossible to separate the two processes by which they have been formed.

Deposits carrying mica of commercial size have been found in the United States in the following States: North Carolina, New Hampshire, Virginia, South Dakota, Colorado, New Mexico, Idaho, Arizona, Georgia, South Carolina, Alabama, California, Maine, Connecticut, New Jersey, Maryland, Wyoming, Nevada, and a few other States. In the first nine, and probably more, of the States mentioned there has been a production of mica at one time or another. In foreign countries mica of commercial size has been found in India, China, Japan, Canada, Mexico, Brazil, Argentina, German East Africa, Australia, and other countries.

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[a] Pratt, Joseph Hyde, Mica: Mineral Resources U. S. for 1904, U. S. Geol. Survey, 1905, p. 1179.

CONDITIONS GOVERNING MINING METHODS.

There is a wide variation in the methods used in mining mica, depending at times on the conditions of occurrence of the mica, and at other times on the location of the deposits, the cost of labor, and the ability of the individuals or companies to operate them. Where the mica deposits are somewhat regular in content, direction, and extent, it is possible to work them by systematic methods similar to those employed in mining for other minerals. Regular shafts, inclines, crosscuts, drifts, stopes, and winzes can be profitably employed, and power used for drills, hoisting, pumping, etc. Where the mica deposits are irregular in shape and extent, pinching and swelling from place to place, and are folded with the inclosing rocks or badly mashed and faulted, it is not possible to work them systematically.

The tendency in the past, prior to the last few years, has been to work all mica mines only for present values, with too little regard for future production. In this way the majority of the mines have been so opened that, after their value has been proved, it has been very costly to prepare them for extensive operation. Of course a deposit must be proved valuable before extensive work is undertaken. Too often the miner testing the deposit must have some returns for his labor, and accordingly he follows the mica wherever found, by pits, crosscuts, inclines, shafts, and tunnels, irregularly spaced. Thus the mine is given a poor start, and the farther such work is carried the more difficult it becomes to begin systematic mining. Very often, however, when a mica deposit is irregular in shape the only feasible way of learning its extent is to follow the mica streak wherever it may lead, and accordingly systematic prospecting is not possible.

In Canada there seems to be a stronger tendency for systematic mica mining than in the United States, especially in the phlogopite deposits in pyroxenic rocks, which are probably more regular in nature than most muscovite deposits in pegmatite. Mining in New Hampshire and the Western States has been carried on more systematically than much of that in North Carolina. In the latter State, however, the mica deposits are being more and more methodically opened and mined wherever possible. Unfortunately, there are a large number of deposits in this State which are of such irregular occurrence that it is impossible to use regular methods of development. In India the deposits are more irregularly worked than in any other region, since nearly everything is done by hand, even to removing mica and waste from the mines.

The use of power for drills, hoisting, and pumping, as well as systematic mining and other labor-saving devices, is also governed largely by the cost of labor. In India, where the wages are extremely low, 6 to 8 cents per day for miners, 4 or 5 cents for ordinary labor (male or female), and 3 cents for children, the use of primitive methods and equipment is nearly universal. In North Carolina labor-saving devices are being introduced with the higher cost of labor. In other mica-mining regions in America, mentioned above, where the cost of labor has been high, the employment of labor-saving devices and careful mining methods have been correspondingly advanced.

MANUFACTURE OF MICA.

SHEET AND PUNCH MICA.

The methods employed in preparing sheet mica for the market do not differ greatly, even in widely separated localities. In some cases the successive steps in the preparation of sheet mica may be carried out by different parties in different places. Thus the miner may sell to the small dealer his entire product in rough blocks or crystals. After splitting the latter and removing imperfections the small dealer grades the sheets according to size and quality, and in turn sells to the larger dealer or manufacturer. The latter cuts the mica into whatever patterns there may be a demand for and sells his product to the jobber. As a general rule, however, two or more of these operations are carried out by the same party, and often a company mines and prepares its own mica for the trade.

The usual operations for preparing mica, after the rough material has been obtained from the mines, are as follows:

The rough crystals, weighing from a fraction of a pound to many pounds, are split with wedges and knives into sheets of suitable thickness for cutting into patterns. The rough edges are trimmed off with knives held at an angle to the cleavage plane while cutting, and harmful inclusions and other imperfections are removed. The next step consists in cutting the sheets into patterns of such size and shape as may be in demand. This operation requires considerable judgment, in order that there may be a minimum of loss by waste. Whereas formerly it was customary to have a "scriber" mark the outline of the pattern to be cut from each sheet, this is now almost entirely done by the man who does the cutting. The latter lays a templet made of metal or composition on the sheet of mica, and after choosing the most favorable form and largest size possible, cuts around the edge of the templet with large shears. These shears have the lower blade stationary, while the upper one is generally operated by hand. Machine knives operated by power are in use, however, in the larger cutting establishments of Canada.

Considerable mica is punched into disks, washers, and other forms for electrical use. The chief demand is for sizes under 2 inches in diameter, though disks and rings are punched with a diameter of over 4 inches. The different forms of punches in use are operated by hand or by power. The output from power machines is larger than that from hand punches.

GRINDING SCRAP MICA.

NORTH CAROLINA.

Less than half of the scrap mica produced in North Carolina is ground in that State. Much of it, especially from the counties southwest of Asheville, as Haywood, Jackson, Macon, and Transylvania, where there have been no grinding mills up to this time, goes to Richmond, Va., where it is ground by the Richmond Mica Company. It is probable, however, that there will be several mica-grinding mills in operation in this region before long. A mill is being erected by the Hanson Mill Company (June, 1907) at Dillsboro, to grind and manufacture mica as well as other mineral products of the surrounding region, as feldspar, talc, and graphite. The General Electric Mica Manufacturing Company, also of Dillsboro, owns a plant for manufacturing mica and expects to grind scrap mica by a new process. The grinding will probably be accomplished by emery wheels. In Mitchell and Yancey counties nearly all the scrap mica has been ground locally by three mills in the neighborhood of Plumtree, Mitchell County. Another larger and well-equipped mica-grinding mill was erected by Mr. John L. Lynch during 1906 at Penland, Mitchell County. This mill is the largest in the State and is located on a railroad at a convenient place for a large number of mica producers to dispose of their waste and scrap. With the erection of two new mica-grinding mills and with other mills under consideration the production of scrap mica should be largely increased in North Carolina in the near future.

The following is a general description of the type of grinding mill in use in Mitchell County: Both steam and water power, or a combination of the two when the water supply is insufficient, are employed. The mica is first shaken thoroughly in rocker washing tubs, by which the filth is removed. The grinding is accomplished by soft-wood beaters through which large spikes are driven with the ends projecting on all sides. These beaters have an elliptical cross section and are from 30 to 36 inches in diameter and from 6 to 10 inches thick. They revolve horizontally in large wooden tubs and are so arranged that they can slip up and down vertically with their shaft when they become clogged in any position by an excess of mica. The tub is of suitable size for the beater to revolve in and is from 30 to 36 inches high. The scrap mica is placed in the tub with water and the beater set in motion. As the latter revolves the steel spikes beat and tear the mica. It requires about twelve hours to grind a charge, which often becomes steaming hot toward the end of the operation. Water is added as needed. From the grinding tubs the mica, now in the form of a mush, is washed to settling vats, where, after eight to twelve hours, the water is decantered off. The mica mush is then spread on cloth-covered drying tables, beneath the surface of which heat is supplied by steam pipes or in other ways. After eight to ten hours the mica mush is dried and is removed from the tables on the cloth in the form of cakes or lumps. The latter are crushed and beaten apart in disintegrators or pulverizers, and the ground material is sized off in hoppers or screens by bolting through silk sizing mesh.

A charge consists of from 400 to 500 pounds of scrap, according to the size of the grinder. From three-fourths to four-fifths of this is returned from the sizing screens as over size and is placed in the grinder with the next charge. The beaters are run at from 250 to 300 revolutions per minute. At one mill it was said that a larger percentage of 160-mesh ground mica was obtained than of any one of the other sizes separated—that is, 10, 60, 80, or 100 mesh, the sizes commonly separated at the mills. Different sizes down to "bran mica" can be separated whenever ordered.

At one time in North Carolina scrap mica was ground with buhrstones, which were revolved over a tub on which the stone rested. The ground mica was continually washed down into the tub and passed out through small holes in the side of the tub.

COLORADO.

The utilization of scrap and waste mica in the manufacture of lubricants for car axles has become a somewhat important industry in the West. An extensive plant erected for the preparation of mica for this purpose in Denver, Colo., has been described by Mr. Fritz Cirkel as follows:[a]

The mica comes to the factory in carloads just as it is taken from the mine. It is fed by boys into two machines, which cut it into fragments about half an inch square. By a system of pneumatic tubes the mica so cut is delivered to the atomizing machines, which grind it into powder. Each machine consists of two steel shafts 3 feet long, with a series of spirally arranged beaters, of gun metal, which revolve in a close case. These machines make from 5,000 to 7,000 revolutions per minute. The fingers on one shaft run between the fingers on the other, so that when the material is passed through the pneumatic tubes from the feeding machine to the atomizers at a velocity of 15,000 feet a minute the work of atomizing is instantaneous.

The mica, now reduced to minute particles, continues its course at the same velocity through another set of pneumatic tubes to the sizing bins. Here the current is so retarded by a special mechanism that it causes the material to settle, according to its fineness, in the various compartments, of which there are six. Compartments containing the graded mica powder rest upon hoppers or bins immediately over the mixing pans. Into the latter the several grades of mica powder are drawn and, by means of mechanical mixers, with which the pans are provided, treated with the proper percentage of oils and other ingredients.

Directly over the hoppers are located the oil tanks, which supply the mixers by a pipe running down the outside of the hopper, at the end of which is a faucet.

At one end of the bins is the "dust arrester," a cylindrical machine 4 feet in diameter and 10 feet high. Any of the material too light and fine to settle is driven into this machine by air currents and is drawn off as needed.

It is stated that before this machine was invented no other pulverizing machine had a capacity of more than 300 or 400 pounds a day, and that the material was not sufficiently fine for lubricating purposes. It is claimed for this concern that it can pulverize about 5 tons in a day of ten hours and that it turns out an excellent lubricant.

CANADA.

The processes used by Canadian firms for grinding mica have been briefly discussed by Mr. Fritz Cirkel.[b] Much difficulty is experienced in grinding mica, and some firms have returned to the old-fashioned buhrstones. The processes used, however, are generally kept secret. The International Mica Company, of Gananoque, Ontario, uses the following process:

The mica is first roughly screened and then cleaned before entering the grinder, which is a sheet-iron cylinder 9 feet long by 30 inches in diameter, punched in rows and set at an incline of $1\frac{1}{2}$ inches in its length. As the machine slowly revolves, loose pieces of steel, inclosed in the cylinder, pulverize the mica until fine enough to drop through the holes, which are three-sixteenths inches in diameter. It is then sized and graded in trommels from flakes down to the finest powder, the finest screens being of silk. The plant is operated by waterpower on the Gananoque River.

USES.[c]

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.

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[a] Mica, its occurrence, exploitation, and uses: Mines Branch, Dept. of Interior, Canada. 1905, p. 88.
[b] Loc. cit., p. 49.
[c] Smith, George Otis, Mica: Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, pp. 1280–1281.

As an insulating material, mica occupies a place that can not be filled by any other substance. Its toughness and elasticity have already been mentioned, but equally important characters are its infusibility and softness. In the majority of cases where mica is used for insulating purposes in electrical apparatus, the muscovite variety, or white mica, is as serviceable as the "amber" or phlogopite variety. Both kinds are used for building into larger sheets of "micanite" or "mica board." For insulation between segments of commutators in dynamos and motors there is nothing superior to the Canadian phlogopite and certain varieties of India mica. The latter is of about equal hardness with the hard-drawn copper segments placed on each side of it in the commutator, and the whole wears down evenly, preventing sparking. Though considerable muscovite is used for the same purpose, it does not give the same satisfaction as the phlogopite. For all electrical insulation the two varieties, when clear and pure, are extremely efficient. The insulating qualities of mica are, however, according to Mr. P. O. Maloney,[a] greatly reduced by contact with oil. In some cases the power of sheet mica to withstand an insulation test under high potential currents was lessened by one-half when the plate was coated with paraffin oil.

Black-specked mica, in which the spots are due to dendritic growths of minute magnetite crystals, is much less capable of withstanding high-pressure currents, and accordingly finds less extensive use in the electrical industry. It is often stated[b] that "specked" mica is valueless for electrical purposes. This is disproved, however, by the quantity of specked mica mined each year and sold to electrical dealers. It is claimed that the crystals of iron oxide, especially when of appreciable size, have a tendency to short circuit high potential currents through the mica. Several large mica-manufacturing firms, however, report that there is a good demand for specked mica, since it costs only from one-half to two-thirds as much as the clear, and it can safely be used for all insulation purposes, other than for armatures, where the current is to be under 1,000 volts. One large company in North Carolina stated that its supply of this grade did not meet the demand, and that it did not encourage the use of specked mica, as there was more money in the better grades. Many large electrical manufacturers do not use specked mica, even in apparatus where it would be perfectly satisfactory, since they hear it condemned by many people and know that whenever there is trouble with any piece of apparatus the blame will be laid on the specked mica. The chief complaints against specked mica come from the Canadian producers and from some of the large buyers of domestic mica. The reasons for this are that the Canadians find it difficult to compete with the United States production, since the price is lower than for clear mica, though they have a tariff to contend with in either case; and the large buyers prefer to deal in higher-grade material, for by doing so larger profits are realized.

Where the specks are between the laminations and rarely of appreciable thickness, as in the North Carolina specked mica, they can sometimes be eliminated, entirely or in part, by splitting. Where

[a] Cirkel, Fritz, Mica, its occurrence, exploitation, and uses: Mines Branch, Dept. of Interior, Canada, 1905, p. 89.
[b] Eng. and Min. Jour., vol. 79, 1905, pp. 633 and 1237; Colles, G. W., Mica and the Mica Industry: Philadelphia, 1906, p. 20.

low-potential currents are used, however, it is not necessary to remove the specks, since scarcely any thickness of the laminations is ever intersected by them.

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 arresters, 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 both regular and irregular form and of different sizes, according to the quality of "mica board" desired, are arranged and cemented together to form thick sheets of any size in demand. 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-sized 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 electrician's 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 miners' 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 diaphragms, 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 paper, the luster obtained by the use of the muscovite dust having the advantage of both permanency and brilliancy. Specked mica is seldom used for grinding where a good grade of ground mica is desired, since it spoils the color and quality of the latter.

PRODUCTION.

The production of mica during 1906 in the United States came from eight States—North Carolina, Colorado, New Hampshire, Virginia, Idaho, South Dakota, New Mexico, and Connecticut—here named in the order of the value of their output.

The production of sheet mica amounted to 1,423,100 pounds, valued at $252,248, an increase of 498,225 pounds in quantity and of $91,516 in value over 1905. This increase is nearly all due to the growing production of North Carolina, which is credited with 800,440 pounds, valued at $205,756, while the aggregate production from the other States showed but little gain.

The total production of scrap mica in the United States in 1906 was 1,489 short tons, valued at $22,742, an increase of 363 tons in quantity and of $4,886 in value over 1905. Of this quantity North Carolina produced 1,129 tons, valued at $11,940, while the other States produced 360 tons, valued at $10,802. The much greater value placed on scrap mica in the other States as compared with North Carolina is due to their distance from the markets and to the high prices paid for scrap in the Western States, where freight charges on material from the East would be excessive. The value given for the North Carolina product represents the prices paid for scrap and waste mica at the points of production.

It has been found necessary to make a correction in the figures of production for 1905, because of later information received at the Survey. Thus the total output of sheet mica in the United States during 1905 is given as 924,875 pounds, valued at $160,732, in place of 851,000 pounds, valued at $185,900; and of scrap mica as 1,126 short tons, valued at $17,856, in place of 856 short tons, valued at $15,255. The increase in quantity of both sheet and scrap came from North Carolina, with a corresponding increase in values, while the reduction in value of total sheet produced was made to better suit the relations between the quantity and value of the output from other States. Thus the production of North Carolina during 1905 was 742,875 pounds of sheet mica, valued at $117,732, and 445 short tons of scrap mica, valued at $4,976, while the remainder of the production came from Colorado, New Hampshire, Georgia, South Dakota, and New Mexico, named in the order of relative importance.

The condition in which sheet mica comes from the producers varies considerably. This is especially true in North Carolina, where certain producers manufacture their product into forms ready for use, while others simply split the rough blocks of mica into sheets one-tenth of an inch or less in thickness and grade them into sizes, in which form the mica is sold. The smaller producers often sell their output in rough block form without any preliminary grading. It is very difficult to learn what part of the output of the different States represents the manufactured product and what part represents the rough material. In North Carolina about one-half of the production represents manufactured mica, while in New Hampshire and Virginia the production reported to the Survey represents rough sheet mica. It is hoped that next year a separation of these products can be made in the statistics of production. For 1906, however, the production will have to be given as heretofore, containing the rough, graded, and manufactured mica taken together.

It becomes increasingly difficult to separate the figures of production of small size sheet and of scrap mica. Whether a certain lot of mica is to be wholly or in part used as scrap, or is to be cut into small sheets or punched, depends entirely on variable conditions. If the producer or the purchaser considers it of sufficient value to be used for small sheet or punch, he will grade it for that purpose, if there is a cutting establishment within reach. Should it be necessary to ship the rough mica some distance to be manufactured, however, he will sell all small material as scrap at the nearest grinding mill. Thus, in one place mica of certain size is manufactured into sheets, and at another the same grade will be treated as scrap.

A large part of the scrap mica comes from the waste at the cutting establishments and is more valuable for grinding than the rough, small sizes, for it is generally much cleaner. Such material was at one time in the form of rough sheet mica, and if the output were given for all the material in the rough sheet form the production of sheet would be enormously increased, while that of the scrap would show a large falling off. Since it is not possible to obtain statistics from all the small producers in North Carolina, the production of the large producers and those small ones who do not sell to the large ones has to be used in preparing statistics of production. In this way part of the production is necessarily given in the form of cut mica, the waste from which is given as scrap. In North Carolina the production of scrap mica by this method amounts to about one-half the total production of scrap, and if given as crude sheet mica it would increase the quantity of the latter by over a million pounds.

The mica industry in this country is expanding rapidly to meet the rapidly growing demand for that material. At present the effects of the increase are more felt in North Carolina than in any other State. New companies have formed, however, to operate in several other States—Virginia, South Carolina, Georgia, Alabama, and Colorado. New Hampshire showed a decided gain in production in 1906, while Virginia and Idaho again appear on the list of producers. No production was reported from Georgia by the companies operating in 1905, though it is likely there will be a production in 1907, since it is reported that a company formed to mine at Tworun expects to set up a grinding mill. With a new company organized to mine mica near Heflin, Randolph County, Alabama should appear in the list of producers in 1907. This new company is the Great Southern Mica Company, of Ohio, which is reported to be preparing for extensive operations in the near future. In Colorado a new enterprise has been organized under the name of the Canyon City Mica Mills and Mining Company. It is said this company expects to build a mill for the treatment of its product at Canyon. The production reported from South Dakota and New Mexico remains about stationary, notwithstanding rumors of the working of rich deposits in each State. Connecticut enters the list of producers with a small output, mostly scrap mica, while Maine reports a small production, which had not been sold at the close of the year. Though mica mining has been reported at various times in California, no information has been received relative to any production. Any companies or individuals interested in mica mining in this or any other State not mentioned in this report would materially aid the work of the Survey by sending their names and addresses, and information regarding their operations, to the Director of the United States Geological Survey.

Production of mica in the United States, 1880–1906.

Year.	Sheet mica.		Scrap mica.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Short tons.*		
1880	81,669	$127,825			$127,825
1881	100,000	250,000			250,000
1882	100,000	250,000			250,000
1883	114,000	285,000			285,000
1884	147,410	368,525			368,525
1885	92,000	161,000			161,000
1886	40,000	70,000			70,000
1887	70,000	142,250			142,250
1888	48,000	70,000			70,000
1889	49,500	50,000			50,000
1890	60,000	75,000			75,000
1891	75,000	100,000			100,000
1892	75,000	100,000			100,000
1893	51,111		156		88,929
1894	35,943		191		52,388
1895	44,325		148		55,831
1896	49,156	65,441	222	$1,750	67,191
1897	82,676	80,774	740	14,452	95,226
1898	129,520	103,534	3,999	27,564	131,098
1899	108,570	70,587	1,505	50,878	121,465
1900	456,283	92,758	5,497	55,202	147,960
1901	360,060	98,859	2,171	19,719	118,578
1902	373,266	83,843	1,400	35,006	118,849
1903	619,600	118,088	1,659	25,040	143,128
1904	668,358	109,462	1,096	10,854	120,316
1905	924,875	160,732	1,126	17,856	178,588
1906	1,423,100	252,248	1,489	22,742	274,990

IMPORTS AND EXPORTS.

The imports of mica into the United States during 1906 were the largest ever recorded. The quantity of unmanufactured and trimmed mica entered for consumption was nearly twice as great as in 1905 and exceeded the previous largest imports, in 1902, by 814,882 pounds. The value of these imports in 1906 was considerably more than twice as great as in either 1902 or 1905, the years in which the values of the imports have hitherto been greatest. The quantity and value of mica imported into the United States annually from 1900 to 1906, inclusive, are shown in the following table:

Mica imported and entered for consumption in the United States, 1901–1906, in pounds.

Year.	Unmanufactured.		Cut or trimmed.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	1,598,722	$299,065	78,843	$35,989	1,677,565	$335,054
1902	2,149,557	419,362	102,299	46,970	2,251,856	466,332
1903	1,355,375	288,783	67,680	29,186	1,423,055	317,969
1904	1,085,343	241,051	61,986	22,663	1,147,329	263,714
1905	1,506,382	352,475	88,188	51,281	1,594,570	403,756
1906	2,984,719	983,981	82,019	58,627	3,066,738	1,042,608

A small quantity of mica is exported each year, for which figures have not been obtained for calendar years. The exports for the last five fiscal years, ending June 30, respectively, have been valued as follows: 1902, at $3,857; 1903, $4,615; 1904, $1,118; 1905, $2,611; 1906, $8,935. These exports went chiefly to the United Kingdom until 1906, when the largest exports were to Canada.

CONSUMPTION AND DOMESTIC PRODUCTION.

The statistics of production and importation of sheet mica show a total consumption in the United States of 4,489,838 pounds in 1906, as against 2,519,445 pounds in 1905, an increase of about 78 per cent. When it is remembered that less than one-third of this quantity comes from the home production, it will be seen what a field there is for an extension of the industry in the United States. These figures can not be used for a close comparison, for the reason that to represent properly the home production of rough sheet mica there should be added to the production given more than a million pounds of waste from maufacturing sheet and punch mica, which are at present included under scrap mica. If this were done, the average value per pound of sheet mica would drop from 17.7 cents to less than 10 cents, as compared with 34 cents for imported mica. Even in this case, with the quantity of production and of imports approaching equality, a comparison would still be unfair, for the imported mica would be of larger size and of much greater value than the home production. The larger sizes and greater value of imported mica are due to the fact that no small sizes can be imported in competition with the home product, the tariff being 20 per cent ad valorem, plus 6 cents per pound for rough and 12 cents for manufactured mica.

PRICES.

It is very difficult to make a definite statement on the prices of sheet mica. An average taken from the quantity and value of the total production would be very misleading, as part of that represents the manufactured material and part the rough product, and, since the prices vary widely for different sizes, an average value would not be representative unless the proportion of various sizes of sheet were known. The prices realized in North Carolina mica have advanced considerably in the last few years and are much better than they were a decade ago.

The average prices per pound of sheet mica in 1906 as obtained for several States were as follows: North Carolina, 25.7 cents; Colorado, 25.2 cents; New Hampshire, 3.6 cents; Virginia, 2 cents; Idaho, 2.5 cents. The large discrepancies between these values are due to the fact that part, at least, of the North Carolina and the Colorado mica was manufactured or selected material, while the output of the other States was reported entirely for rough, unsorted mica.

According to Mr. Louis McCarthy, of Boston, who is familiar with the mica trade, the prices[a] paid for cut sheet mica in North Carolina range from 20 cents up to $7 per pound, according to size. For punched mica the prices paid are from 40 cents per pound for 1 inch up to 75 cents for 2½-inch disks and 60 to 75 cents per pound for 1 to 2 inch washers.

The prices paid for sheet mica by a prominent firm in Boston are given in the following table:

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[a] Personal communication.

Prices per pound of first-grade clear sheet mica in February, 1907.

Uncut mica.[a]		Manufactured selected mica.[b]	
Size.	Price.	Size.	Price.
Inches.		*Inches.*	
$1\frac{1}{2}$ by 2	$0.13	$1\frac{1}{2}$ by 3	$0.60 to $0.75
2 by 2	.25	2 by 2	.70 to .85
2 by 3	.40	2 by 3	.88 to 1.10
3 by 3	.75	3 by 3	2.20 to 2.75
3 by 4	1.15	3 by 4	2.60 to 3.25
3 by 5	1.75	3 by 5	3.00 to 3.75
4 by 6	2.25	4 by 6	3.80 to 4.75
6 by 8	2.50	6 by 8	5.40 to 6.75

[a] Prices paid in North Carolina.
[b] Prepared from standard price list of the company.

From this table it will be seen that good prices are offered for mica either in the rough or manufactured, though the small producers often fall far short of receiving such prices. It will also be seen that the value recorded for the production of mica at the mines is small compared with the value offered by dealers in the markets. One cause for low average prices obtained from statistics of production will be found in the immense production of small sheet mica, for which there is a great demand that can not be supplied by imports on account of the tariff. A large proportion of this small mica, in North Carolina at least, came from the dumps of old mines. These dumps were torn up and worked over for the small sheets thrown away by the miners in earlier days when there was no demand for them.

The average price of scrap mica, as obtained from the table of production, is $15.27 per short ton, while the value in North Carolina is $10.57. Prices quoted by different producers in North Carolina range from less than $8 to more than $15 per ton. In the majority of cases, however, the price is given by the producer as $10 per ton. The average price of scrap mica for the rest of the country is $30.05. This high value is caused by the extreme prices current in the Western States.

The industry in this country, especially in the Eastern States, is prosperous. With increasing prices paid for mica more mines have been opened and new companies formed to develop and operate mica mines, and with the growing interest in the industry the production in 1907 should show a substantial increase over that for 1906.

FOREIGN PRODUCTION.

CANADA.

The exports of mica from Canada[a] during 1906 are placed at 913 short tons, valued at $581,919.

INDIA.

The exports of mica[b] from India in 1905 amounted to 133,159 hundredweight, valued at £142,008, as against 18,250 hundredweight,

[a] Summary of the mineral production of Canada for 1906: Mines Section, Geol. Survey Canada, 1907.
[b] Rec. Geol. Survey, India, vol. 34, pt. 2, 1906.

valued at £83,183, in 1904. The increase in value did not keep pace with the increase in quantity, since the mica now extracted in Bengal is of very inferior quality.

CEYLON.

Two prospects foi phlogopite in Ceylon have been described by Dr. A. K. Coomaraswamy.[a] From one of these, crystals 18 inches in diameter, though somewhat flawed, have been obtained. The vein has only been superficially worked and would probably yield better material if opened deeper. In the report for the same bureau for 1905 the mica-bearing rocks are described as pyroxenites, composed chiefly of diopside, phlogopite, hornblende, and scapolite, with smaller quantities of sphene, plagioclase, pyrite, apatite, spinel, and often carbonates as accessory minerals. Attention is called to the close resemblance to the pyroxenic rocks associated with the apatite (*and mica*) deposits of Canada.

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[a] Administration Reports, Min. Survey Ceylon, pt. 4, 1904, p. E 19.

MINERAL WATERS.

By Samuel Sanford.

DEFINITION OF MINERAL WATER.

In the following statistics the term mineral water covers any natural water sold still or carbonated, in bulk or packages, for table or medicinal use. The water may come from a well, a spring, or even a lake—the source is immaterial. Ten parts or ten thousand parts of solids may be in solution in each million parts of the water; the degree of mineralization is not considered. The water may be sold in pint bottles or delivered in bulk for a certain price per month; the manner of marketing is of no more importance than the source or mineral content. The essential points are that the water shall be, within certain limitations to be stated, a natural water, and shall be an article of commerce. No account is taken of carbonated waters prepared from public supplies, of which hundreds of thousands of gallons are sold annually, nor are public supplies included. A well or spring that is drawn on by some public service system is credited with only as much water as, so far as can be ascertained from the returns, is sold separately for its real or supposed "mineral" value. In other words, water used for ordinary domestic and general industrial purposes is excluded from this report.

In like manner water that is given away—water that is furnished free for drinking or bathing to guests at hotels or to patients at sanitariums—has been omitted wherever there are data available to show the proportion of water so used. Hence, as actual sales fall far short of the total quantity used, particularly of such waters as are drunk at various fashionable resorts for their medicinal value, the totals do not represent the full magnitude of the trade.

Another factor that reduces this year's totals is the attempt made to limit them to waters sold as water. In the manufacture of ginger ale and various so-called soft drinks millions of dollars are invested. Most of these beverages retail at 5 cents a glass, but the carefully prepared ginger ales, as can be seen from the menu of any first-class hotel or restaurant, sell at a higher price than some wines. In the preparation of many of these high-grade beverages spring water is used, since it is better adapted to carbonating. But in this report no account is taken of spring water used for soft drinks, even when the returns from a spring permit estimates to be made of the quantity marketed in such form. At the same time, the totals include all spring and well water sold as water, whether still or carbonated.

CLASSIFICATION OF MINERAL WATERS.

For the purposes of this report the term mineral water is used in its commercial definition, but from a therapeutic standpoint it might be defined much more broadly. Any water that has power to affect the functions of the human system in any way may have curative value. As the physiologic effects of the various compounds shown by a water analysis vary widely, as some are relatively inert, though present in considerable quantities, and others are potent, though extremely diluted, and as a water of very low mineral content may be of decided benefit in the treatment of some bodily derangements, there is practically no water that may not be classed as mineral from a therapeutic standpoint. In taking account of the substances in solution and in attempting to classify spring and well waters on a therapeutic or chemical basis regard must be had to the great dilution of the solid matter present. According to the views of chemists to-day the mineral matter in a given sample of water is not present in the form of definite, unchanging chemical compounds. Instead, the ultimate particles of these compounds are to be regarded as more or less dissociated, the components, or ions, being ever in motion, uniting and separating. The chemical combinations given in old water analyses are regarded as merely hypothetical, and chemists now usually state the results of an analysis in ionic form, giving the proportions of the various elements and of the acid radicals which may combine to form the definite compounds found in the residue obtained by evaporating a sample of the water to dryness. No scheme of classification of mineral waters can be satisfactory which does not consider the content of the waters from this standpoint. Hence, as it is formulated with regard to the ion rather than the chemical compound, the best classification yet proposed is that of Haywood and Smith.[a]

The chemical composition of water from a well or spring is determined by various factors, chief of which are the texture and composition of the material through which it has passed in its underground journey and the depth from which it comes. The connection between composition and probable course of circulation is not always obvious, and the mineralization of a particular spring or well may baffle the best skill of the geologist. It is believed, however, that for the majority of the springs and wells making the returns used in compiling this report data are available from which interesting and important deductions can be drawn. The Survey, in connection with wider investigations carried on by its water-resources branch, has collected thousands of analyses and is endeavoring to procure, as a basis for further study, all available analyses of water from commercial springs. The attention of owners and proprietors is called to the matter in the hope that they will extend to the Survey in its scientific investigations the same courtesy that they have shown for many years in reporting production.

IMPORTANCE OF THE MINERAL-WATER TRADE.

The statistics presented in the following pages do not reflect the full importance of the mineral-water trade of this country, nor can they be used in making comparisons between the present state of the

[a] Haywood, J. K., and Smith, R. H., Mineral waters of the United States: Bull. 91, Bureau of Chemistry, U. S. Dept. Agriculture, 1905, pp. 100.

trade and its condition ten or fifteen years ago. The growing desire for pure and wholesome beverages, and the prosperity of the country have combined to increase the demand enormously. The great number of wagons carrying mineral water in every large city shows that this demand is being met. No less than thirty more or less widely advertised American springs have agencies at New York, and one Chicago firm reports that in 1906 it distributed within the limits of the city of Chicago 3,000,000 gallons of spring water.

REVIEW OF MINERAL-WATER TRADE IN 1906.

GENERAL CONDITIONS.

The springs that market table waters in great cities and are controlled by companies having capital adequate to meet the exigencies of the trade formed the basis of a large and successful industry in 1906. The medicinal springs that advertise extensively also, almost without exception, report that sales in 1906 showed a satisfactory gain over those in 1905. With the smaller springs the case was different. Those that sell comparatively little water, but are the sites of resorts that during prosperous years are visited by thousands of people fared variously. Some of these resorts suffered from unpleasant weather in July and August, 1906, which kept the attendance below what it would have been with more sunshine. Those springs which supply local demands for table water and do a bulk rather than a bottle business experienced the inevitable ups and downs of the trade. Most of them sold as much water as in 1905 and a few sold considerably more. There was about an average increase in the number of springs making returns for the first time. On the other hand, abundant rainfall over most of the country tended to restrict demand during the summer, and the installation by cities and towns of filtration plants or of supplies drawn from unpolluted sources reduced the quantities sold by some springs. Of unusual causes affecting local trade the great San Francisco fire was the most important. It apparently put some small concerns entirely out of business and greatly reduced the demand for bottled water—inevitable results of the general paralysis of business at the most important center of consumption in the State.

A comparison of the returns for 1905 and 1906 shows that there was a decline in the volume of trade in 20 States—Arizona, California, Colorado, Florida, Georgia, Indiana, Indian Territory, Iowa, Maine, Massachusetts, Michigan, Mississippi, Montana, New Hampshire, North Carolina, North Dakota, Oregon, Tennessee, Texas, and Virginia; and a gain in 29—Alaska, Alabama, Arkansas, Connecticut, District of Columbia, Idaho, Illinois, Kansas, Kentucky, Louisiana, Maryland, Minnesota, Missouri, Nebraska, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming. In a number of States the losses or gains are more apparent than real, the failure of a single large spring to furnish information regarding sales in 1905 or 1906 more than accounting for the relative losses or gains shown by a number of States.

The net increase of reported production in 1906 compared with 1905 was 1,974,034 gallons. The changes by States, including the number of springs reporting sales, and the gains or losses in gallons sold and in value of total output, are given in the following table:

Comparative production of mineral waters in 1905 and 1906.

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	3		8,181		$2,371	
Arkansas	1		253,760		54,785	
California		10		446,809		$154,699
Colorado	1			73,750		14,257
Connecticut	Same.		248,358		53,465	
Florida		1		69,426		6,121
Georgia	2			139,349		23,084
Illinois	4		148,703		29,292	
Indiana		2		432,187	17,178	
Iowa	2			76,000		7,600
Kansas		2	92,907		42,099	
Kentucky	7		163,855		33,726	
Maine		1		39,859	12,426	
Maryland	Same.		137,457		13,707	
Massachusetts		7		344,308	1,733	
Michigan	2			1,782,272		203,831
Minnesota	1		940,329		42,707	
Mississippi		1		51,721		527
Missouri	2		147,650		19,065	
New Hampshire	Same.			31,550	33,300	
New Jersey		2	191,155		191,740	
New Mexico		1	18,500		1,680	
New York	2		861,196		240,796	
North Carolina	2			24,648		2,331
Ohio	4		847,653		46,274	
Oregon		2		2,235	4,416	
Pennsylvania	3		183,692		85,941	
Rhode Island	Same.		9,940		692	
South Carolina	5		1,099,664		269,907	
Tennessee	Same.			842,320		77,390
Texas	Same.			481,655		22,336
Vermont	Same.		4,500		1,600	
Virginia	6			343,080		130,194
Washington	2		8,500		699	
West Virginia	4		32,152		7,397	
Wisconsin	Same.		1,595,884		967,979	
States or Territories not included above: Alaska, Arizona, District of Columbia, Idaho, Indian Territory, Louisiana, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming	1		161,167		41,985	
Total	54	29	7,155,203	5,181,169	2,216,960	642,370
Net increase	25		1,974,034		1,574,590	

PRODUCTION.

In the report for 1905 the attempt was made, for the first time, to differentiate table and medicinal waters, and to give data regarding springs used as resorts and those at which the water is used for bathing. The same attempt is made in this report. It is believed that, owing to apparently close estimates made by proprietors of a considerable number of springs, the proportionate values of the medicinal and the table waters given for the year 1906 are good approximations of the truth.

In calculating total values the retail price of each water at the spring has been used. Because water is intrinsically cheap, the price to a consumer (except for a few medicinal waters) represents the cost of getting the water to him rather than the inherent value of the water itself. A spring in a region where springs of the same general character are plentiful is almost valueless; yet its water, if forced on the public notice, may bring, in small bottles, $4 per gallon. Hence it is assumed that the average value of a spring water is to be determined by the average price paid by the consumer.

The following table gives a summary of the mineral-water production in 1906, including the number of springs reporting, the number of gallons sold, the average retail price per gallon at the spring, and the value of both medicinal and table waters:

Production and value of mineral waters in the United States in 1906, by States.

State or Territory.	Number of springs reporting.	Quantity sold, in gallons.	Average retail price per gallon at spring.	Value of medicinal waters.	Value of table waters.	Total value mineral waters.
Alabama	10	65,450	$0.40	$19,385	$6,690	$26,075
Arkansas	8	727,765	.14	33,706	71,580	105,286
California	29	1,487,975	.35	245,534	274,981	520,515
Colorado	15	829,850	.14	36,168	80,198	116,366
Connecticut	8	453,473	.17	1,300	75,527	76,827
Florida	7	71,494	.31	15,000	7,049	22,049
Georgia	10	130,900	.11	6,135	8,400	14,535
Illinois	15	574,453	.14	17,560	59,727	77,287
Indiana	21	464,988	.97	445,915	6,445	452,360
Iowa	5	227,500	.11	23,150	550	23,700
Kansas	13	305,957	.29	77,147	12,660	89,807
Kentucky	12	547,605	.14	52,458	23,683	76,141
Maine	28	1,127,928	.23	110,669	147,916	258,585
Maryland	5	593,671	.10	4,577	53,757	58,334
Massachusetts	52	3,857,955	.05	20,538	189,614	210,152
Michigan	19	902,528	.08	15,440	57,917	73,357
Minnesota	7	8,621,979	.02	9,126	166,551	175,677
Mississippi	8	254,279	.21	49,084	3,736	52,820
Missouri	17	618,400	.16	48,871	47,674	96,545
New Hampshire	5	781,500	.30	52,463	178,187	230,650
New Jersey	8	585,215	.41	40	237,097	237,137
New Mexico	5	94,000	.19	11,250	6,450	17,700
New York	42	6,481,074	.14	153,477	739,999	893,476
North Carolina	12	156,352	.20	29,085	2,328	31,413
Ohio	27	1,790,767	.09	31,593	132,414	164,007
Oregon	7	30,850	.41	2,816	9,707	12,523
Pennsylvania	30	1,506,286	.19	91,097	188,957	280,054
Rhode Island	4	220,770	.07	0	16,161	16,161
South Carolina	12	1,458,494	.24	271,254	77,490	348,744
Tennessee	14	411,698	.14	44,427	14,044	58,471
Texas	28	1,045,315	.12	109,013	13,072	122,085
Vermont	6	77,500	.29	9,412	12,738	22,150
Virginia	43	1,997,207	.21	182,921	235,987	418,908
Washington	6	38,500	.28	2,362	8,438	10,800
West Virginia	10	122,880	.33	36,010	21,450	57,460
Wisconsin	27	8,252,718	.29	316,704	2,105,990	2,422,694
Other States and Territories[a]	14	1,603,119	.12	55,054	139,936	194,990
Total	589	48,518,395	.17	2,630,741	5,435,100	8,065,841

[a] Includes Alaska, Arizona, District of Columbia, Idaho, Indian Territory, Louisiana, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming.

In addition to the totals shown in this table account must be taken of the production of those springs from which returns are not available. These delinquent springs numbered 239 in 1906, of which 57 reported in 1905 aggregate sales of 3,250,813 gallons, valued at $509,410. In the absence of any evidence to the contrary, it is assumed that the delinquent springs are still producing, and it is further assumed that their output for 1906 is two-thirds that of 1905. The following total estimate is obtained by adding the number and the estimated output of these springs to the totals of the preceding table:

Total estimated production of mineral waters, 1906, in gallons.

	Number of springs.	Quantity sold.	Value.
Springs reporting	589	48,518,395	$8,065,841
Delinquent springs	239	2,889,273	493,809
Total	828	51,407,668	8,559,650

TRADE CONDITIONS AND PROSPECTS.

The tables show the conditions in the mineral-water trade in 1906, as compared with those in 1905. The summary indicates a gain of 25 in the number of springs reporting sales, a net increase in production of 1,974,034 gallons and a rise in the total estimated value of the sales reported amounting to $1,574,590. On the assumption previously made of the output of springs not reporting—an assumption based on the experience of previous years—the total output should be 2,889,273 gallons larger and the value $493,809 more. With this change made there was a gain in gallons over the total estimated figures for 1905 of 3,817,587 and an increase in total estimated valuation of $1,748,039.

These figures indicate a prosperous year, and it is probable that more mineral water was marketed in the United States in 1906 than in any previous year, a probability confirmed by the gain in imports. The enormous growth of the trade, including the spring waters sold still or carbonated, in demijohns or bottles, the artificial vichy, seltzer, etc., retailed in siphons, and the great array of soft drinks put out by bottling houses, in many of which water from privately owned springs or wells is used, has been already mentioned. There is every indication that the demand will continue, and that consumption will increase at a faster rate than the growth of population. But while the output bids fair to show even greater gains within the next few years, those forces which shape the commercial progress of the day are plainly at work in the mineral-water trade. To advertise, pay agents, build bottling houses, and maintain a large force of employees requires capital, and the successful conduct of the business calls for talent. It is inevitable, therefore, that in the competition for trade the large companies will crowd out the smaller, and that those large companies which are managed with most sagacity will do the most business.

This does not mean that all small springs will be forced out of the market. On the contrary, it is certain that the number of small producers will grow. The increasing pollution of the rivers from which most American towns and cities are supplied, the comparatively slow growth of an effective public sentiment against such pollution, contemporaneous with increasingly rapid recognition of the necessity of pure water, indicate that in hundreds of American cities and towns spring water will be bought for table use while the public supply is under suspicion, and that after any danger of contagion or any unsightly appearance or unpleasant taste has been removed by filtration or chemical treatment many people will continue to buy spring water for its superior lightness and palatableness.

The following table shows the number of springs, the quantity and the value of the mineral waters marketed from 1883 (when the Survey began to collect statistics of the trade) down to 1906, inclusive:

Estimated production of mineral waters, 1883–1906.

Year.	Number of springs.	Quantity sold, in gallons.	Value.	Year.	Number of springs.	Quantity sold, in gallons.	Value.
1883	189	7,529,423	$1,119,603	1899	541	39,562,136	$6,948,030
1884	189	10,215,328	1,459,143	1900	561	[a] 45,276,995 47,558,784	[a] 5,791,805 6,245,172
1885	224	9,148,401	1,312,845				
1886	225	8,950,317	1,284,070	1901	659	[a] 54,733,661 55,771,188	[a] 7,443,904 7,586,962
1887	215	8,259,609	1,261,463				
1888	198	9,578,648	1,679,302	1902	721	[a] 63,174,552 64,859,451	[a] 8,634,179 8,793,761
1889	258	12,780,471	1,748,458				
1890	273	13,907,418	2,600,750	1903	725	[a] 40,107,147 51,242,757	[a] 6,788,426 9,041,078
1891	288	18,392,732	2,996,259				
1892	283	21,876,604	4,905,970	1904	738	[a] 41,969,145 [b] 50,723,500	[a] 6,218,873 [b] 7,198,450
1893	330	23,544,495	4,246,734				
1894	357	21,569,608	3,741,846	1905	731	[a] 46,544,361 47,590,081	[a] 6,491,251 6,811,611
1895	370	21,463,543	4,254,337				
1896	377	25,795,312	4,136,192	1906	828	[a] 48,518,395 51,407,668	8,065,841 8,559,650
1897	441	23,255,911	4,599,106				
1898	484	28,853,464	8,051,833				

[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 one by a comparative statement of the number of springs listed and reporting and of the quantity and value of the mineral waters sold in 1905 and 1906:

Number of mineral springs and quantity and value of mineral waters sold in 1905 and 1906.

State or Territory.	1905.				1906.			
	Springs reporting.	Total springs.	Quantity, in gallons.	Value.	Springs reporting.	Total springs.	Quantity, in gallons.	Value.
Alabama	7	10	57,269	$23,704	10	12	65,450	$26,075
Alaska					1	1		
Arizona	1	4			1	4		
Arkansas	7	8	474,005	50,501	8	10	727,765	105,286
California	39	47	1,934,784	675,214	29	44	1,487,975	520,515
Colorado	14	19	903,600	130,623	15	21	829,850	116,366
Connecticut	8	15	205,115	23,362	8	16	453,473	76,827
District of Columbia	2	3			1	4		
Florida	8	9	140,920	28,170	7	11	71,494	22,049
Georgia	8	11	270,249	37,619	10	10	130,900	14,535
Idaho	1	1			1	1		
Illinois	11	18	425,750	47,995	15	21	574,453	77,287
Indiana	23	28	897,175	435,182	21	36	464,988	452,360
Indian Territory	1	1			2	2		
Iowa	3	7	303,500	31,300	5	9	227,500	23,700
Kansas	15	16	213,050	47,708	13	17	305,957	89,807
Kentucky	5	5	383,750	42,415	12	16	547,605	76,141
Louisiana	2	3	774,652	62,106	1	3		
Maine	29	30	1,167,787	246,159	28	32	1,127,928	258,585
Maryland	5	10	456,214	44,627	5	10	593,671	58,334
Massachusetts	59	70	4,202,263	208,419	52	74	3,857,955	210,152
Michigan	17	26	2,684,800	277,188	19	28	902,528	73,357
Minnesota	6	6	7,681,650	132,970	7	7	8,621,979	175,677
Mississippi	9	10	306,000	53,347	8	12	254,279	52,820
Missouri	15	25	470,750	77,480	17	28	618,400	96,545
Montana	1	2			1	2		
Nebraska	1	1			1	2		
Nevada	0	1			0	1		
New Hampshire	5	5	813,050	197,350	5	5	781,500	230,650
New Jersey	10	15	394,060	45,397	8	15	585,215	237,137
New Mexico	6	7	75,500	16,020	5	7	94,000	17,700
New York	40	54	5,619,878	652,680	42	54	6,481,074	893,476
North Carolina	10	14	181,000	33,744	12	18	156,352	31,413
North Dakota	1	1			1	1		
Ohio	23	24	943,114	117,733	27	29	1,790,767	164,007

Number of mineral springs and quantity and value of mineral waters sold in 1905 and 1906—Continued.

State or Territory.	1905.				1906.			
	Springs reporting.	Total springs.	Quantity in gallons.	Value.	Springs reporting.	Total springs.	Quantity in gallons.	Value.
Oklahoma	1	2			1	2		
Oregon	9	11	33,085	$8,107	7	11	30,850	$12,523
Pennsylvania	27	35	1,322,594	194,113	30	34	1,506,286	280,054
Rhode Island	4	4	210,830	15,469	4	4	220,770	16,161
South Carolina	7	11	358,830	78,837	12	15	1,458,494	348,744
South Dakota	1	2			1	8		
Tennessee	14	15	1,254,018	135,861	14	16	411,698	58,471
Texas	28	32	1,526,970	144,421	28	35	1,045,315	122,085
Utah	0	2			1	2		
Vermont	6	6	73,000	20,550	6	6	77,500	22,150
Virginia	37	51	2,340,287	549,102	43	64	1,997,207	418,908
Washington	4	4	30,000	10,101	6	9	38,500	10,800
West Virginia	6	11	90,728	50,063	10	14	122,880	57,460
Wisconsin	27	38	6,656,834	1,454,715	27	43	8,252,718	2,422,694
Wyoming	1	1			1	2		
States or Territories of one or two springs each, including those for which figures are not given in the above list			667,300	90,899			1,603,119	194,990
Total	564	731	46,544,361	6,491,251	589	828	48,518,395	8,065,841

The outlook for medicinal waters is as promising as that for table waters. While those springs which make the widest appeal to the public and support this appeal by the merits of their waters secure the larger share of the trade, there are thousands of springs, used as resorts, whose owners make no attempt to market the waters extensively, but put before the public the charms of nature, the therapeutic worth of the waters, and the provisions made for the comfort of guests. The patronage of such resorts must continue to increase. The success already attained by some establishments that have systematic courses of mineral-water treatment is proof that similar resorts will be established at other springs, and it is fair to assume that ultimately many American resorts will be as liberally patronized as the long-famous European spas. With a wide variety of climate and manifold scenic attractions, the United States has as great a range of medicinal waters as any nation of Europe. The exploitation of these waters will require time and money, but everything indicates that the output will increase for years to come,.

TRADE BY STATES.

ALABAMA.

In Alabama during 1906 the mineral-water trade showed steady growth. Two new producers reported, the Leeds Mineral Well and the Rosedale Mineral Spring. The total number of springs reporting sales was 3 more than the year before. The number of gallons sold is given as 65,450, a gain of 8,181 gallons over 1905. The average retail price at the spring was 40 cents, the total value being $26,075, of which $19,385 is estimated to be the value of the water used for medicinal purposes. Four of the springs are reported to be resorts, having aggregate accommodations for 550 people, and the water at two of these is said to be used for bathing purposes. The reporting springs are:

Bailey Springs, Florence, Lauderdale County.
Healing Springs, Healing Springs, Washington County.
Ingram Lithia Springs, near Ohatchee, Calhoun County.
Leeds Mineral Well, Ohatchee, Calhoun County.
MacGregor Springs, Spring Hill, Mobile County.
Magnolia Spring, Magnolia Spring, Baldwin County.
Opelika Mineral Well, Lee County.
Rosedale Mineral Springs, Tuscaloosa, Tuscaloosa County.
Wilkinson Matchless Mineral Well, Greenville, Butler County.
York Aperient Well, York, Sumter County.

ALASKA.

Alaska made its first appearance in the Survey's list of mineral-water producers in 1906. A Seattle company, which is developing a spring, shipped a considerable quantity of water this year. The spring is:

Zarembo Spring, Zarembo Island.

ARIZONA.

No addition to the list of Arizona commercial springs was made in 1906. The single spring reporting is said to be a resort with accommodations for 200 guests and facilities for using the spring waters for bathing. This spring is:

Castle Hot Springs, Hot Springs, Yavapai County.

ARKANSAS.

There is a decided gain in the mineral water output of Arkansas for 1906 as compared with 1905. The number of springs reporting sales is 8, and 2 new springs—the Howard Mineral Wells and the Parnall White Sulphur Springs—were added to the list. The number of gallons sold is given as 727,765, a gain of 253,760 gallons over 1905, due mainly to the greatly increased business of one of the larger shippers. The average retail price at the spring was 14 cents. The total value of the output was $105,286, of which $33,706 is estimated to be the value of the water used for medicinal purposes. The total valuation shows a gain of $54,785 over 1905. At 6 of the springs are resorts, having in all accommodations for 2,000 people. The water at 3 of these springs is said to be used for bathing. The springs reporting are:

Arkansas Lithia Spring, near Hope, Hempstead County.
Arsenic Spring, Hot Springs, Garland County.
Howard Mineral Wells, Batesville, Independence County.
Mountain Valley Springs, Mountain Valley, Garland County.
Ozarka Spring, Eureka Springs, Carroll County.
Parnall White Sulphur Springs, Orlando, Bradley County.
Potash Sulphur Spring, Lawrence, Garland County.
Ravenden Springs, Ravenden Springs, Randolph County.

CALIFORNIA.

The mineral-water trade of California was reduced by the great disaster at San Francisco, which cut off demand from that important market. Many springs in the southern part of the State and those frequented by tourists did a good business. The number of springs reporting is 10 less than in 1905. The total sales were 1,487,975 gallons, valued at $520,515, a loss of 446,809 gallons in sales and of $154,699 in value, compared with 1905 figures. The average retail price at the spring was 35 cents. Of the total value $245,534 is the estimated value of the medicinal water and $274,981 that of the table water. Twenty of the springs are said to be used as resorts and to have aggregate accommodations for about 4,000 people. The water at 13 of them is stated to be used for bathing purposes. The springs which reported sales in 1906 are named below:

Aetna Spring, Lidell, Napa County.
Alhambra Spring, New Martinez, Contra Costa County.
Allen Springs, Allen Springs, Lake County.
Blairs 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.
California Geysers, Sonoma County.
Castalian Spring, Inyo County.
Castle Rock Springs, Castle Rock, Shasta County.
Cook Spring, 28 miles west of Williams, Colusa County.
Isham Springs, 12 miles east of San Diego, San Diego County.
Lytton Spring, Lytton, Sonoma County.
McDowell Spring, Hopland, Mendocino County.
Mount Ida Mineral Spring, Oroville, Butte County.
Napa Soda Spring, Napa Valley, Napa County.
Pacific Congress Spring, Saratoga, Santa Clara County.
Purity Spring, Sausalito, Marion County.
Samuel Soda Spring, near St. Helena, Napa County.
San Benito Spring, Tres Pinos, San Benito County.
Seltzer Springs, Highland Springs, Lake County.
Shasta Spring, Shasta Springs, Siskiyou County.
Tassajara Hot Spring, Monterey 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.
Vichy Springs, Napa, Mendocino County.
Walbridge Spring, Tuscan Springs, Tehama County.
White Sulphur Spring, Eden Hot Springs, Riverside County.
Witter Medical Spring, Witter, Lake County.

COLORADO.

The 1906 returns indicate a decrease from 1905 in water sold and in value of sales. Three new producers reported, Fowler Spring, Pagosa Springs, and the Pueblo Magnetic Mineral Well. The loss in sales, 73,750 gallons, and the decline in value, $14,257, are more than accounted for by the lack of returns from one spring which reported in 1905. The mineral-water trade of the State seems as a whole to have been prosperous. Of the total water sold, about a half is said to be for table purposes and half for medicinal use. Resorts, having accommodations for several thousand people, are located at 5 of the springs, and at 4 the water is reported to be used for bathing purposes. The 15 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.
Columbia Spring, Denver, Denver County.
Fowler Spring, Township 21, Otero County.
Glenwood Hot Springs, Glenwood Springs, Garfield County
Golden Lithia Spring, Golden, Jefferson County.
Manitou and Cheyenne Springs, Manitou, El Paso County.
Pagosa Springs, Pagosa Springs, Archuleta County.
Pueblo Magnetic Mineral Well, Pueblo, Pueblo 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 mineral-water trade in Connecticut shows a gain in sales and in value, but these gains are due to the large volume of business reported by a single spring which ships to New York City. Most of the smaller springs report smaller sales than in 1905, the decline being accounted for by lessened local demand consequent on improved quality of city supplies and a wet summer. Nearly all the water shipped is for table use. 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:

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.
Mohican Springs, Fairfield, Fairfield County.
Pequabuck Mountain Spring, Bristol, Hartford County.
Stafford Spring, Stafford Springs, Tolland County.
Varuna Spring, North Stamford, Fairfield County.

DISTRICT OF COLUMBIA.

The single spring reporting from the District of Columbia showed a gain in gallons sold of about 20 per cent in 1906 compared with 1905. This increase was probably due to the prevalence of typhoid fever, uncertainty regarding the origin of the epidemic, and a demand for pure water. The water of the spring is not used for medicinal purposes. This spring is:

Gitchie Crystal Spring, Benning.

FLORIDA.

The indicated decline in the mineral-water trade of Florida is probably more apparent than real; it is largely accounted for by estimates of output in 1906 being closer than the 1905 returns. The number of gallons sold is given at 71,494 gallons, valued at $22,049. The average retail price per gallon of all the water at the springs was 31 cents. About one-third of the water is estimated to be used as table water and two-thirds for medicinal purposes. All of the springs are reported to be used as resorts, having aggregate accommodations for several thousand people, and the water at all of them is said to be used for bathing. The springs reporting are as follows:

Espiritu Santo Spring, near Tampa, 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, Suwanee County.
White Sulphur Springs, White Springs, Hamilton County.

GEORGIA.

The returns for Georgia for 1906 show a marked decrease from the 1905 production, the total estimated value being less than half, although 10 producers reported as against 8 in 1905. The quantity also decreased about one-half. The cause of this decrease is probably the same as that reported for other States, namely, that the 1906 figures are closer estimates than the 1905 returns. The average retail price at the springs was 10 cents per gallon. Resorts, having accommodations for about 800 people, are situated at 5 of the springs, and the water at one is said to be used for bathing purposes. The springs reporting are as follows:

Austell Lithium Spring, near Austell, Cobb County.
Artesian Lithia Well, Austell, Cobb County.
Bowden Lithia Spring, Austell, Cobb County.
Catoosa Spring, Catoosa County.
Cox Mineral Spring, Waynesboro, Burke County.
Daniel Mineral Spring, Onion Point.
Hughes Mineral Well, Rome, Floyd County.
Lithari Spring, Austell, Cobb County.
Menlo Spring, near Menlo, Chattooga County.
Thomas Springs, Menlo, Chattooga County.

IDAHO.

The sole spring in Idaho from which returns are received reports a prosperous year with sales about 14 per cent larger than in 1905. This spring is:

Idanha Springs, Soda Springs, Bannock County.

ILLINOIS.

Trade conditions in Illinois during 1906 were extremely satisfactory there being an estimated increase of about 35 per cent in the number of gallons sold and about 50 per cent in total value. This increase was caused partly by the failure of certain springs to report in 1905, but chiefly by the greater consumption of bottled waters at several large cities, notably Chicago, resulting from doubts as to the purity of public supplies. Three new shippers reported—the Carbondale Crystal Water Works, the Depler Mineral Spring, and the Libertyville Mineral Spring. The number of gallons sold is given as 574,453, a gain of 148,703 gallons over 1905. The average retail price at the spring was 14 cents, the total value being $77,287, of which $17,560 is the estimated value of the water used for medicinal purposes, and $59,727 that of table water. The total valuation shows a gain of $29,292. Five of the springs are reported to be the sites of resorts, and the water at 3 of these is said to be used for bathing purposes. There are 15 springs reporting sales:

Abana Spring, Libertyville, Lake County.
Aqua Vitae Mineral Springs, near Maquon, Knox County.
Black Hawk Spring, Rock Island, Rock Island County.
Carbondale Crystal Water Works, Carbondale, Jackson County.
Deer Lick Mineral Springs, Deerfield, Lake County.
Depler Mineral Spring, Lewistown, Fulton County.
Diamond Mineral Spring, near Grantfork, Madison County.
Gravel Spring, 5 miles northwest of Jacksonville, Morgan County.
Greenup Mineral Wells, Greenup, Cumberland County.
Libertyville Crystal Spring, Libertyville, Lake County.
Macinac Spring, near Carlock, Woodford County.
Mokena Mineral Spring, near Mokena, Will County.
Perry Mineral Spring, northeast part of Pike County.
Sanicula Spring, Ottawa, Lasalle County.
White Diamond Spring, South Elgin, Kane County.

INDIANA.

While there is apparently a great decline in the quantity of water sold by Indiana springs in 1906 as compared with 1905, individual returns show that the trade was moderately prosperous. All the large springs sold more water than in 1905, as did nearly all the smaller springs. The decrease of nearly 50 per cent in the estimated production is due to the liberal estimates made in 1905 and previous years for certain springs and to the elimination from the 1906 figures of outputs of springs now supplying public-service systems. Two new springs sending returns are the Artesian Mineral Spring and the White Crane Mineral Spring. The total output, according to the statements of shippers, was 464,988 gallons. The average retail price was 97 cents, the total value being $452,360, of which six-sevenths is estimated to be the value of the water used for medicinal purposes and one-seventh that of table water. The total valuation shows a gain of $17,178. Nine of the springs reporting are said to be used as resorts, having aggregate accommodations for over 4,000 people, and the water of 9 is, as reported, used for bathing. Four more springs which report no sales are stated to be resorts and to have facilities for mineral-water baths. The 21 springs which report sales in 1906 are:

Artesian Mineral Spring, Terre Haute, Vigo County.
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.
French Lick Springs. (See Pluto, Proserpine, and Bowles springs.)
Greenwood Mineral Well, Greenwood, Johnson County.
Kickapoo Magnetic Spring, Attica, Warren County.
King's Mineral Well, 14 miles north of New Albany, Clark 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, Proserpine, and Bowles springs, French Lick, Orange County.
West Baden Springs, West Baden, Orange County.
White Crane Mineral Spring, Dillsboro, Dearborn County.

INDIAN TERRITORY.

Most of the mineral-water output of Indian Territory is said to be used for medicinal purposes. The list of commercial springs now comprises two names, the Germicide Well reporting sales for the first time in 1906. This spring is stated to be a resort with accommodations for 200 guests and facilities for using the well water for bathing. The 2 springs reporting are:

Beach Spring, Sulphur, Chickasaw Nation.
Germicide Mineral Well, Wagoner, Creek Nation.

IOWA.

Two springs reported sales for the first time in 1906—Heston's Springs and the Lineville Mineral Spring—but one spring which sold considerable water in 1905 sold none in 1906, and returns from other springs are incomplete. The estimated 1906 sales are 227,500 gallons, valued at $23,700. Nearly all the Iowa water is used for medicinal purposes. Two springs are resorts with accommodations for several hundred people and bathing facilities. The 5 springs from which estimates of production are at hand are:

Boone Mineral Well, Boone, Boone County.
Colfax Spring, Colfax, Jasper County.
Heston's Spring, Fairfax, Jefferson County.
Lineville Mineral Spring, Lineville, Wayne County.
Red Mineral Spring, Eddyville, Wapello County.

KANSAS.

In Kansas the mineral-water trade had a prosperous year, some of the larger springs making notable gains. The increased sales are due chiefly to energetic canvassing for possible consumers. One new spring, the Chautauqua, report sales. The total number of gallons sold is given as 305,957, a gain of over 40 per cent compared with 1905. The average retail price at the spring was 13 cents; the total value was $89,807, of which $77,147 is estimated to be the value of the water used for medicinal purposes. The total valuation shows a gain of 80 per cent over 1905. Nine of the springs are used as resorts, and have aggregate accommodations for 1,000 people. The water at 8 of them is said to be used for bathing purposes. The reporting springs are:

Abilena Spring, Abilene, Dickinson County.
Blasing Natural Medical Spring, Manhattan, Riley County.
Boon Mineral Spring, Topeka, Shawnee County.
California Spring, 4 miles north of Ottawa, Franklin County.
Chautauqua Spring, Chautauqua, Chautauqua, County.
Geuda Spring, Geuda, Cowley County.
Hoover Mineral Spring, Onaga, Pottawatomie County.
Merrill Spring, Carbondale, Osage County.
Phillips Mineral Spring, Topeka, Shawnee 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.

A satisfactory condition of the Kentucky mineral-water trade in 1906 is indicated by the returns, though these take no account of the business done at many resorts where water is furnished free to guests. Probably the total value of the mineral-water industry in the Blue Grass region alone is not less than $200,000 annually. The returns received for 1906 show a gain of over 40 per cent in output and of about 79 per cent in value, due largely to an increase in springs reporting. Five of the springs making returns are resorts, and at 3 the water is used for bathing. Reports of sales were received from 7 springs which either had never reported before or had not reported in some years. These were: Beechwood Springs, Big Bone Spring, Glen Lily Spring, Renfro White Sulphur Lithia Spring, Royal Magnesian Spring, Smith's Mineral Well, and Upper Blue Lick Springs. The 12 reporting springs are:

Anita Spring, Lagrange, Oldham County.
Beechwood Springs, Beechwood, Owen County.
Big Bone Spring, Boone County.
Blue Lick Springs, Blue Lick Springs, Nicholas County.
Glen Lily Spring, Bowling Green, Warren County.
Hamby Salts, Iron, and Lithia Springs, Dawson Springs, Hopkins County.
Lexington Lithia Springs, Lexington, Fayette County.
Renfro White Sulphur Lithia Spring, Lexington, Fayette County.
Royal Magnesian Spring, Lagrange, Oldham County.
Smith's Mineral Well, Kilby, Christian County.
Upper Blue Lick Springs, Davidson, Nicholas County.
White's Crab Orchard Salts Springs, Crab Orchard, Lincoln County.

LOUISIANA.

Only one Louisiana spring reported sales in 1906, but the mineral-water trade evidently had a prosperous year, as the returns from the one spring show that its business in 1906 exceeded its 1905 business by more than the large sales reported by the other spring which made returns that year. The water of the spring reporting is used for both medicinal and table purposes, and the spring is the site of a resort. This spring is:

Abita Spring, St. Tammany Parish.

MAINE.

During 1906 the mineral-water trade in Maine showed slight change from the year before. The number of reporting springs is 1 less, and 2 new springs were added to the list of those making returns. There was an increase of about 5 per cent in value and a decrease of about 4 per cent in gallons sold, these changes being accounted for by the greater sales of certain waters used for medicinal purposes and the falling off in demand for table water at towns where there had been improvement in the public supply. Local consumption was also adversely affected by abundant rainfall. Somewhat more than one-half of the water is used for table purposes. Resorts having aggregate accommodations for several hundred people are located at 6 of the springs; at 2 of them the water is said to be used for bathing purposes. The 28 springs from which reports of sales are available are:

Baker Puritan Spring, Old Orchard, York County.
Crystal Mineral Spring, Auburn, Androscoggin County.

Forest Spring, Litchfield, Kennebec County.
Glenrock Mineral Spring, Greene, Androscoggin County.
Highland Mineral Spring, Lewiston, Androscoggin County.
Glenwood Spring, St. Albans, Somerset County.
Indian Hermet Mineral Spring, Wells, York County.
Katagudos Spring, Eastbrook, Hancock County.
Keystone Mineral Spring, East Poland, Androscoggin County.
Mount Hartford Cold Spring, Hartford, Oxford County.
Mount Oxford Spring, Sumner, Oxford County.
Mount Zircon Spring, Milton Plantation, Oxford County.
Oak Grove Spring, Brewer, Penobscot 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, Waldo County.
Ticonic Spring, Winslow, Kennebec County.
Underwood Spring, Falmouth Foreside, Cumberland County.
Wawa Lithia Spring, Oqunquit, York County.
Windsor Mineral Spring, Lewiston, Androscoggin County.

MARYLAND.

The mineral-water trade showed a satisfactory growth during 1906, the production increasing 31 per cent, while the value was about 30 per cent greater than in 1905. One spring, the Altamont, placed its water on the market during the year for the first time. Less than a tenth of the stated output is used for medicinal purposes, the remainder being table water. At 2 of the springs are resorts, with accommodations for about 500 people. The 5 springs from which estimates of sales are available are:

Altamont Spring, Deer Park, Garrett County.
Artoisinal Well, Baltimore, Baltimore County.
Carroll Spring, Forest Glen, Montgomery County.
Chattolanee Spring, Chattolanee, Baltimore County.
Takoma Spring, Takoma Park, Montgomery County.

MASSACHUSETTS.

The decline shown in the volume of the mineral-water trade in Massachusetts is attributable to two causes—a lessened demand for the water of springs sold locally, consequent in part on the abundant rainfall, and in part on improved quality of the public supply at various cities, and the elimination, as far as possible, from the 1906 returns of spring or well water sold in the form of ginger ale and other soft drinks. That the trade prospered is shown by the fact that after making deduction for water thus used the total value was greater than in 1905. The average low price per gallon is accounted for by the large proportion sold for table purposes, and by the fact that a considerable part of that classed as table water is supplied to factories in bulk at less than 5 cents per gallon. Three new springs, the Crescent, the Pocahontas, and the Rock, report sales during the year. The total number reporting is 7 less than in 1905. About nine-tenths of the water is used for table purposes, the remainder as medicinal water. Only 4 of the 52 springs heard from are the sites of resorts, and none of the waters are stated to be used for bathing purposes. The following 52 springs report sales:

Abbott Spring, Methuen, Essex 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 Natural Spring, Belmont, Middlesex County.
Burnham Spring, Methuen, Essex County.
Chapman Crystal Mineral Spring, Stoneham, Middlesex County.
Crescent Spring, Brockton, Plymouth County.
Diamond Spring, Lawrence, Essex County.
El-Azhar Spring, Lowell, Middlesex County.
Everett Crystal Spring, Everett, Middlesex County.
Farrington Silver Spring, Milton, Norfolk County.
Fulton Spring, Medford, Middlesex 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.
Hillcrest Spring, Rowley, Essex County.
Katahdin Spring, Lexington, Middlesex County.
King Philip Spring, Mattapoisett, Plymouth County.
Leland Spring, Natick, Middlesex County.
Lexington Spring, Lexington, Middlesex County.
Lovers Leap and Deep Glen Springs, Lynn, Essex County.
Massasoit Spring, West Springfield, Hampden County.
Monatiquot Spring, South Braintree, Norfolk County.
Mount Holyoke Lithia Spring, South Hadley, Hampshire County.
Mount Pleasant Spring, Lowell, Middlesex County.
Nemasket Spring, Middleboro, Plymouth 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.
Robbins Spring, Arlington Heights, Midddlesex County.
Rock Spring, Newburyport, Essex 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.
Stevens Spring, Lawrence, Essex County.
Sterling Spring, West Lynn, 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.

MICHIGAN.

The report of the mineral-water trade in Michigan in 1906 shows a great decline in gallons sold and in value of output. This decline is really not as great as indicated, since nine-tenths of the total decline in output is due to the fact that no account is taken this year of water furnished to guests for bathing at one or two resorts; still, a comparison of the returns made this year and last shows that most of the springs reporting sold less water in 1906 than in 1905. The reasons for this decline are not clear, though weather conditions may have had some effect. A few of the springs used as resorts sold as much water as in the year before, and 1 spring notes an increase in business of over 300 per cent, but its water is used chiefly for making soft drinks. Two new springs are the Lansingwold and the Ogemaw. About one-fifth 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 19 springs from which returns are available are:

Andrews Magnetic Mineral Spring, St. Louis, Gratiot County.
Bromo-Hygeia Mineral Well, Coldwater, Branch County.
Cooper Farm Spring, Birmingham, Oakland County.
Clementine Spring, Mount Clemens, Macomb County.
Dearborn Mineral Spring, Dearborn, Wayne County.
Lansingwold Spring, Paris Township, Kent 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.
Ogemaw Spring, Maltby, Ogemaw 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 this State had a prosperous year, the number of gallons sold being 12 per cent larger than in 1905 and the value increasing about 32 per cent. The increase is due to the demand for pure water in large cities, particularly in Minneapolis. The Rock Spring reported sales for the first time, making 7 springs sending returns. Less than 6 per cent of the State's total output is used for medicinal purposes. None of the springs is the site of a resort, but the water of one is said to be used for bathing. The 7 springs to report sales are:

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.
Rock Spring, Shakapee, Scott County.
Trio Siloam Spring, Austin, Mower County.

MISSISSIPPI.

The mineral-water trade in Mississippi seems to have been fairly satisfactory during 1906. Three of the springs making returns increased their sales over 1905; one reported a large decline, and another sold no water. Two springs, the Lauderdale Spring and the Vosburg Mineral Spring, put their waters on the market for the first time. Less than 10 per cent of the total output is used as table water. At 6 of the springs are resorts with total accommodations for a thousand guests, and at 3 the water is used for bathing. The 8 springs reporting are:

Arundel Lithia Spring, near Meridian, Lauderdale County.
Browns Wells, Browns Wells, Copiah County.
Castalian Spring, near Durant, Holmes County.
Lauderdale Spring, near Meridian, Lauderdale County.
Mammoth Spring, Mammoth Springs, Percy County.
Robinson Mineral Spring, near Pocahontas, Madison County.
Stafford Mineral Spring, Stafford, Jasper County.
Vossburg Lithia Spring, Vossburg, Joseph County.

MISSOURI.

In 1906 the mineral-water trade of Missouri was decidedly prosperous; nearly all the springs making returns show an increase over 1905, and most of them attribute the increase to their waters being better known. Two new springs, the Soda Carbonic Spring and the Sparkling Lithium Spring, reported sales. The total number of springs heard from is 2 more than in 1905. The number of gallons sold is given as 618,400, an increase of nearly 25 per cent over the 1905 returns. The average retail price at the spring was 17 cents, and the total value was $96,545, of which about half is estimated to be the value of the water used for medicinal purposes. The total value shows a gain of 25 per cent compared with the year before. Nine of the springs are said to be resorts, with aggregate accommodations for several thousand people, and the water at 6 of these is reported to be used for bathing purposes. The springs making returns for 1906 are:

American Spring, St. Louis, St. Louis County.
Aqua Vitae Mineral Spring, Canton, Lewis County.
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 Creek, Pike County.
Jackson Lithia Spring, Mount Washington, Jackson County.
Kal-I-Nat Bitter Spring, Bowling Green, Pike County.
McAllister Springs, McAllister, Saline County.
Soda Carbonic Spring, Excelsior Springs, Clay County.
Sparkling Lithium Spring, Central Park, Clay County.
Sweet Spring, Sweet Springs, Saline County.

MONTANA.

Only 1 of the 2 springs credited to Montana reports sales in 1906. Only about one-tenth of its water is sold for table purposes, the rest being for medicinal use. This spring is:

Lissner's Mineral Springs, Helena, Lewis and Clark County.

NEBRASKA.

A new Nebraska spring is the only one to report sales in 1906. About three-fourths of the water sold is used for medicinal purposes and one-fourth as table water. This spring, which is the site of a resort with accommodations for several hundred people, is:

Shogo Lithia Spring, Milford, Seward County.

NEW HAMPSHIRE.

The mineral-water trade in New Hampshire held its own during the year, the output showing a decline of about 4 per cent, but the value increasing about 17 per cent. A little less than one-fourth of the water is estimated to be used for medicinal purposes, the remainder as table water. A few of the springs are used as resorts, but at only 1 is the water used for bathing. The 5 springs from which estimates of output are available are:

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 Springs, Temple, Hillsboro County.

NEW JERSEY.

A belief that the public supplies of several cities were polluted and the increased demand from New York for table water above suspicion caused the remarkable growth of the New Jersey mineral-water trade in 1906. One spring, which was favorably situated for meeting market needs, sold nearly three times as much water as in 1905. Practically all of the New Jersey spring water is used for table purposes, and the average value per gallon is remarkably high—41 cents retail at the springs. This high valuation is chiefly accountable for the total value of the mineral water sold rising from $45,397 in 1905, to $237,137 in 1906. None of the springs is stated to be used as a resort or for bathing purposes. The 8 springs reporting are as follows:

Beech Spring, near Woodbury, Gloucester County.
Hatawanna Spring, Budd Lake, Morris County.
Indian Spring, Rockaway, Morris County.
Kalium Spring, Collingswood, Camden County.
Kanouse Oakland 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.

Of the 7 springs credited to New Mexico, 5 report sales for 1906. The condition of trade during the year was fairly satisfactory. Some springs showed gains and some losses, but the total number of gallons sold is estimated to have been 25 per cent greater than in 1905, with an increase in value of about 10 per cent. Three of the springs are stated to be resorts, with total accommodations for 200 people. At 2 of them the water is used for bathing. The 5 springs are as follows:

Artesian Coyote Well, 13 miles east of Albuquerque, Bernalillo County.
Carlsbad Springs, Carlsbad, Eddy County.
Faywood Hot Spring, Faywood, Grant County.
Macbeth Spring, Las Vegas, San Miguel County.
Ojo Caliente Spring, Ojo Caliente, Taos County.

NEW YORK.

Although the prosperity of the New York mineral-water trade during 1906 may not have been as great as the returns indicate, yet the increased demand for table water of unquestionable purity at New York City, resulting from newspaper discussion of the pollution of the Croton watershed, was largely responsible for the sales gaining nearly 15 per cent and the total value nearly 37 per cent on the 1905 figures. Seven springs were added to the list of those reporting sales, viz, the Boonville, Briarcliff, Gordon White Sulphur, Pleasant Valley, Putnam, Setauket, and Sulphur springs. The total number of those reporting is 42, or 2 more than in 1905. The number of gallons sold is given as 6,481,074 and the average retail price at the spring as 14 cents. Of the total value about one-sixth is estimated to be the value of the water used for medicinal purposes. Some 15 of the springs are situated at or near resorts with total accommodations for several thousand people, but the water at only 3 of them is used for bathing. The list of springs sending returns for 1906 is as follows:

Artesian Natural Mineral Spring, Franklin Springs, Oneida County.
Artesian Lithia Spring, Ballston Spa, Saratoga County.
Avon Sulphur Springs, Avon, Livingston County.
Ayers Amherst Mineral Spring, Williamsville, Erie County.
Baldwin Mineral Spring, Cayuga, Cayuga County.
Breesport Oxygenated Mineral Spring, Breesport, Chemung County.
Chautauqua Lithia Spring, Westfield, Chautauqua County.
Chemung Spring, Chemung, Chemung County
Clyde Mineral Spring, Clyde, Wayne 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.
Gordon White Sulphur Springs, Shawnee Springs, Schoharie County.
Great Bear Spring, near Fulton, Oswego County.
Hide Franklin Spring, Ballston Spa, Saratoga County.
Kirkland Spring, Franklin Springs, Oneida County.
Magnetic Flint Rock Spring, Elmira, Chemung 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 Springs, Saratoga County:
- Arondack Spring.
- Champion Spring.
- Chief Spring.
- Congress Spring.
- Emperor Spring.
- Geyser Spring.
- Hathorn Spring.
- High Rock Spring.
- Patterson Mineral Spring.
- Royal Spring.
- Saratoga Carlsbad Spring.
- Saratoga Seltzer Spring.
- Star Spring.

Setauket Spring, East Setauket, Suffolk County.
Split Rock Spring, Franklin Springs, Oneida County.
Sulphur Spring, Hornby, Steuben County.
Vita Spring, Fort Edward, Washington County.
Washington Lithia Spring, Ballston Spa, Saratoga County.

NORTH CAROLINA.

On the face of the returns there was a decided falling off in the activity of the mineral-water trade during 1906 as compared with 1905. Most of the springs report smaller sales, only a few noting an increase. Probably the decline is less than it appears to be, as the returns of several springs reporting losses indicate that their 1905 totals may have been round-figure estimates. A wet summer no doubt affected the trade of some springs used as resorts. Cleveland Springs, Connelly Springs, Glen Alpine Spring, and Moores Spring are 4 new names on the list of producers, and the total number reporting sales is 2 more than last year. The number of gallons sold is estimated at 14 per cent less than in 1905 and the total value at about 7 per cent less. Over nine-tenths of the water is used for medicinal purposes. Ten of the springs are stated to be at resorts which have, all told, accommodations for over 2,000 people. The water at 5 of them is said to be used for bathing. The springs reporting are:

All Healing Spring, Alkalithia Springs, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Spring, Bullock, Granville County.
Cleveland Springs, Shelby, Cleveland County.
Glen Alpine Spring, Brindletown, Burke County.
Jackson Spring, Jackson, Moore County.
Mida Spring, near Charlotte, Mecklenburg County.
Moores Springs, Moores Springs, Stokes County.
Panacea Spring, near Littleton, Warren County.
Seven Springs, near Goldsboro, Wayne County.
Thompson Bromine Arsenic Spring, Crumpler, Ashe County.
Vade Mecum Spring, Vade Mecum, Stokes County.

NORTH DAKOTA.

North Dakota has but 1 spring reporting sales for 1906. It is a resort.

Hydatso Spring, Tower City, Cass County.

OHIO.

The mineral-water trade of Ohio prospered during 1906. As the great majority of the springs are not used as resorts and most of the output is sold as table water, the weather is less a factor in the trade than in some States. The increased sales reflect the demand for pure drinking water and the general prosperity of the State. The Arcturus Lithia Spring, the Collingwood Spring, the Jefferson Spring, and the Navahoe Spring are new names reporting. The springs making returns number 27, or 4 more than in 1905, and the number of gallons sold is given as 1,790,767, a gain of nearly 90 per cent. The average retail price per gallon at the spring of the different waters was 27 cents, and the total value was $164,007, of which less than one-fourth is estimated to be the value of the water used for medicinal purposes.

The total value shows a gain of 39 per cent over 1905. Six of the springs are reported to be used as resorts, having aggregate accommodations for about 500 people. The water at 3 of them is stated to be used for bathing. The springs from which returns have been received are:

Adams County Mineral Spring, Mineral Springs, Adams County.
Alba Spring, Rockport, Cuyahoga County.
Arcturus Lithia Spring, Akron, Summit County.
Beech Rock Spring, Zanesville, Muskingum County.
Bellmore Mineral Spring, Fairfield, Columbiana County.
Buckeye Lithia Spring, Martins Ferry, Belmont County.
Crum Mineral Spring, Austintown, Mahoning County.
Collingwood Spring, Toledo, Lucas 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.
Jefferson Spring, Jefferson, Fairfield 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.
Purtlebaugh Spring, Urbana, Champaign County.
Quakerdale Spring, Belmont County.
Ripley Bromo-Lithia Spring, Ripley, Brown County.
Sand Rock Spring, Canton, Stark County.
Spark Mineral Spring, Bryan, Williams 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.

The single spring to represent Oklahoma reports a decided gain in sales in 1906. About half of the water sold is for medicinal use.

Lewis Crystalline Lithia Well, Oklahoma City, Oklahoma County.

OREGON.

Most of the Oregon springs heard from report that more water was sold in 1906 than in 1905, and none reports a decrease. The slightly smaller total number of gallons sold in 1906 is chiefly due to the delinquency of two springs reporting in 1905. The average retail price per gallon of the different waters at the spring was 41 cents, and three-fourths of the total value, which amounted to $12,523, is the value of medicinal water. The gain in value over 1905 was more than 50 per cent. At 5 of the springs are resorts which can accommodate a total of 300 guests. The water of 2 of the springs is said to be used for bathing. The following 7 springs report sales:

Boswell Mineral Spring, Boswell, Douglas County.
Cascade Mineral Spring, Cascadia, Linn County.
Colestin Spring, Colestin, Jackson County.
McBean Soda Spring, Soda Valley, Grant County.
Siskiyou Spring, Soda Springs, Jackson County.
Sodaville Mineral Spring, Sodaville, Linn County.
Wolfer's Mineral Spring, Hubbard, Marion County.

PENNSYLVANIA.

The number of springs reporting sales was 27 in 1905 and 30 in 1906. There was a considerable gain in the total sales of Pennsylvania water this year and a marked improvement in the aggregate value. Table waters are the principal output, the value of these being over two-thirds of the total. The increased demand is largely due to the badly polluted condition of many rivers drawn on for city supplies. Two new springs reported sales—the Bruce Subrock and the Shohola. The total number of gallons sold in 1906 is estimated at 1,506,286, an advance of 14 per cent on the 1905 figures. The average retail price per gallon of all the waters at the spring was 19 cents. The total value was $280,054, of which $91,097 is the value of the water used for medicinal purposes, and $188,957 is the estimated value of that used as table water. The total value shows a gain of 45 per cent, compared with 1905. Resorts are situated at or near 12 of the springs and have accommodations for nearly 3,000 guests. At 4 of the springs the water is said to be used for bathing purposes. The 30 springs reporting are as follows:

Bedford Chalybeate Spring, near Bedford, Bedford County.
Bedford Mineral Spring, Bedford, Bedford County.
Bruce Subrock Artesian Spring, Pillsbury, Allegheny County.
Buena Vista Springs, Buena Vista, Franklin County.
Calvin White Sulphur Springs, Sulphur Springs, Bedford County.
Cloverdale Lithia Spring, Newville, Cumberland County.
Corry Artesian Spring, Corry, Erie County.
De Vita Mineral Springs, Cambridge Springs, Crawford County.
East Mountain Lithia Well, Factoryville, Wyoming County.
Glacier Spring, Ephrata, Lebanon County.
Glen Summit Spring, Glen Summit Springs, Luzerne 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, Wilkesbarre, Luzerne County.
Ponce de Leon Spring, near Meadville, Crawford County.
Pulaski Natural Mineral Spring, Pulaski, Lawrence County.
Rennyson's Tredyffin Spring, Berwyn, Chester County.
Ross-Common Spring, Ross-Common, Monroe County.
Saegertown Mineral Spring, Saegertown, Crawford County.
Shohola Spring, Walker Lake, Pike County.
Sizerville Mineral Spring, Sizerville, Cameron County.
Springboro Spring, Springboro, Crawford County.
Tuckahoe Mineral Spring, Northumberland, Northumberland County.
Whann Lithia Spring, Franklin, Venango County.
White House Spring, Neversink Mountain, Berks County.

RHODE ISLAND.

All the water marketed from Rhode Island springs is sold for table use or in the form of ginger ale and other soft drinks. There was a normal gain in business during 1906. The number of springs reporting is 4, the same as in 1905. The number of gallons sold is 220,770, an increase of 5 per cent over 1905. The average retail price per gallon at the spring was 7 cents and the total value was $16,161, a gain of nearly 5 per cent on the 1905 figures. The reporting springs are:

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 great increase in the output and total value of mineral waters in South Carolina is due almost wholly to the large sales reported by a single spring. Springs at or near resorts, which mostly sell water for medicinal use, seem to have had a good year. The Antley, Bryan, Rock Cliff Lithia, and Vernon springs report sales for the first time, and the number of springs making returns is 12—5 more than in 1905. The number of gallons sold is given as 1,458,494, a gain of over 300 per cent. The average retail price per gallon at the spring was 24 cents, and the total value was $348,744, a gain of over 300 per cent. Nearly three-fourths of the total value represents medicinal water. Five of the springs are said to be used as resorts and to have accommodations for nearly 1,000 people. The water at 2 is used for bathing. The 12 springs from which returns of output are available are:

Antley Springs, St. Mathews, Orangeburg County.
Bryan Spring, Youngs Island, Colleton County.
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.
Rock Cliff Lithia Spring, Spartanburg, Spartanburg County.
Verner Spring, Greenville, Greenville County.
Wert Spring, Wert Springs, Union County.
White Diamond Lithia Spring, near Kings Creek, York County.
White Stone Lithia Springs, White Stone, Spartanburg County.

SOUTH DAKOTA.

Although this State is credited with 8 springs, but 1 reports sales for 1906. It is stated to be a resort and its waters are said to be used for bathing. This spring is:

Minnehaha Springs, Sioux Falls, Minnehaha County.

TENNESSEE.

On the face of the totals given in the tables of production there appears to be a phenomenal decline in the quantity of mineral waters marketed in Tennessee during 1906. Individual reports, however, do not warrant this conclusion. Some springs sold more water than in 1905 and some sold less, the gains and losses about balancing, except in the case of one spring, which reported sales of only one-tenth of its 1905 figures. To this spring the total decline is due. One spring, the Bon Aqua, makes return of sales for the first time. Resorts situated near 11 of the springs can accommodate over 1,500 people. None of the waters are reported to be used for bathing. The 14 springs heard from are:

Bon Aqua Spring, Bon Aqua, Hickman County.
Deep Cave Lithia Well, near Nashville, Davidson County.
East Brook Spring, Eastbrook, Franklin County.
Hinson Springs, near Lexington, Henderson County.

Horn Springs, Horn Springs, Wilson County.
Idaho Springs, near Clarksville, Montgomery County.
Montvale Spring, Montvale, Blount County.
Red Boiling Spring, Red Boiling Springs, Macon County.
Rhea Springs, Rhea Springs, Rhea County.
Richardson's 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.
Wright's Epsom Lithia Spring, Mooresburg, Hawkins County.

TEXAS.

During 1906 the mineral-water trade of Texas seems to have been fairly prosperous. The smaller springs, particularly those from which reports are received that show careful accounting, did about the same amount of business as in 1905, the total of their sales being slightly larger. Returns from some of the larger shippers show some discrepancies, and it is possible that the 1906 figures represent actual sales more nearly than did the 1905 returns. Five springs—the Burdette, Love's Mineral, Loretto Mineral, Port Arthur Mineral, and Rain's Tioga Mineral Wells—report for the first time. About eight-ninths of the total output is used for medicinal purposes. There are said to be resorts in the vicinity of 16 of the springs, the aggregate accommodations being sufficient for several thousand people. At 8 the waters are used for bathing purposes. The 28 springs reporting sales are:

Burdette Well, Lockhart, Caldwell County.
Capp Wells, Longview, Gregg County.
Camizo Mineral Spring, Camizo Springs, Dimmet County.
Crystal Well, Oran, Palo Pinto 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.
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:
    Cicero Smith Well.
    Congress Well.
    Crazy Well.
    George P. Barber Well.
    Gibson Well.
    Pike Well.
    Sangcura Sprudel Spring.
    Specific Well.
    Texas Carlsbad Well.
    White Sulphur Well.
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.

UTAH.

Of the two commercial springs credited to Utah, one reports selling water in 1906. It is said to be used as a resort.

Metcalf Spring, Deseret, Millard County.

VERMONT.

The mineral-water trade of Vermont shows a decrease in sales for 1906. This decrease, however, was the result of the less active exploitation of 2 springs, all the other springs reporting either gains or the same production as in 1905. About one-half of the water is used for medicinal purposes and about half as table water. Resorts are located at 4 of the springs, and at 3 of them the water is used for bathing. Accommodations for over 1,000 people are available. The same springs as in 1905 report sales:

Alburg Lithia, Chalybeate, 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.

The mineral-water trade of Virginia showed no changes of importance during 1906. The output declined and the total value advanced. New names added to the list of producers are Buckhead, Bennett Mineral, Campfield Lithia, Day's Point Artesian Lithia, and Holly Lithia. Two large producers did not report. About one-third of the water sold is for medicinal purposes, and unpleasant weather restricted the patronage of those medicinal springs which are the site of resorts. There are 19 of these with accommodations for 2,000 guests. The water at 5 of them is used for bathing. The 43 springs from which returns are available are:

Alleghany Spring, Alleghany Springs, Montgomery County.
Bath Alum Spring, Warren Springs, Bath 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.
Buckhead Spring, Buckhead Springs, Chesterfield County.
Burnett Mineral Spring, Hudson Mill, Culpeper County.
Campfield Lithia Spring, Chesterfield County.
Como Lithia Spring, East Richmond, Henrico County.
Crockett Arsenic Lithia Springs, Crockett Springs, Montgomery County.
Day's Point Artesian Spring, Smithfield, Isle of Wight County.
Erup Mineral Spring, Glencarlyn, Alexandria County.
Farmville Lithia Spring No. 2, Farmville, Prince Edward County.
Fonticello Spring, near Richmond, Chesterfield County.
Golindo Lithia Spring, Augusta County.
Harris Anti-Dyspeptic Spring, Burkeville, Nottaway County.
Holly Point Lithia Spring, Chesterfield County.
Houston Chlorinated Lithia Spring, Houston, Halifax County.
Hume Spring, Bancroft, Alexandria County.
Hunter Pulaski Alum Spring, Walkers Valley, Pulaski County.
Jeffress Lithia Silica Spring, Jeffress, Mecklenburg County.
Jordan White Sulphur Spring, Winchester, Frederick County.
Kayser Lithia Spring, Staunton, Augusta County.
Lone Jack Spring, Lone Jack Station, Campbell County.
Magee Chlorinated Lithia Spring, Clarksville, Mecklenburg County.
Massanetta Spring, Massenetta Springs, Rockingham County.
Mecklenburg Mineral Spring, Chase City, Mecklenburg County.
Mulberry Island Chlorinated Lithia Well, Mulberry Island, Warwick 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.
Roanoke Red Sulphur Springs, near Salem, Roanoke County.
Rubino Healing Springs, Healing Springs, Bath County.
Seawright Magnesia Lithia Spring, Staunton, Augusta County.
Stribling Springs (alum, blue sulphur, and chalybeate), near Staunton, Augusta County.
Virginia Aetna Lithia Spring, Roanoke, Roanoke County.
Virginia Magnesia Alkaline Spring, near Staunton, Augusta County.
Wallawhatoola Alum Spring, near Millboro Springs, Bath County.
Wyrick Spring, Crockett, Wythe County.

WASHINGTON.

The mineral-water trade in Washington prospered during 1906. Two new springs reported sales, Birch Hill Mineral Springs and Wild Pigeon Spring, making the total number of commercial springs 6 There was a gain of over 25 per cent in output and of about 7 per cent in value. About one-fourth of the water sold is used for medicinal purposes, the remainder as table water Four of the springs are reported to be resorts, and at all the water is used for bathing purposes. The 6 springs are as follows:

Birch Hill Mineral Springs, Chattaroy, Spokane County.
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.
Wild Pigeon Spring, Kalama, Cowlitz County.

WEST VIRGINIA.

About two-thirds of the mineral water from West Virginia springs is sold for medicinal purposes. The season was not particularly favorable for the summer resort trade, but the energetic exploitation of the waters of several springs resulted in raising the total sales more than 30 per cent above the 1905 figures. The average retail price was 33 cents, and the total value $57,460. The total number of springs reporting is 10, there being three new names among them—Apollo Spring No. 2, Basilithic Salt Water Well, and Carney Sulphur Springs. Resorts are located at 6 of the springs and are said to have accommodations for over 3,000 guests. At 5 of the springs the water is used for bathing purposes. The list is as follows:

Apollo Spring No. 2, Woodsdale, Ohio County.
Basilithic Salt Water Well, Webster Springs, Webster County.
Borland Mineral Well, Borland, Wood County.
Carney Sulphur Springs, Pence Spring, Summers County.
Greenbrier's Spring, Bargers Springs, Summers 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.

Systematic advertising and an energetic search for new markets are important factors in the gains shown by Wisconsin springs in 1906, as compared with 1905. The output increased 24 per cent, while the total value was 66 per cent greater. New springs are Crystal Rock, Chippewa, Endter's Crystal, Hiawatha, and Maribel. Nearly nine-tenths of the output is sold as table water, and the high average retail price, 29 cents, is due to the large proportion of water sold in bottles holding 1 quart or less. At or near 10 of the springs are resorts which can accommodate over 2,000 people. The water at 1 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.
Chippewa Spring, Chippewa Falls, Chippewa County.
Darlington Mineral Spring, Darlington, Lafayette County.
Endter's Crystal Mineral Spring, Oshkosh, Winnebago County.
Fort Crawford Spring, Prairie du Chien, Crawford County.
Hiawatha Spring, Janesville, Rock County.
Lebenwasser Mineral Spring, Green Bay, Brown County.
Maribel Mineral Spring, Cooperstown, Manitowoc County.
Nee-Ska-Ra Mineral Spring, Wauwatosa, Milwaukee County.
St. John's Spring, Green Bay, Brown County.
Salvator Mineral Spring, Green Bay, Brown County.
Sanitas Fountain, Stony Beach, Winnebago County.
Sheboygan Mineral Spring, Sheboygan, Sheboygan County.
Solon Springs, Solon Springs, Douglas County.
Waukesha Springs, Waukesha County:
- Almanaris Spring.
- Anderson's Waukesha Spring.
- Arcadian Spring.
- Bethesda Spring.
- Crystal Rock Mineral Spring.
- Glen Rock Mineral Spring.
- Silurian Mineral Spring.
- Waukesha Imperial Spring.
- White Rock Mineral Spring.

Wautoma Rainbow Mineral Spring, Wautoma, Waukesha County.

WYOMING.

The sole spring reporting sales from Wyoming is stated to be a resort with accommodations for 50 guests. The spring water is used for bathing.

Saratoga Hot Spring, Saratoga, Carbon County.

IMPORTS AND EXPORTS.

IMPORTS.

The following table shows 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, 1901–1906.

Year.	Natural waters.		Year.	Natural waters.	
	Quantity (gallons).	Value.		Quantity (gallons).	Value.
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
1903	[a] 2,851,964	[a] 846,294	1906	3,157,609	1,012,333

[a] Including artificial.

EXPORTS.

Several American springs are stated to have agencies in Canada and Mexico, and a number report shipments to these or other foreign countries in 1906. The Department of Commerce and Labor, however, has no report of these shipments, and no exports of mineral waters have been reported since 1883, in which year they were insignificant.

MONAZITE AND ZIRCON.

By Douglas B. Sterrett.

INTRODUCTION.

The demand for thorium for the manufacture of Welsbach and other forms of incandescent gas mantles has increased yearly, and until some other invention takes the place of these mantles this demand will continue. Improvements are made from time to time in the manufacture of gas mantles, and two new inventions with this object in view have been reported—one in use in Germany, the other in England. The German mantle uses a form of copper cellulose impregnated with the proper salts; the English mantle is made more durable by adding an ingredient called "laddite" to the thorium and cerium solution in which the mantle is dipped. It is said that the latter mantle has not been injured after burning 2,500 hours.[a]

The minerals from which thorium and the other rare metals used in the manufacture of gas mantles are obtained are monazite, thorianite, and thorite. The bulk of the supply of thorium is obtained from monazite, which is essentially an anhydrous phosphate of cerium, lanthanum, and didymium, containing a small and variable percentage of thorium. Though occasionally found in crystals and masses of many pounds weight, the source of the commercial material is in the form of sand. The grains are opaque to translucent and sometimes transparent, and they vary from light yellow to reddish yellow to brownish in color. They are also sometimes slightly greenish. The freshly broken or unaltered mineral has a resinous luster. This luster is brilliant, especially on the cleavage faces. The mineral is brittle and has a hardness of 5 to 5.5. It can readily be crushed between the teeth and yields a soft grit, quite distinct from the harder minerals sometimes mistaken for it. The specific gravity varies from 4.9 to 5.3, and is mostly over 5.

Thorite is a silicate of thorium, theoretically containing 81.5 per cent of thoria, though practically it generally carries less than 70 per cent. Thorianite is an oxide of thorium containing uranium and the metals of the cerium group, and carries from 70 to 80 per cent of thoria. These two minerals have been obtained in commercial quantity only in Ceylon.

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[a] Consul F. W. Mahin, Nottingham; Daily Cons. Rept., January 10, 1907.

MONAZITE.

NORTH CAROLINA, SOUTH CAROLINA, AND GEORGIA.

LOCATION AND OCCURRENCE.

The area in which workable deposits of monazite have been found in the Carolinas is growing yearly, especially to the southwest in South Carolina, where parts of Laurens, Pickens, Anderson, and Oconee counties are now included. This extends the belt in which deposits of commercial value are known to exist nearly to the Georgia line. To the northeast the belt has been extended beyond the limit set for it in southern Caldwell and northern Catawba counties into northern Iredell County, and will doubtless be traced farther. This area contains upward of 3,000 square miles, and includes parts or all of Iredell, Caldwell, Catawba, Burke, McDowell, Gaston, Lincoln, Cleveland, Rutherford, and Polk counties in North Carolina, and Cherokee, Laurens, Spartanburg, Greenville, Pickens, Anderson, and Oconee counties in South Carolina.

Monazite has been found at other places outside of this area, but as yet no workable deposits have been developed. Thus Nitze[a] mentions the finding of monazite in Hall County, Ga., near The Glades, on the north side of Chattahoochee River, about 10 miles northeast of Gainesville, where it occurs in the gold placers of Flat Creek and its tributaries, the Glade, Stockeneter, Hamilton, and Huram branches.

A prospect in the extreme northeast corner of Georgia, in Rabun County, is being investigated at the present time for its values in monazite and gold. Through the courtesy of the party interested in the property the writer has learned that the concentrates assay over 5½ ounces of gold per ton, with 30 per cent of cerium oxide and 4 per cent of thorium oxide. Since such a high content of cerium would correspond to nearly pure monazite, carrying no other minerals such as are generally found in concentrates, the oxide of lanthanum and didymium were probably included in that report for cerium. In that case the concentrates would run a little over 40 per cent monazite if the rare earth oxides found by assay all came from monazite. If the percentage of concentrates that can be washed from the gravel is large, such a deposit is very promising.

Among other places, monazite is reported to occur in some quantity at a few localities in Clay County, N. C. At Wilkesboro, N. C., a small quantity of monazite was found in a trial panning in Cub Creek. The area of known commercial deposits of monazite will doubtless be extended both to the northeast and to the southwest as the demands for monazite increase and the old deposits become exhausted.

The greater part of the monazite belt lies in the Piedmont Plateau. The belt crosses the South Mountains, however, in Burke, McDowell, and Rutherford counties, and borders on the foothills of the Blue Ridge. In the monazite region the elevations of the Piedmont Plateau vary from 700 or 800 feet to 1,500 feet above sea level. Much of this area is dissected by river and creek valleys from 50 to 300 or 400 feet deep.

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[a] Monazite and monazite deposits in North Carolina: North Carolina Geol. Survey, Bull. No. 9, 1895, p. 28.

Workable deposits of monazite do not occur everywhere in the monazite belt as described, but are confined to certain smaller belts whose direction and extent are controlled by the trend and continuity of certain rock formations from which are derived the deposits found chiefly in the gravels and sands of creek and stream beds and adjoining bottom lands. Gravel deposits may be too low grade to work on the upper part of a stream, while lower down, where the area drained contains favorable rock formations, the gravels may be rich. Hence for successful prospecting a general knowledge of the geological formations and ability to recognize those from which the monazite of the placers is derived is desirable.

GEOLOGY.

Classes of rocks.—Practically all of the rocks of the monazite region are either gneisses or schists.[a] The most important formation includes both of these types and is called Carolina gneiss. Other rock formations are gneissoid and porphyritic granite, hornblende gneiss and diorite, pegmatite, peridotite and allied rocks, and diabase.

The Carolina gneiss is by far the most extensive formation in the monazite region and appears in nearly every section. The granite-gneiss rocks are next in importance and occur in belts and irregular-shaped masses throughout the area of the Carolina gneiss. These granite masses vary from small dikes measured in feet or inches in thickness to large bodies 3 or 4 miles across. After the granites come the hornblende gneisses, which are most prominent along the northwest side of the region, where they are generally associated with large granite masses. Hornblende gneisses occur in other portions of the monazite belt, but are not of so much importance. The Carolina gneiss presents considerable variations in composition and structure. The most common types are mica, garnet, cyanite, and graphite gneisses and schists, or combinations of two or more of these types. These rocks vary from light gray to dark gray in color and often have a light bluish-gray to bluish-black cast when graphite is abundant in them. Some of the schists are fine grained and are often composed of several distinguishing minerals, as muscovite, biotite, cyanite in fine needles, and graphite, besides fine grains of quartz and other minerals; others are composed of the same minerals in coarser grains or flakes. Garnets appear in each rock type and may be fairly large even in the finer grained schist. The presence of much pegmatitic material is a characteristic feature of the Carolina gneiss.

The granite gneisses are either biotitic, muscovitic, or hornblendic in composition, and in places have a typically porphyritic texture. In the latter case the feldspar phenocrysts generally assume an augen form, caused by crushing and elongation in the direction of shearing. There is an abundant development of small red garnets throughout many large areas of these granites. A microscopic section cut from a porphyritic granite forming the bed rock at the Moon mine, 9 miles east of south of Greenville, S. C., contained the following minerals: Microcline, orthoclase, albite, quartz, biotite, muscovite, garnet, and a little zircon. The rock showed the effect of shearing, with the

[a] Complete descriptions fitting many of these types of rocks may be found in the geologic folios published by this Survey; see Geologic Atlas U. S., folio 116 [Asheville], folio 124 [Mount Mitchell], by Arthur Keith.

development or introduction of secondary minerals. The feldspar phenocrysts had been fractured and elongated, and secondary quartz had been deposited between the fragments. As a result of these metamorphic processes the feldspar crystals form augen-shaped bodies which lie parallel to the schistosity of the rock mass. The garnet is plainly secondary, and contains considerable quartz intergrown and included within it. In other parts of the region, as in the Carpenters Knob section and much of Cleveland County, N. C., there are large areas of granite gneiss which have an even granular texture and are composed chiefly of white feldspar, gray quartz, biotite, muscovite, and garnet.

The hornblende gneisses and diorites are the only other types of rock of much importance in the monazite region. The hornblende gneisses are nearly black to dark green in color, and are composed chiefly of small interwoven and matted hornblende crystals. They grade into diorite, which is also dark colored but contains a noticeable amount of feldspar and has a granitoid texture. These hornblendic rocks are more prominent throughout the northwestern side of the monazite belt, where, along with large areas of granite, they assume considerable importance.

Pegmatite is of common occurrence throughout the region, especially in those areas where commercial deposits of monazite are found. There is a wide variation in the nature of this pegmatite. In some places it occurs as distinct masses or bodies with the typical composition and texture—that is, composed of quartz and feldspar, with or without mica and other accessory minerals, crystallized out on a large scale. In other places the pegmatite represents a recrystallization of portions of rock formations with the formation or introduction of the component minerals of pegmatite. Sometimes the secondary minerals consist chiefly of quartz with smaller quantities of the others. Often it is difficult to determine whether certain smaller rock masses are granite or pegmatite, when the texture is not very coarse and the relations to the inclosing rocks can not be clearly seen in the small portions exposed.

The peridotites are not of very common occurrence in this region. They are dark green to greenish-black basic rocks, containing the ferromagnesian minerals olivine, pyroxene, and sometimes hornblende as their chief constituents. The peridotites often outcrop prominently and generally leave rounded, "nigger-head" bowlders on the surface near their outcrop. In the majority of cases, however, the peridotites will be found to have partly altered to soapstone or serpentine at the surface. In some cases the whole mass has been thus metamorphosed.

Diabase is not uncommon in certain parts of the monazite region, and is readily recognized by its dark color, weight, and the characteristic spheroidal or "nigger-head" bowlders it leaves scattered over the surface.

Age.—Most of the gneisses and schists of the monazite region are of great age and represent highly metamorphosed sedimentary and igneous rocks. The metamorphism, folding, and faulting of these rocks have been extreme, and in most cases it is difficult to determine the original nature of the formations, since much of the sedimentary bedding and igneous texture has been destroyed by mashing and recrystallization. This is especially true of the Carolina gneiss, which is the oldest formation represented and has been cut by intrusions of later age. The hornblende gneiss and diorite, the peridotite, and part, at least, of the granite-gneiss are also very old rocks and are intermingled and folded with the parts of the Carolina gneiss in a very complex way. Other gneisses and granites are of later age and have not been subjected to the same degree of shearing as the older ones, so that the development of schistosity in them has not been so extensive as in the older types. The gneisses and schists, particularly of the Carolina gneiss, have been interbanded with and cut at all angles by numerous streaks of pegmatitic or granitic material. These streaks range from a fraction of an inch upward in thickness. In some places pegmatization is so thorough that mica gneiss has become strikingly like granite gneiss.

Associations of monazite.—The best deposits of monazite have been found in or near areas where large granite masses outcrop or where pegmatization of the country rock has been extreme. On the other hand, where the gneisses and schists are nearly free from pegmatitic material and there are no granite masses in the neighborhood the stream gravels are found to be very poor in monazite. When monazite has been found in place to any extent in the country rock it has not been in the ordinary pegmatite streaks and masses, but in portions of the rock formations where there has been extensive recrystallization, with the development or introduction of pegmatitic material. Such pegmatization is locally a common feature of the Carolina gneiss, which is accordingly a favorable kind of rock for the occurrence of monazite.

Monazite deposits in regions where hornblende rocks are abundant generally contain a large percentage of black sands. In such cases it is often difficult to concentrate the monazite to a marketable grade. As an offset to this, however, especially in regions where granite is associated with the hornblendic rocks, gold is often found in the concentrates in more than sufficient quantity to pay the cost of separation, and in the same localities the concentrates generally carry also a quantity of zircon sufficient in some cases to pay for the separation. This zircon is in the form of small clear crystals with a brilliant luster, which range in size up to 1 millimeter square and about 2 millimeters long. A fairly clean separation can be made by cleaning with an electromagnetic machine and careful washing. The quantity and the size of the zircon crystals found in the monazite concentrates are in general smaller in the deposits located in areas of Carolina gneiss than in the granitic and hornblendic rock; likewise the quantity of gold found in the deposits in areas of Carolina gneiss is smaller and rarely pays the cost of separation.

Weathering and soils.—The rocks of this region have undergone such extensive weathering that good outcrops are the exception, and a thick mantle of residual soil covers much of the country. The kind of rock underlying certain soils can be determined, unless decomposition has been too thorough, by studying the outcrops and the gradations from such exposures into the residual soil. Thus the nature of the soils furnishes a clew as to the probability of monazite being present in quantity in the gravel of the streams; and, conversely, the nature of the country rock that a stream drains can often be told and the probable occurrence of monazite be conjectured by examining the débris in the gravels of the bottom lands and of the stream bed.

The Carolina gneiss, on partial disintegration and decomposition, often forms a gravelly soil with a red clayey matrix. This is especially characteristic of the graphite-cyanite type, which is abundant in parts of the region. The pebbles are composed of small fragments of the original rock, often tufts of cyanite, impregnated with hematite or limonite, or small pieces of pure iron ore.

Garnets may or may not be present. On more complete decomposition a reddish clayey soil results, with no decided characteristics. Other types of the Carolina gneiss, in which mica is an important constituent, leave a micaceous soil which often assumes a purplish color. Granites, on partial disintegration and decomposition, yield light sandy soils. Often blocks of undisintegrated granite occur scattered through the soils, giving additional evidence of the nature of the underlying rocks. On more complete decomposition granite yields soils of a light to dark reddish color, depending on the quantity of ferromagnesian minerals in the original rock, as biotite or hornblende. The quartz grains of the granite remain as sand mixed through a clayey matrix. Where the Carolina gneiss and granite are intimately associated, or where pegmatization has been extensive in a body of Carolina gneiss, there results a sandy soil, characteristic of granite, containing scattered through it pebbles of iron ore, characteristic of the Carolina gneiss. The relative importance of the iron-ore pebbles decreases in the soils as the quantity of pegmatite or of granite in the rock formations increases. These features of the soils are especially marked on the broad flat ridges characterizing much of the Piedmont Plateau. The hornblendic rocks yield a dark reddish-brown to chocolate-colored clayey soil which is very characteristic.

MINING AND CLEANING.

Wet concentration.—Nearly all of the monazite shipped from the Carolinas has been obtained from gravel deposits. These deposits lie in and along the stream and creek beds, where the monazite has collected after liberation from the decomposing gneisses and schists of the region. A part of the production for 1906, however, was obtained from a monazite-bearing gneissic rock by crushing and then separating on concentrating tables. The percentage of monazite contained in the ore treated in either type of deposit is small and probably does not often run over 1 per cent.

The usual method of working the gravel deposits has been washing in sluice boxes, though in 1906 concentrating tables were employed at several places. The form of table most used is the Wilfley or one of similar type. It is set up at the mine as convenient as possible to the gravel deposit to be treated, and is operated by a gasoline or kerosene motor. The gravel is dumped into a shaking hopper through which water is continually passing. The sand is washed through the hopper and passes over the table, while the oversize is shoveled out. At one mine the gravels are raised by a mechanical elevator and the oversize is removed in a revolving screen, from which the sand is passed over a table. In the better class of machines a number-one product can be taken off in the first washing, and the middlings be passed over a second time along with new sands. In some cases, however, where only two grades are separated, concentrates and tailings, a considerable quantity of rough concentrates is first washed out and then carefully sent over the machine a second time. In this way the grade of the sand is raised, and a very clean product is obtained.

The degree of concentration it is possible to attain by wet methods depends largely upon the composition of the gravels to be treated and the care used in treating them. Where black sands, such as magnetite, ilmenite, etc., and other minerals with a high specific gravity are abundant it is difficult to bring the concentrates up to 50 per cent monazite, even with good concentrating tables, and the product from sluice boxes may run as low as 15 per cent and under. In more favorable deposits, where the percentage of black sand is not large, a concentrate running 80 or even 90 per cent can be obtained with concentrating tables, while in sluice-box washing the grade can be brought up to 70 or even 80 per cent. Where the monazite is separated from the hard rock formations the grade has been brought up to 95 per cent and over by the use of concentrating tables. Taking the monazite region as a whole, there are not many large gravel deposits which will yield concentrates of over 40 per cent monazite in sluice-box concentration, and the average yield of crude monazite would probably not be far from 30 per cent. Should the use of concentrating tables increase, the grade of the crude monazite produced will be raised correspondingly.

Formerly the deposits of monazite-bearing gravels in the bottom lands along the creeks and streams were worked without any thought of the land being left in such a condition that farming could be resumed after mining had ceased. So the soils were washed away, and the gravels were piled up in irregular heaps and ridges. In this way the best farming lands were being ruined, and those farmers who had leased their monazite deposits found themselves possessors of nearly worthless land, with only the money received on the leases. This has been remedied in many cases by more systematic working of the gravel beds. The top soil is thrown on the side of the working pit opposite to that on which the deposit lies, and the underlying gravel is washed. When the next block of gravel is opened the soil is thrown off upon the gravel already washed in the adjoining pit. By spreading the gravel out somewhat evenly and placing the soils smoothly over it nearly the whole land is kept in condition for farming after the monazite has been removed.

It has been found that, when the stream gravels are washed for monazite and then left for a few months, especially in rainy weather, another crop, so to speak, of monazite can be obtained. This results from the washing in of monazite from the surface of the surrounding fields and hills, where it has been left by the decomposition of the original rock matrix. With this end in view, the lands draining into the streams should be plowed now and then, to give the surface waters a chance to wash the monazite into the stream beds. In many cases the farmers have preferred to wash the stream gravels themselves once or twice, or more times, a year. The usual cultivation of their farm land keeps a fresh supply of monazite stirred up in the fields, from which much of it is washed into the creeks.

Electrical cleaning.—A portion of the crude monazite is shipped to the manufacturers as it comes from the mines. The greater part, however, is cleaned by electrical machinery at local cleaning mills in the monazite region. In this way the percentage of monazite in the sand is greatly increased and the freight charges on waste products are minimized. The different types of machinery in use are (1) the Wetherill electro-magnetic machine and its modifications, (2) a machine in which the minerals are deflected by electro magnets while falling, and (3) a static machine.

Of the Wetherill machines there are two specially designed, improved types operated in different parts of the region—one in North Carolina, the other in South Carolina. In these machines there are four magnetic fields, which lift the different varieties of sand from a main conveying belt passing through them. Smaller belts, between the main belt and the magnetic pole lifting the minerals, carry the sand attracted by the different magnets out of the magnetic field and drop it into proper receptacles. In this way magnetic iron is removed by the first field; titanic iron, garnet, and other minerals of similar magnetic intensity by the second; and coarse and fine monazite by the third and fourth fields, respectively. Quartz, rutile, zircon, gold, and other highly nonmagnetic minerals pass off as tailings. This type of machine readily cleans the sand to 90 per cent, and is able to raise it to 95 per cent monazite by careful handling. In another type of Wetherill machine, of which several have been used in the monazite region, there is but one magnetic field, which generally removes magnetic and titanic iron and garnet, while the monazite is left with the quartz, zircon, and other highly nonmagnetic minerals. The cleaned product from this machine probably averages about 80 per cent, and does not often run over 85 per cent monazite. When the field magnets are properly constructed it is possible to pass the sand through the machine a second time under a much higher magnetic intensity and to free the monazite of many of the other minerals left with it in the first cleaning.

In the second type of the electro-magnetic machine the sand is passed over a series of belts, and the separation is effected by the deflection in a magnetic field of the grains of mineral as they fall over the ends of the belts. The different minerals are drawn out of their ordinary course of fall by powerful magnetic fields and are carried off in different chutes. In this way a very clean separation of monazite is said to be effected.

In the electro-static machine all the minerals but monazite and garnet are lifted from the sands. This is accomplished by a cylinder about 2 feet in diameter and 3 feet long, covered with sheets of vulcanite, slightly separated from one another, 8 by 12 inches square and three-eighths of an inch thick. The vulcanite is excited by rubbing with felt-covered cylinders revolving at a high rate of speed. The speed is regulated by cone pulleys, and is made greater when the atmosphere contains considerable moisture. The sand is heated by two gasoline lamps before exposure to the electrified cylinder. The latter is revolved slowly, and all the sand attracted to it is removed by brushes.

MONAZITE IN ORIGINAL MATRIX.

NEW COMPANY AND PLANT.

A new company entered the Carolina monazite field during 1906. This was the British Monazite Company, representing the South Metropolitan Gas Light Company of London, which undertook to mine monazite to secure a source of supply that could be depended on at times when the selling price of thorium products becomes excessive, or the supply in the market is limited by monopolies. The new company located about 3 miles northeast of Shelby, N. C., where it has opened the old Campbell mine with improved machinery and methods. The proposition at this mine is different from that of any other mine being operated in the region, and consists in crushing a monazite-bearing rock and separating out the monazite with concentrating tables. For this purpose a frame-work mill, well designed for the placing of the machinery used in treating the ore, was built adjacent to the outcrop of the ore body. Through the courtesy of Mr. Hugh Stewart, manager for the company, the following outline of the operation is given:

From the quarry the ore rock is trammed to the mill and dumped on the feed floor whence it receives the following treatment:

1. Crushed in Gates gyratory crushers to 1 inch.
2. Elevated to bin, whence it is discharged to rolls crushing to one-sixth inch diameter.
3. Product from the latter is discharged into sizing apparatus (sieves). Material of one-fourth inch diameter or under goes through sieve and is discharged into second elevator. Material over one-fourth inch goes over sieve and is discharged into second crushing rolls, where it is reduced to one-eighth inch and is also discharged to second elevator.
4. Second elevator sends ore into Huntington mills, fitted with 16-mesh screens, through which the ore is discharged.
5. Ore from the Huntington mills is collected in hoppers and fed to 1 Wilfley and 3 Overstrom tables. The seconds and thirds from the first Wilfley and middlings from the Overstroms are passed over a second Wilfley table for final concentration.

The product from the mill runs between 90 and 95 per cent monazite. A higher grade product can be obtained by careful treatment, but is not necessary. The company works the stream gravels on its property with sluice boxes and treats the concentrates obtained on one of the Wilfley tables, bringing it up to nearly 90 per cent monazite.

Ore deposit.—At the time of visit the ore rock was being mined from a shallow open quarry over 150 yards long in a northerly direction and from 8 to 25 yards wide. The cut varied from 5 to 20 feet in depth and was irregular in shape. The rock was generally removed through the full height of the working face and the ore material was cobbed out. This was not usually difficult, as the ore rock differed in appearance from the lean. The rock was somewhat jointed and, being partly weathered, was easily removed with the aid of dynamite. The ore was hauled in tram cars, drawn by horses or mules, from the quarry to the mill at the southeast corner of the cut.

Monazite was found in all of the rock taken from the cut, though the material used for ore occurred in bands varying from a few inches to 3 or more feet in thickness, interbedded with lower grade material. In places two or more streaks were worked for ore at the same time. All rock carrying above 0.4 or 0.5 per cent monazite was treated as ore; beds carrying a lower percentage were discarded. Mill tests made on some of the lean streaks showed only 0.03 per cent monazite.

Geology.—The country rock is Carolina gneiss, which has been considerably altered along certain strata by pegmatization. The beds have been thrown into a series of gentle folds. The latter, as exposed in the quarry, were from 20 to 50 or more feet from axis to axis. The rock as a whole is a pegmatized graphitic biotite gneiss, in which certain beds have been more highly recrystallized or pegmatized than others. The beds carrying larger percentages of monazite are those with a typical augen structure. The latter is due to porphyritic feldspar crystals, and small bodies of pegmatite, ranging from the size of a grain of wheat to that of a walnut, scattered through the gneiss. Beds where pegmatization has been small, or where nearly the whole rock has been replaced by pegmatite, do not carry as much monazite as those in an intermediate position.

Under the microscope sections cut from specimens from one of the ore streaks show quartz, feldspar, biotite, graphite, muscovite, monazite, limonite in films and stains, and a very little zircon. Though the feldspar has been partially kaolinized and was mostly lost during the grinding of the sections, it seems to be chiefly orthoclase and microcline; but a few small fragments of albite are left in one of the sections. The greater part of the quartz is plainly secondary. It occurs in bands or streaks of grains running with the schistosity of the rock. In some places the quartz has been deposited in the fractures or between grains of other mineral, while in other places it includes fragments of such minerals as biotite and graphite. Inclusions of gas cavities and some very fine acicular mineral, probably rutile, are not uncommon in the quartz. Biotite occurs in interwoven laths and crystals roughly parallel with the banding of the rock. The pleochroism of the biotite is light yellow-brown to dark greenish-brown. The graphite occurs as plates and laths, in general lying parallel to the banding of the rock, and exhibiting various relations to the associated minerals. In some cases it is interbanded with, and even interleaved with, biotite, while in others the plates are turned across the schistosity. Monazite occurs in contact with the various minerals of the sections, though it is more often included in or surrounded by grains of quartz and biotite.

The rock has been so thoroughly recrystallized that it is impossible to say just what the original minerals were. The quartz was evidently the last mineral to be added, and the biotite was probably the first to be formed during recrystallization. Much of the graphite was apparently contemporaneous with the biotite; the remainder was plainly formed later. It would be difficult to give the order of formation of the muscovite, feldspar, and monazite. They are intermediate between the biotite and the quartz, or in some cases probably contemporaneous with the latter.

WESTERN STATES OF THE UNITED STATES.

The investigations carried on by the concentrating plant of the United States Geological Survey at Portland, Oreg., during 1905 and 1906[a] have shown the wide occurrence of monazite in the Western States. Appreciable quantities of monazite were found in samples from the gravel deposits of California, Colorado, Idaho, Indiana, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. In many cases it would seem that workable deposits exist, judging from the percentage of monazite recorded in the tests. In Idaho especially there have been a number of monazite-bearing deposits recorded in the following counties: Ada, Boise, Idaho, Lemhi, Lincoln, Nez Perce, Owyhee, Shoshone, and Washington. In practically every case where monazite was found there was considerable zircon present. When it is remembered that many of the western deposits on which tests have been made carry gold and platinum it will be seen that they should be paying propositions if carefully handled.

[a] Day, David T., and Richards, R. H., Black sands of the Pacific Slope: Mineral Resources U. S. 1905, U. S. Geol. Survey, 1906, pp. 1175–1258.

IDAHO.

Several years ago Mr. Waldemar Lindgren, of the Geological Survey, called attention to the occurrence of a notable mass of monazite in the granite areas of the Boise Basin.

In 1906 investigation showed that the black sand residues left in the sluice boxes of the placer mines in the Boise Basin contained much monazite, frequently 50 to 200 pounds to a ton of concentrates. Similar investigation established the fact that the old tailing dumps left by previous placer miners were also rich in this material. When the original sand, including sand down Grimes Creek, was washed out for gold there were left in the residue the heavier minerals, especially monazite, in much greater proportionate quantity than in the original sand.

Publications of the Geological Survey calling attention to these considerable quantities of monazite in the Boise Basin led to the formation of the Centerville Mine and Milling Company, at Centerville, Idaho, for the purpose of extracting monazite from the old placer workings. Machinery was installed, and two or three tons of monazite were collected by the time severe weather set in in November, 1906. Now, in the spring of 1907, additional machinery for the magnetic separation of the monazite from the concentration of the tailings on a Wilfley table has been ordered, and much monazite is being gathered by sluicing the old placer claims preliminary to cleaning up on tables.

FOREIGN SOURCES.

BRAZIL.

The principal source of supply of monazite for the world's consumption has been Brazil. In the United States, however, the market for the monazite has not only practically been supplied by the home production, but during the last several years a considerable amount of high-grade sand has been exported. In return, however, there is a large importation of manufactured thorium nitrate each year.

The Brazilian deposits lie along the coasts of the States of Bahia and Espirito Santo. The monazite occurs in the sand banks and dunes on the beaches, where it has undergone partial concentration by the action of the tides and waves. Gravel deposits of commercial value have also been reported along the Rivê Parahyba, where a plant has been erected to test their value. The exploitation of the Brazilian beach deposits was first undertaken by John Gordon, an American. In the early days of mining Gordon shipped monazite sand as ballast at a cost of less than \$15 per ton to Hamburg, Germany, where he realized large profits on it, since the lowest price at that time for sand carrying 5 per cent of thoria was \$95 to \$120 per ton. Later he was forced to enter an agreement with the German combination of thorium manufacturers without being able to establish the intended monopoly of the export of Brazilian monazite. In 1903 the Brazilian legislative assembly decided that the deposits of monazite sand along the coast belonged to the Federal Government and forbade their exploitation. Later bids were let for the privilege of working these sands, and the rights were finally secured by A. C. de Freytas Company, of Hamburg. This company guaranteed a royalty of 50 per cent of the sales made and an annual production of 1,700 tons. The de Freytas Company soon went into partnership with Gordon, and together they made an agreement to sell their whole product to the German thorium syndicate. From the latter they were to receive, in addition to the selling price, a share of the profits from the sale of thorium nitrate. In this way the thorium syndicate has held a partial monopoly over the production of monazite from Brazil.

When it was found that other manufacturers of thorium products were able to obtain supplies elsewhere and that the whole output of Brazil could not be controlled, the German thorium syndicate decided to kill out all competition. Accordingly, in January, 1906, the price of thorium nitrate was reduced to nearly half of that prevailing at the time. The quantity of nitrate sold to each consumer was limited to his demands and was so placed as to conflict with the attempted sales of companies not in the thorium syndicate. In this way the aquisitions by brokers of large quantities of low-priced thorium nitrate for speculative purposes was avoided. This cut in the price of nitrate has been injurious or fatal to several smaller manufacturers of thorium products who had supplies of high-priced material in stock, though it has not seriously affected larger well-established firms mining their own monazite. The effect on the production of monazite in the United States has been very small, and it is doubtful whether the total output was in reality less than in 1905. The production all came from North Carolina and South Carolina, and represents the output of five companies, with a few independent producers. Three of the smaller companies, once active in the region, have either been forced out of business or handled no sand during 1906.

As reported by Consul-General G. E. Anderson,[a] the exports of monazite in 1906 were 4,787 short tons, valued at $480,843, as compared with 4,881 short tons, valued at $485,184 in 1905.

The federal authorities of Brazil continue to charge about 50 per cent on exports of monazite, and the quality of the sand obtained is not so good as formerly. Exporters state that they can not ship their monazite to the United States, since the tariff of 6 cents per pound for 5 per cent thorium constituent is prohibitory.

AFRICA.

The monazite deposits of the Oban Hills and of Kukuruku Hill of southern Nigeria,[b] Africa, were still further investigated during 1905. So far the Oban Hills have yielded the richest samples.

RUSSIA.

In Russia the discovery of rich deposits[c] of thorium-bearing mineral has lately been reported in an abandoned mine in the province of Perm.

MALAY STATES.

The occurrence of monazite with alluvial tin ore has been reported at Pahang in the Malay States.[d] A sample of the tin concentrate contained about 13 per cent monazite with a content of 8.38 per cent

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[a] Monazite sand in Brazil: Mining World, June 1, 1907, p. 691.
[b] (London) Min. Jour., December 29, 1906.
[c] New York Globe, April 27, 1907.
[d] Eng. Min. Jour., November 17, 1906, from Selangor Govt. Gazette, September 14, 1906.

thoria. This monazite does not much resemble the sand from the Carolinas and Brazil, since the grains are of an opaque whitish color. It should pay to separate this monazite magnetically before the tin ore is smelted, for the thoria content is unusually high.

SOUTH AUSTRALIA.

A recent report in the (London) Mining Journal[a] tells of the finding of monazite in South Australia, on Kangaroo Island, about 30 miles from Kingscote. This discovery has not been authenticated as yet.

CEYLON.

During 1905 there was considerable prospecting for thorianite in Ceylon,[b] resulting in the finding of numerous small deposits and an export of 17,900 pounds, valued at $24,110. Thorianite is a new mineral, discovered in 1904 in Ceylon. It carries from 70 to 80 per cent of thoria, and has a specific gravity between 9 and 10. Thorianite has been discovered in almost microscopic crystals in the sands of various rivers and is found to be of widespread occurrence in Ceylon. The matrix has not yet been discovered, though the pegmatites, cutting the acid leptynites of the region, have been suggested as the possible source. Besides thorianite and thorite, monazite has been discovered in the river gravels of Ceylon. In some places gold is found with these thorium-bearing minerals, and it seems the deposits could be profitably worked with mechanical separators for their several valuable minerals. According to Consul William Morey,[c] of Colombo, the exports of thorianite during the first three months of 1906 showed a falling off, for only 1,110 pounds, valued at $2,525, were shipped. About 100 pounds of thorite, valued at $97 were shipped in 1905.

ZIRCON.

The demand for zircon has not been large, and has generally been met in the United States by the intermittent working of the Jones and other mines near Zirconia, Henderson County, N. C. At these places the zircon is found in bodies of pegmatite outcropping along the top of a hill for a distance of over a mile. The zircon occurs in simple tetragonal crystals of small size, up to one-half inch square and 1 inch in length. There are a number of associated minerals, among which are many of those carrying rare earths, as xanthitane in abundance, with some titanite, titaniferous garnet, polycrase, allanite, auerlite, monazite, xenotime, and cyrtolite. Other minerals are orthoclase in crystals, epidote, staurolite, stilbite, magnetite, apatite, quartz, and decomposed hydrated mica. The formations are badly weathered and are readily excavated through the shallow depths of most of the workings. The zircon is separated from the decomposed matrix without much difficulty by rough crushing and washing.

As already mentioned, zircon, in small, clear crystals can be obtained in quantity as a by-product from much of the monazite concentrates. A clean separation can be made with electrical machinery and by careful washing. With this object in view the concentrating plant of the United States Geological Survey at Chapel Hill, N. C., is at present

[a] (London) Min. Jour., March 30, 1907.
[b] Administration Reports, 1905, Min. Survey of Ceylon, pp. E 6 and 7.
[c] Daily Cons. Repts., No. 2598, June 25, 1906.

engaged in making careful tests as to the best method of separating zircon, garnet, and other products of commercial value from monazite concentrates.

The output of zircon in 1906 amounted to about 1,100 pounds, valued at $248, and it all came from Henderson County, N. C. There was a call for several tons of zircon during the last part of 1906, but a supply could not be obtained before the close of the year. This demand has increased, and zircon is being mined during the present year as fast as possible to fill orders.

PRODUCTION.

The production of crude monazite sand in the United States during 1906 amounted to about 2,000,000 pounds, which averaged about 30 per cent monazite. Of this quantity North Carolina contributed about five-sixths and South Carolina furnished the remainder. The grade of this was so variable and the prices realized on different lots were so irregular that it has been found safer to estimate the quantity of monazite produced as concentrates. This is especially true since the greater part of the output is cleaned by local mills in the region before shipping to the manufacturers and the grade is brought up to at least 80 per cent monazite. Estimating the quantity and value of all the sand produced in 1906 on an 80 per cent basis, the production was: North Carolina, 697,275 pounds, valued at $125,510; South Carolina, 148,900 pounds, valued at $26,802—a total of 846,175 pounds, valued at $152,312.

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; of monazite, zircon, and columbite in 1905; and of monazite and zircon in 1906:

Production, in pounds, of monazite in the United States, 1893–1906.

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	1906	[d] 847,275	152,560

[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.
[d] Including 1,100 pounds of zircon, valued at $248.

The greater quantity of monazite sand recorded for 1905 as compared with 1906, without a corresponding excess of value, is due to the fact that in 1905 the quantity represents in part concentrates and in part crude sand, while the whole production for 1906 is placed on the basis of concentrates.

IMPORTS AND EXPORTS OF MONAZITE.

According to the Bureau of Statistics, of the Department of Commerce and Labor, there were no imports of monazite or other thorium-bearing minerals into the United States during 1906. A considerable quantity of thorium nitrate, however, has been imported during the last five years. The quantity and value of these imports are given in the following table:

Imports, in pounds, of thorium nitrate into United States, 1902-1906.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	42,815	$131,350	1905	52,378	$269,504
1903	64,520	232,155	1906	40,090	139,929
1904	58,655	249,904			

Considerable monazite was exported to Germany and England in 1906. This was high-grade sand in each case, and amounted to from one-fourth to one-third of the output of the United States.

PRICES.

The price of thorium nitrate has shown some remarkable variations during the last thirteen years, as appears in the following table:[a]

Prices (per kilogram of 2.2046 pounds) of thorium nitrate, 1894-1906.

Early in 1894	$476.00
January, 1895	214.00
July, 1895	119.00
November, 1895	71.40
May, 1896	35.70
October, 1896	$21.42
October, 1899	7.14
Later, and in 1905	12.61
January, 1906	6.43

The prices paid for crude monazite in the North Carolina and South Carolina mining regions varied from 1½ cents per pound for very low-grade concentrates with small thoria content to 15 or more cents for the better grades. The average price was nearly 8 cents per pound.

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[a] Southern Industrial and Lumber Review, September, 1906.

PEAT.

By Marius R. Campbell.

During the year 1906 scarcely any advance was made in the utilization of peat in the United States. About the usual number of companies were organized and glowing prospectuses were issued, but little or nothing was done toward the development of the peat industry in general. Many of the plants that were in operation experimentally in 1905 closed down during the year, so that at the end of 1906 it is probable that there were fewer plants in operation than at the close of 1905.

No one questions the possibility of converting a fine, dense, homogeneous peat into a fair quality of fuel suitable for both domestic and steaming purposes, but the troublesome conditions connected with the work—conditions which have caused most of the failures—are the excessive cost of production and necessarily low price of the product. All methods of handling peat so far devised require heavy machinery and considerable hand labor, and both of these are expensive. Seemingly the only way to improve these conditions is to manufacture it in a large way wholly by machinery.

During the year three companies have reported experimental work—Winter Park Electric and Fuel Company, Orlando, Fla., which uses the Leavitt machine; Wolverine Peat Fuel Company (Limited), near Vicksburg, Mich., which uses the Dolberg machine; The Lamertine Heat, Light, and Power Company, near Vicksburg, Mich., which uses a machine of special type owned by the company.

The method of handling the peat is essentially the same in all of the plants that have reported, namely: (1) Digging from bog either by hand or machine; (2) transporting in car or conveying apparatus to mill; (3) disintegrating in mill; (4) molding into bricks; (5) drying by natural exposure until the water is reduced to about 15 or 20 per cent.

The Winter Park Electric and Fuel Company has departed from this practice slightly, as it now dispenses with the molding into bricks, simply dumping the disintegrated peat on the ground and letting it dry in irregular masses which later are broken with hammers into lumps. This is reported to give excellent satisfaction and to save the trouble and expense of bricking the wet pulp. It has the disadvantage, however, of taking more space in storage, and it may be possible that this method would not work so well in other parts of the United States as it does in the hot climate of Florida; but it is worth considering, as it effects considerable saving in the cost of manufacture.

One of the most complete plants that the writer has seen for the manufacture of peat into fuel is that of the International Fuel and Power Company, which is nearly ready for operation at a bog located not far from Ogdensburg, N. Y. The plant is built on a large dredge, and the progress of the peat through the machine from the time it leaves the bog until it is delivered in the form of briquettes is entirely automatic. The bog is located on the east side of Black Lake, in a position that makes dredging operations easy. The peat is raised from the bog in bucket conveyors, dropped into the hopper of a disintegrating machine, passed through steam-jacketed pipes to drive off moisture, and then, while hot, is briquetted under immense pressure. The product, according to the claims of this company, contains less than 5 per cent of moisture. This plant is very complete and well built, and there seems to be little doubt that briquettes can be successfully produced; but whether they can be be made cheaply enough to compete with Pennsylvania soft coal at $3.25 per ton seems to be a question. Doubtless, if this operation is successful, it will lead to the utilization of many other peat bogs in northern New York.

As reported in Mineral Resources for 1905, Florida machine peat makes an excellent fuel for the manufacture of producer gas, yielding fully as good results as Texas and North Dakota lignites. The results of tests made are briefly as follows:

Steam and producer-gas tests on peat and lignite.

Kind of fuel.	Fractional part of an electrical horsepower produced from 1 pound of fuel.	
	In producer plant.	In steam plant.
Florida peat	0.330	0.143
North Dakota lignite (1)	.335	.099
North Dakota lignite (2)	.309	.118
North Dakota lignite (3)	.308	....
Texas lignite (1)	.388	....
Texas lignite (2)	.299	....

Where power is the object sought, the best method of utilizing peat seems to be to convert it into producer gas. Tests so far made seem to be sufficient to demonstrate that peat can be used in this way, but there are many questions yet unsolved. Probably the two most important of these are to determine the maximum amount of moisture that can be used in a producer and whether it is necessary to disintegrate the peat and mold it into bricks.

If the manufacture of producer gas from peat proves to be commercially successful, central power plants will doubtless be established at the bogs and the peat thus converted into electricity, which will then be transmitted wherever power is required. In this way the cost of transportation of a fuel with a heavy percentage of moisture will be avoided and the power will be readily available in large or small amounts wherever needed.

As has been already stated, the manufactured fuel from peat in the United States has thus far been experimental only, and the statistics are therefore of little value. It is estimated, however, that from 500 to 1,500 tons were produced in 1906.

During the year there was imported into the United States 8,557 short tons of peat, valued at $45,344. This was imported largely as peat moss and used chiefly for stable litter.

PRECIOUS STONES.

By Douglas B. Sterrett.

INTRODUCTION.

The native gems of southern California, as tourmaline, beryl, kunzite, topaz, essonite, etc., are being mined, cut, and sold in some quantity by jewelers of San Diego and Los Angeles. Good lapidaries are employed at both towns, and the cut stones are retailed in the East and abroad as well as locally. The greater part of the output of California stones, however, is shipped East for cutting.

In Maine, where precious stones of a similar class are mined, the cutting is nearly all done locally and the sale of gems is limited chiefly to the State, good prices being realized by retailing to tourists. The discovery of kunzite, or lilac-colored spodumene, at Andover, Oxford County, Me., will add a new interest to the gem industry of that State if pieces large enough for cutting are found. The material so far found has come from near the surface and was somewhat fractured. It is hoped that better, flawless mineral will be found with depth.

Gem tourmaline and beryl are mined at a new locality near Canyon, Colo., and are cut, at present at least, largely for local sales.

Chrysoprase is known to exist at many places in California and has been mined in considerable quantity. There was a large production in 1906, part of which was high-grade material.

There has been a large decrease in the production of turquoise in the Southwestern States, from Texas to southern California. Several of the companies formerly operating in that region reported good material to be very scarce, and many companies did not attempt mining during the year. If turquoise is to be a popular stone this season, as is reported from London in the Jeweler's Circular Weekly, the scarcity of the native stone should cause a revival of activity in the development of the American turquoise deposits.

The discovery of gem corundum during 1906 in the gold placers of Washington County, Idaho, adds a new locality for the occurrence of blue and other colored sapphires in the United States. Stones of considerable beauty have been found, and it is to be hoped that predictions regarding the finding of sapphires in quantity and in other parts of the State will prove true.

The importation of diamonds for consumption during 1906 again showed a large increase over the preceding year; and this in spite of a 7 per cent increase in value for rough material. The increase of imports of rough diamonds is the first substantial one in three years, and indicates, it is hoped, an expansion of the cutting industry in this country; but there is room for a larger field of work for the industry, not only in cutting smaller stones, but in cutting a larger portion of the stones imported for consumption.

The demand for domestic fresh-water pearls has been strong, and the production large, but it can not be accurately given. They came chiefly from the Mississippi Valley region. A portion of the production has been exported, and in return there has been an importation of nearly two and a half million dollars' worth.

AMBER.

BURMA.

The production of amber[a] in the Myitkyina district of Burma was considerably greater in 1905 than in 1904, owing, it is said, to the peaceful condition of the country. The value, however, fell from £9 15s. to £7 10s. per hundredweight, owing to the increased output and the inferior quality of the material. The production in 1905 was 126 hundredweight, valued at £945, as against 86 hundredweight, valued at £838, in 1904.

AZURITE SANDSTONE.

UTAH.

A small specimen of rich deep-blue azurite sandstone from La Sal district, Utah, was sent to the Survey by Mr. F. G. Hillman, of New Bedford, Mass. It is thought the stone might be useful for finishing doorways or similar ornamental purposes. The texture as a sandstone would probably prohibit its use in small ornaments, since it would be difficult to give the stone a high polish. The deposit is located 70 miles from a railroad station, and is in a mountainous district. Should it prove attractive and a demand arise for it, it is said that a supply of this stone could be obtained, though as yet it has not been quarried in any quantity.

BERYL.

NORTH CAROLINA.

In North Carolina the American Gem and Pearl Company operated their aquamarine mine at Spruce Pine, Mitchell County, during part of the year. It is said that the gem-bearing portion of the pegmatite is too irregular in direction and contents to pay the cost of mining.

Aquamarine and golden beryl of very fine clear color have been found from time to time in the South Mountains in Burke County. Most of the material has been obtained from near the surface and was, in many cases, somewhat flawed, though stones of fair size have been found.

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[a] Records Geol. Survey India, vol. 34, pt. 2, 1906, p. 62.

MASSACHUSETTS.

Blue and yellow beryls of good gem quality were found at Royalston, Mass., during the year. One crystal of blue beryl was estimated by Mr. H. S. Williams, formerly of the American Gem and Pearl Company, as being worth $200.

COLORADO.

Beryl and aquamarine were reported from the tourmaline deposit in the Royal Gorge vicinity, Colorado, operated by Mr. C. A. Beghtol, of Canyon.

EMERALD.

AUSTRIA.

In a letter from Mr. Arthur Thompson to the editor of the Mining Journal,[a] the emerald mines of Austria are briefly described. The mines are located in the Salzburg Mountains at an elevation of over 8,000 feet above the sea and about 7 miles from Habach station, up the Habach Valley, on a narrow-gage railroad. They have been worked in a dilatory, immethodical way. Their value may be judged from the fact that in 1902 about 68,000 carats were mined by six miners in less than four months' time.

The emerald-bearing matrix (a micaceous and steatitic light-gray and copper color formation) is reached by four levels driven into the steep declivity of the mountain, varying in depth of from 600 to 700 feet below the top of the divide or pass of the two mountains constituting the great Legback Valley. The emerald-bearing strata are defined on one side by a highly hornblendic schist and a massive, well-marked gneiss formation on the other, while in some parts between these formations large outcrops of serpentinous and other magnesian rocks are observable; consequently the general geological make-up of this valley is characteristic of the richest emerald-bearing strata of the oldest and most famous emerald mines in various parts of the world, especially the celebrated and ancient Muzo mines of the United States of Colombia.

The greatest depth reached in the workings is only about 200 feet, though it is expected that operations will be carried into the heart of the mountains.

COLOMBIA.

According to Mr. Henry C. Granger,[b] emerald mining in Colombia is a Government monopoly. Short leases only are granted, and 80 per cent royalty is charged.

Conditions at the emerald mines of Muzo, Colombia, are described as follows by an English engineer who examined the mines for the Colombian Government.

The mines are situated in the State of Boyacá, about one and one-half hours' ride from the small town of Muzo. The Muzo district, though hot, is healthy; water and timber are abundant, and the land is fertile. Labor also seems to be easily obtainable.

The emerald deposits vary in height from 3,000 to 4,000 feet above the sea level. Their area extends over many leagues, the Government property alone being estimated at 40,000 hectares.

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[a] Mining Jour. (London), June 30, 1906.
[b] Eng. and Min. Jour., August 4, 1906, p. 194.

There has been for some time a scarcity of water in the mines. There are in the district, however, a number of small streams which could be tapped, and which by means of a ditch, 2 leagues in length, would give a large and constant supply of water to the mines from a high level, thus giving greater pressure for working a monitor or extending the present tank system. Since the report was written, work on this ditch has been begun.

The further improvements recommended to the Government by the writer of the report include a dam to be built across the stream, with sluice to release the water when necessary, so as to sweep away the débris, which now is accumulating to a dangerous extent, a sawmill plant, a monitor and connections, new housing for workmen, storerooms, etc., and new tools and mining appliances, the total cost being estimated at £20,000.

He also advises that the road from Simijaca to Muzo should be put in order, and that a bridge for mule traffic should be built over the river Guaso.

He estimates that if his recommendations are carried out, and the mines properly worked, there should be an annual profit of £200,000. He believes, moreover, that by opening up the old workings on the other side of the valley, opposite the present Muzo mine, another and probably equally productive mine might be worked. He considers, indeed, that the only limit to the production would be the quantity that could be sold without seriously reducing the price of emeralds.[a]

CALIFORNITE (VESUVIANITE).

CALIFORNIA.

About 2 miles east of Exeter, Tulare County, Cal., a vein of compact vesuvianite or californite has been opened on the top of a rounded hill, 500 feet above the valley. Mr. Frank L. Hess, of the United States Geological Survey, who examined the deposit, states that the vein varies from 2 to 4 inches in thickness and lies with small magnesite veins in serpentine. Some material was taken from a prospect hole about 20 feet deep, but none was shipped. In a polished hand specimen the stone appears to have been brecciated and cemented together again by flesh-colored magnesite in small seams, veinlets, and irregular masses. The color of the californite is a nearly clear apple-green, which forms a pleasing contrast with the included portions of the flesh-colored magnesite. This combination would be very attractive in small ornaments and mosaics, while pieces large enough for small table tops and similar decorative purposes might be obtained by cutting some of the gray-green to greenish-black serpentine along with the californite.

CHRYSOPRASE.

CALIFORNIA.

One of the chrysoprase mines in Tulare County, Cal., operated by the Himalaya Mining Company of New York, was visited during the year by Mr. Frank L. Hess, of this Survey, who furnished the notes from which the following information was compiled:

The mine is situated about 8 miles southeast of Porterville, and about one-half mile south of Deer Creek, in a rough serpentine knob. The chrysoprase veins can be traced some distance to the north along the top of the hill. The country rock is a serpentine, covering a large area. In many places this serpentine is badly decayed and weathered away, while in others it forms prominent outcrops. In the latter case the serpentine has been rendered more or less hard by silicification. In some places it has the shining waxy luster of the precious

[a]Mining Jour. (London), February 2, 1907.

varieties. Often, near the chrysoprase veins, the serpentine is badly decomposed and is stained with nickel. The chrysoprase is found in veinlets and veins from one-fourth inch to 8 or 10 inches thick, cutting through the serpentine. The color of the chrysoprase varies considerably in different veins and in different parts of the same vein. In some cases the middle portion has a fine green color of the valuable shade, while in others gem material may occupy any portion in the vein. The greater part of the larger veins is not of good gem quality, and the best material is confined chiefly to the thin veins or the thinner portions of the veins.

The main workings are on the south side of the hill. They consist of two shallow open cuts, extending probably 20 to 25 feet into the hillside, where they meet, and about 15 feet deep in the deepest part, with other smaller openings. Much good chrysoprase is obtained as float by plowing up and harrowing the land lower down on the gentler slopes of the hill. In this way the loose rocks are turned up, and, after exposure to the rain, the good chrysoprase is readily picked out. The operation is then repeated and another crop gathered.

It is reported that from this mine about 3 tons of material have been shipped from which it was said about 300 pounds of gems could be cut. That portion unsuitable for gem purposes is to be shipped to Germany for cutting into slabs for mosaics. Large masses of silicified serpentine, weighing several hundred pounds, with light-colored chrysoprase veins an inch or less thick are to be shipped also. In a fire on the property during the year, nearly 4 tons of chrysoprase ready for shipment were burned and practically destroyed. Much of it lost its color and was so badly cracked by the heat as to be valueless.

On the north side of the hill opal veins have also been found in a decomposed serpentine. The veins are all small, ranging in thickness from an inch down. In some cases the opal has a green color, like that of the chrysoprase, and is called chrysopal.

The same company has operated chrysoprase mines at Venice Hill, about 10 miles east of Visalia and near Exeter. These deposits are about 35 miles and 28 miles respectively north-northwest of the Deer Creek deposit. Small deposits are also reported on White River 25 miles south of Porterville, but their value is, so far, doubtful. Beautiful specimens of chrysopal are found in a serpentine hilltop just east of Plano, about 1½ or 2 miles south of Porterville, but it is not known to have been used commercially.

DIAMOND.

PROSPECTING IN THE UNITED STATES.

Authentic reports of the finding of diamonds in Arkansas during 1906 were received at this office, and there were rumors of diamond discoveries in the localities mentioned in the following paragraphs. A report on the Arkansas discoveries is appended to this paper.

California.—The discovery of what has been called a "diamond pipe" near Oroville, Cal., by Mr. M. J. Cooney, has caused considerable comment in various papers both East and West. The deposit in question was found along the west bank of Feather River, about a mile north of Oroville, in ground from which 20 to 60 feet of alluvium had been washed off during hydraulic gold-mining operations. The outcrop is being vigorously prospected, and it is expected that a small experimental washing plant will be installed. Mr. Cooney kindly furnished specimens of certain rocks he considered to be typical of the formation near Oroville and to be identical with the kimberlite and associated rocks of South Africa. The specimens marked "blue" were soft, highly serpentinized rocks whose original nature could not be determined. In a thin section under the microscope the rock was found to contain rounded crystals of some mineral, probably olivine, entirely altered to serpentine. The section contained a great deal of serpentine throughout, with some in little streaks and veinlets. There were small fragments, apparently a variety of feldspar, of some larger crystals, mostly lost in grinding. In hand specimens portions of the rock have a brecciated appearance, while other pieces appear to have a more even texture. The color is dull, ranging from greenish to bluish green to bluish black. Slickenside partings are not uncommon in various directions through the small pieces examined. Specimens of two other types of rock were "bull's-eyes," or spherical balls with concentric layer structure, and concretions or nodules of calcium carbonate. The "bull's-eyes" range in size from that of an egg up, and have been formed by the weathering of a fine-grained basic rock, probably of the basalt or diabase family. It has a fine porphyritic texture with a slight development of amygdules.

According to Mr. Cooney, the "bull's-eyes" and lime nodules were found on the surface and to a depth of 20 feet, mixed with earthy material and somewhat cemented together. This gradually gave place to soft yellow ground at 25 feet. The yellow ground held out to a depth of 40 feet, where a semisiliceous stratum, "somewhat like the 'floating reefs' encountered in the diamond chutes or pipes of South Africa," was met. Below this came in the "blue ground" described above. The following minerals are reported by Mr. Cooney in the Oroville serpentine or "blue" and "yellow" earths as similar to those minerals commonly associated with the diamonds in South Africa: Menaccanite, magnetite, olivine, garnets, spinel rubies, topaz, beryl, chrysoprase, agate and other forms of chalcedony, zircons, etc.

The specimens sent to the Survey by Mr. Cooney as typical "blue earth" of the Oroville locality do not bear much resemblance to the genuine kimberlite of South Africa. Points of likeness are the extensive serpentinization in each, a general bluish-green color, and probable brecciation of the California rock compared with the evident extreme brecciation of the kimberlite. On the other hand, the general appearance of the two rocks on close inspection is very unlike. The California serpentine apparently does not contain inclusions of other types of rocks forming the walls, while the kimberlite contains these in quantity, as black shale, conglomerate, quartzite, melaphyre, etc. The numerous plates of biotite common in the true kimberlite were not observed in the California rock. The presence of feldspathic material in the California serpentine indicates a quite different type of rock from the kimberlite. The latter is regarded as a serpentinized volcanic peridotite breccia, with the serpentine probably derived from a less basic rock, possibly of the gabbro or diorite class. As far as can be learned, the presence of "bull's-eyes" is not a prominent feature of the South African diamond mines, while the occurrence of lime concretions is not limited to the outcrop of diamond pipes alone, but is common to large areas of the country around Kimberley, where rocks other than kimberlite outcrop.

It seems likely that the outcrop of rock near Oroville, designated "kimberlite" by Mr. Cooney, is a portion of one of the belts of serpentinized amphibolite schists running through the country in a northwest direction, as mapped in the geological folios[a] of this Survey by Turner, Lindgren, and Becker. The alluvium has been washed off, exposing a portion of such a belt, which has been mistaken for a pipe formation, since it is exposed over a limited area. The rock formation including the region a mile north of Oroville represents a highly metamorphosed series of basic rocks which have yielded amphibolite schists and serpentine. In this formation are included diabase-porphyrites which would readily furnish such specimens as the "bull's-eyes" described above.

Many authenticated finds of diamonds are on record in Butte County, Cal.[b] Some of these have been along Feather River not very far from Oroville. The majority have come from Cherokee Flats, north of Oroville, where Mr. Cooney and his associates own other land on which they expect to prospect. Since the presence of diamonds is well established for this part of California, it remains for some one to locate them in the matrix. Just what the nature of that matrix will be is not known. It may not be a typical kimberlite rock and in the form of a volcanic neck, but one of the other great varieties of basic igneous rocks so plentiful in the region. It has not been proved that a kimberlite formation is essential to the occurrence of diamonds, nor that where such a rock exists it must carry diamonds. Several rock outcrops are known, as in Elliott County, Ky., and Kakanui, New Zealand, where there are basic rocks almost identical in appearance to kimberlite around which no diamonds have as yet been found. On the other hand, diamonds occur in a matrix of hornblende-diabase near Inverell, Australia. Since the composition of many of the rocks of the Oroville region is not very unlike this, it may be that the diamonds will some day be found in a matrix of similar type in that region.

Kentucky.—The revival of interest in the kimberlite rock formations of Elliott County, Ky., was not abated in 1906. The Kentucky Diamond Mining and Development Company, which owns the outcrop of the kimberlite on Isom and Critches creeks, has arranged for a complete washing plant similar to those used in South Africa. This plant is at present (May, 1907) under construction, and, it is expected, will be ready to make a thorough test of the deposit within a few months. The company disclaims the knowledge of any diamonds having been found on its property. Pyrope garnet, diopside, and olivine, however, all of gem quality, have been found, along with other minerals associated with diamonds in South Africa.

Wisconsin.—The discovery of a diamond field near Plum City, Wis., has been reported.[c] It is said the deposit lies outside of the area of glacial drift. As yet there has been no confirmation of these newspaper reports.

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[a] Geologic Atlas U. S., folio 17 (Marysville), folio 18 (Smartsville), and folio 43 (Bidwell Bar), U. S. Geol. Survey.
[b] Turner, H. W., Diamonds of California: Am. Geol., vol. 23, 1899, p. 182.
[c] Jew. Circ. Weekly, October 3, 1906.

CANADA.

In Canada a large diamond was reported[a] found in the Nipissing district, though the report has not been authenticated. Attempts to trace the diamonds found in the glacial drifts of Ohio, Indiana, Michigan, and Wisconsin back to their original source have not so far been successful. Dr. Robert Bell,[b] of the Canadian geological survey, considers the source of the diamonds found in these States to be just north of Lake Superior, where thére is a volcanic area in which igneous rock and shales containing carbonaceous matter are abundant. Débris from this area would have been carried by the ice sheet in the same course as the jasper conglomerate bowlders which are found with the diamonds and have come from the extreme eastern part of the Lake Superior region. In the Muskoka district, east of Georgian Bay, peridotite rocks cut shales carrying carbonaceous matter, thus giving conditions similar to those in South Africa.

SOUTH AFRICA.

De Beers Consolidated Mines.[c]—According to the eighteenth annual report of the De Beers Consolidated Mines operations during the year 1906 were pushed with increased activity. The total production of blue ground at all the mines—De Beers and Kimberley, Wesselton, Bultfontein, and Dutoitspan—was 8,144,979 loads, as against 5,433,357 in 1905; and the total quantity washed was 5,625,592 loads, as against 5,128,015 in 1905. This leaves a remainder of 6,769,126 loads on the floors, an increase of 2,519,387 during the year. The average number of carats recovered per load was slightly less for each of the mines than during the previous year, though this was more than offset by the increased value of the diamonds per carat and the greater number of loads washed. The increase in the number of loads washed came chiefly from the Dutoitspan and the Bultfontein mines, while the others treated less than during 1905. Correspondingly, the increase in the total value of diamonds produced came chiefly from the Dutoitspan and Bultfontein mines, with a smaller increase from the Wesselton. An increased quantity of tailings and débris was treated during the year, with a corresponding increase in the quantity and value of diamonds obtained from such material. The quantity and value of diamonds thus obtained, however, did not equal that from a smaller quantity of tailings treated in 1904.

The total amount of blue ground in sight for all the mines at the close of the year was 64,315,580 loads, as against 59,326,700 loads in 1905. This does not take into consideration the probable great depths to which the mines can be profitably worked below the present lowest levels. At the same rate of washing per year as in 1906 it would take eleven years to exhaust the mines above their present lowest levels, and with the same rate of yield and valuation there would be a product worth £64,000,000.

The five-year contract with the diamond syndicate expired at the close of the year 1906, but was renewed for the same period of time on even more advantageous terms. The market remained strong and the

[a] Jew. Circ. Weekly, August 1, 1906.
[b] Abstract from Jour. Can. Min. Inst., in Eng. and Min. Jour., November 3, 1906.
[c] Eighteenth Ann. Rept. De Beers Consolidated Mines for year ending June 30, 1906.

demand for diamonds has increased so greatly that the management found it necessary to extend washing operations. The sale of diamonds realized £5,607,718, as against £4,802,844 in 1905. The net profits amounted to £2,937,509, from which the amount distributed in dividends was the same as in 1905, £1,800,000, and £916,057 were carried forward. The company found it necessary to lay aside £500,000 to meet the English income tax, levied since 1901, should it be compelled to pay this second tax in the mother country after paying one to the colony.

Transvaal diamond mines.—According to the annual report of the government mining engineer of Transvaal for the fiscal year 1906 the production of diamonds came principally from volcanic pipes, with some from alluvial deposits. The total output in 1906 was 2,610,084 loads washed (including 104,623 loads from alluvial deposits), which yielded 758,406 carats of diamonds, valued at £968,229, as against 1,568,077 loads washed (including 120,827 loads from alluvial deposits), which yielded 995,002 carats of diamonds, valued at £1,198,530, in 1905.

The Premier Diamond Mining Company (Limited), contributed by far the largest part of the diamond production of Transvaal and earned, during the year ending with October, 1906, a profit of £673,349. Two other companies operating pipes in the Pretoria district that contributed to the diamond production were the Kaalfontein and the Montrose Diamond Mining companies (Limited). The new alluvial deposits along the Vaal River, opened for mining in June, 1906, have not come up to expectations.

One of the promising diamond mines of the Transvaal is the Roberts Victor, which was discovered early in 1905; it made a profit during the last six months of 1906 of £39,045.[a] The average yield per load of ground washed was 0.7 carat.

The Vorspoed is another Transvaal diamond mine of recent (September, 1905) discovery and proved value.

BRAZIL.

The following summary of the diamond-mining conditions in Brazil is given by M. Arrajado R. Lisboa:[b]

> The diamantiferous district is very large. It extends from Matto-Grosso to Bahia, crossing the states of Goyaz and Minas-Geraes, which is the principal center of the industry. A French company until recently explored the Boa-Vista mines, near Diamantina, and at present an English company operates the Agua-Suja mines, Bagagem, but operations are still in the installation stage.
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> Lately several diamond-dredging claims of Brazil, on the river Jequitinhonha, the diamantiferous river, have been examined by American companies. On the river Coxipo, in Matto-Grosso, many diamonds have been gathered with the gold, and with appropriate plant, diamond dredging may offer very satisfactory results when competently directed.
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> Carbons exist in the diamantiferous district of Bahia, named Chapada Diamantina. There is no systematic exploration, the diamonds being found by the garimpeiros or washers, who employ primitive processes. Carbons being of comparatively high value their presence in the diamantiferous alluvials of Bahia with the diamond has given an added importance to these deposits during the last few years.

New alluvial diamond deposits were reported at Douradinho, district of Coromandel, Estrella do Sul. The stones are perfectly limpid and of very fine quality, and bring good prices.

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[a] Mining Jour. (London), March 30, 1907.
[b] Eng. and Min. Jour., March 2, 1907.

According to Mr. Francis C. Nicholas[a], many of the diamond deposits of Brazil could be worked by dredging.

Nearly all of the diamonds found in Bahia, Brazil, as well as the carbons, are sent to Paris.[b] The yearly exports increased steadily from 1899 to 1902, after which they fell off. The outlook for a larger trade, however, was better during 1906. The yearly production of carbons from Bahia is estimated at 30,000 carats, all of which go to Paris for distribution, about 10,000 carats being taken by New York.

With the increasing price of diamonds and the failure of the large mines to overstock the market, there has been much activity in prospecting and searching for these stones in many parts of the world during 1906. At the same time, according to Consul George L. Anderson[c], of Rio de Janeiro, stock-jobbing companies have chosen the diamond fields of Brazil for the promotion of their wild-cat speculations and have sold much stock in London, New York, and Chicago. In many cases they have had bad titles for their land, or do not even know its location. The diamonds occur in scattered deposits or pockets, often in places difficult to reach with machinery and equipment necessary for mining. Preliminary or hasty examinations do not suffice to prove the richness of a deposit, and often considerable money is necessary to have the properties examined and carefully tested.

Writing at a later date,[d] Consul Anderson states that mining conditions are becoming better and that the bulk of the diamond production from the Diamantina district still goes to Paris and London, though American mining concerns are purchasing larger quantities of stones and increasing the imports into the United States. The production of diamonds can not be given with any degree of accuracy, since the State government imposes a tax on all stones exported, and the producers try to avoid this by keeping no records of their finds or sales. The average production of the Diamantina region is estimated at about 5,000 carats per month, valued at somewhat over $40 per carat in the rough.

INDIA.

The output[e] of diamonds in India is given for 1905 as 172.41 carats, valued at £2,474, as against 286.48 carats, valued at £2,636, in 1904. The industry furnishes employment to 1,890 persons.

The mode of occurrence of the diamonds in the Bundelkhand States, especially in Panna, is fully described by Mr. E. Vredenburg in the Records of the Geological Survey of India for 1096.[f]

NEW SOUTH WALES.

An interesting discovery of diamonds in matrix has been made at Oakey Creek, near Inverell, New South Wales.[g] Two miners were driving a tunnel through a granite hill to penetrate a basalt-capped deep-lead deposit of stream tin and alluvial diamonds. Three intrusive horn-

[a] Min. World, March 23, 1907.
[b] Jew. Circ. Weekly, February 14, 1906.
[c] U. S. Daily Cons. Repts., July 16, 1906.
[d] Idem, May 15, 1907.
[e] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 53.
[f] Vredenburg, E., Rec. Geol. Survey India, vol. 33, pt. 4, 1906, pp. 273-311; also same volume, pt. 2, pp. 88-90.
[g] David, T. W. Edgeworth, Min. and Sci. Press, January 12, 1907.

blende diabase dikes, standing nearly vertical, were cut through. The first one was about 26 feet thick; the other two were smaller. In the middle of the first dike a diamond of about one-half carat weight was found embedded in solid intrusive rock. Three more small diamonds were later picked out of the more decomposed diabase after it had been exposed to the weather for some time. One of these stones has corrosion hollows on the surface filled with portions of the hornblende diabase matrix.

These specimens, one with the diamond still in the matrix, were exhibited before the geological section of the British Association for the Advancement of Science, and the mode of origin was discussed. Sir William Crookes thought the diamonds had probably formed originally under absolutely nonoxidizing conditions, as would be found in molten iron. Arguments brought against Crookes's theory that the diamonds were originally formed from molten iron were that Doctor Friedlander, of Berlin, had made microscopic diamonds by stirring molten olivine (not very different in composition from the Inverell hornblende diabase) with a graphite rod, and that the diamonds were found in the Novo-Urei meteorite of Russia, which was composed chiefly of silicates. The general opinion seemed to be that the hornblende basalt might well be the original matrix of the diamond, without the necessity of assuming deeply buried masses of metallic iron which were subsequently absorbed by the hornblende basalt.

Consul F. W. Goding reports[a] from New Castle, New South Wales, that rough diamonds have been found lately in Queensland ranging from 1 to 5 carats in weight. The finds have not been numerous, and since European and American merchants have judged them to be of inferior quality exploration has not been pushed vigorously.

Another locality for diamonds in Australia has been reported[b] on the eastern slopes of the Nandewar Range, toward Bingara, where it is said a blue diamond was found and sold locality for £5. At Sydney it brought £32 10s.

TASMANIA.

During 1906 a diamond is reported to have been found on the west coast of Tasmania, at Long Plains. According to Mr. W. H. Twelvetrees, government geologist, the presence of ultra-basic rocks and carbonaceous shale may point to diamond-bearing rock being found in the region. The diamond found weighed about one-eighth carat. It was an octohedral crystal, with a peculiar greenish-yellow tint at the points.

NEW ZEALAND.

Specimens labeled "gem sands" of Kakanui[c] were collected some years ago by the late Professor Ulrich, of the Otago School of Mines, with the idea that gems might be found associated with these sands at some future time. Careful inquiry has failed to discover in the Kakanui region more than a few sapphires of indifferent quality; a jasperoid rock, containing green, yellow, and red bands; and the "gem sands" themselves. The origin of the gem sands has been traced

[a] U. S. Daily Cons. Repts. No. 2819, March 16, 1907.
[b] Mining Jour. (London), May 11, 1907.
[c] Thompson, J. Allen, Gem sands of Kakanui: Trans. and Proc. New Zealand Inst., vol. 38, 1905 pp. 482–495.

back to a volcanic breccia outcropping in several places in that region. This breccia contains all the minerals found in the gem sands, and is similar in appearance and composition to the kimberlite rock of South Africa. In the latter country the kimberlite occurs in necks or pipes of old craters. At Kakanui the breccia is stratified and probably represents a submarine flow. In such a case pipes probably exist in the region, though buried under the flow.

Though diamonds can not be predicted for this region, it will not be surprising if they are found.

BORNEO.

In Netherlands Borneo, according to "Le Diamant,"[a] not only are diamonds found, but there are several cutting establishments where the stones are cut very cheaply. At least 300 polishers and 160 cleavers are at work. The cut stones are bought by native merchants and are shipped to Java, Singapore, and Siam. Not only the stones found in Borneo and Australia are cut, but about 16,000 carats are imported from South Africa. There was much activity in prospecting for diamonds in Netherlands Borneo during 1906, and one report states that stones were found plentifully at Tainam, while extensive digging operations were being carried on near Martapura, in southwest Borneo.

NOTES ON THE DIAMOND INDUSTRY.

Income tax on De Beers Company.—The British Government levied an income tax against the De Beers Consolidated Mines Company, not only for the year 1906, but for several years past. The contention was that the greater part of the company's business was conducted in London, and that it should be taxed there accordingly, regardless of the tax already paid to the Cape Colony government. This new tax amounts to over £100,000 a year, and the total for past years would bring it up to over £600,000. Since this tax is considered unjust, there was some talk of the diamond syndicate moving its offices from London to avoid paying the double tax. America purchases more than one-half of the company's diamond output, while England consumes only about one-sixth. Accordingly, it was suggested that it might be good policy for the company to move its London office to New York. The tax, amounting to something like £600,000, has been paid, however, and it is not probable that this step will be taken at the present time at least.

Diamond cutting.—The question of the establishment of a diamond-cutting industry in South Africa was much agitated by the newspapers of the colonies. It was argued that if an export tax of £1 per carat should be placed on all rough diamonds exported it would cause the mining companies and the diamond syndicate to set up their own cutting establishments in the colonies to escape the tax; and in this way occupation would be supplied for some 15,000 workmen, and a large additional revenue would be earned on the diamond production. It is not likely, however, that the diamond cutters could be attracted from their homes in their native lands unless they were offered greatly increased salaries over what would be required to offset the increased

[a] Jew. Circ. Weekly, May 5, 1907.

cost of living in South Africa. It has been calculated that from the increased revenue for diamonds cut in South Africa wages only about twice those obtained in Holland and Belgium could be paid for cutting, while the cost of living is at least three times as high. No company mining diamonds in South Africa obtains £1 per carat for its stones, and consequently no company could afford to pay such an export tax. Of course the cutting would have to be done chiefly by artisans from abroad for some time to come, since it takes five years in Europe for an apprentice to become anything like an expert cutter, and the wholly uninitiated class in South Africa could not be drilled quickly. A later report[b] announces that an association has formed for the object of establishing a permanent diamond-cutting industry in Cape Colony.

There has been considerable unrest among the diamond cutters in New York and in Europe. The labor unions have demanded increased pay and shorter hours in both countries. An agreement was reached early in the present year (1907) between the diamond manufacturers of America and the Diamond Workers' Protective Union, to last until May 1, 1908. There was about a 10 per cent increase in wages in all departments, affecting the 400 employees in New York. The new scale of wages provides from \$30 to \$65 per week for polishers, \$43 to \$90 for cutters, and \$35 to \$48 for setters. More diamond cutters are coming from Antwerp on account of the higher pay in this country. If wages are raised in Europe to hold the cutters there, the manufacturers in this country will be able to compete with those abroad in cutting still smaller stones instead of those only of one-half carat or more, as at present.

The diamond markets were very strong throughout the year, even with the increase of 7 per cent on the rough material, and the demand seems to have been in excess of the supply. Several large purchasers of diamonds have reported great difficulty in securing all the stones, of the desired quality, needed to meet their requirements. It seems likely that the scarcity of large stones and material in general and the increased pay demanded by the diamond cutters may bring about still another increase in the price of diamonds.

The opinion has been expressed that there would be employment for nearly four times as many diamond workers in New York as at present if the manufacturers would cut stones of smaller size and of less desirable quality. This ought to be possible, since it is said that the 10 per cent duty on cut stones over the rough material gives the American manufacturer a fair margin over the extra cost of labor in New York.

Metric carat.—The use of a carat consisting of 200 milligrams in place of one of about 205 milligrams for weighing diamonds and precious stones was proposed by C. E. Guillaume[c] of Sèvres. This is called the "metric carat" and is intended to simplify the change from an ordinary system of measures to that used in weighing gems. The "metric carat" has been approved by the International Committee of Weights and Measures, and some progress has been made in its use.

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[a] "The diamond-cutting industry," by a student of facts: Mining Journal (London), January 19, 1907.

[b] Jew. Circ. Weekly, May 22, 1907.

[c] Idem, November 7, 1906.

The "sun ray."[a]—A new form of cutting for diamonds, called the "sun ray," has been invented by Herbert Cooper. The claims for the new cut are that it gives smaller loss in cutting, with more brilliancy and better color than in the ordinary "brilliant." The general shape of the sun ray is similar to that of the brilliant, with the exception of more weight left above the girdle. There are 49 facets above the girdle, as against 33 in the brilliant; both forms have 25 facets below the girdle. The facets above the girdle are so placed as to give a double-crown effect. The upper crown is the same as in the brilliant, while the lower crown is cut at a different angle, producing a raised point where 7 facets meet midway between the table and girdle, which gives a rose effect. This rose effect is produced eight times around the stone. Since each rose acts as an individual stone, more light enters and is reflected, causing a great improvement in color and brilliancy.

Diamonds in electrical apparatus.—A large number of small diamonds are used in the electrical industry.[b] Attention has been called to this fact by the protest made by a large electrical manufacturing company against a duty being charged on the importation of stones for industrial purposes. The stones in question were brown colored and had been advanced in value by being cut and polished on one side. They were intended for bearings in electric meters, where the least possible friction is desired.

GARNET.

Almandite.—Mr. C. A. Beghtol reports the opening of a prospect for almandite garnets about 2 miles from Canyon, Colo. The stones are said to be of fine quality and in large quantity, though none have been marketed as yet.

Essonite.—Beautiful essonite garnets have been mined in southern California and over the line in Mexico.

Pyrope.—The pyrope garnets brought in from scattered localities in the Navajo Indian Reservation compose the main value of the production of that stone.

JADE.

BURMA.

The production of jade (jadeite) in Upper Burma in 1904 and 1905[c] was 3,778 hundredweight, valued at £50,726, in 1904, and 2,685 hundredweight, valued at £45,474, in 1905. The only mines worked are in the district of Myitkyina, in Upper Burma. The gréater part of the output is exported from Rangoon, though some is carried overland to China. It is said that the jade industry of Burma[d] is to be stimulated by a railroad built from Manyasrik to the center of the mining district.

According to Consul-General Amos P. Wilder[e], of Hongkong, it is impossible to secure light-green uncut jade except from the Chinese. Canton is the center of trade for southern China, and buyers must

[a] Jew. Circ. Weekly, August 1, 1906.
[b] Western Electrician, May 4, 1907.
[c] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 56.
[d] Eng. and Min. Jour., December 1, 1906.
[e] U. S. Daily Cons. Repts., January 21, 1907.

work through the Chinese to secure their supplies. The jade is sometimes obtained in lumps weighing 1 or 2 pounds. One New York firm found jade cheaper in Peking than in southern China. A Chinese merchant in Hongkong reports that he is ready to supply uncut jade, though there might be difficulty in arranging prices unless the buyer has an agent on the ground, or there be some jeweler in China upon whom he could rely to make his purchases.

ONYX MARBLE.

The opening of new onyx marble quarries by E. and C. Traslosheros[a] near Pueblo, Mexico, promises to meet the demands of the manufacturers in the United States. Hitherto it has been difficult to secure all the rough material needed, as the producers preferred to elaborate the stone themselves, and thus realize greater profits. Samples from the new quarries are of varied colors, some being very beautiful. The price of the onyx at the quarries averages about $150 gold per cubic meter. Delivered at the railroad it varies from $175 to $200 gold.

OPAL.

NEW MEXICO.

Maj. E. W. Hubbard, of the United States Artillery Corps, has furnished some notes on an opal prospect opened near Fort Bayard, N. Mex., several years ago. The prospect is located about one-half mile from the station, and is in a very hard volcanic rock. The opal is called "button opal" in the region around, and is white, with little, if any, fire. It makes a beautiful specimen, however, since the opal is invariably outlined by a zone of black chalcedony.

OPALIZED WOOD.

COLORADO.

Opalized wood was obtained in the eastern part of El Paso County, Colo., along with jasperized wood, by Mr. W. C. Hart.

AUSTRALIA.

The White Cliffs opal region of New South Wales, Australia, continued to yield opals of good quality, for which the miners complained they did not receive full value. For this reason it was arranged to have an agent open showrooms nearer foreign markets, where it was expected lapidaries would be employed to elaborate the stone before selling. Chicago was to be the first place to make this trial, and, if successful, similar establishments would be set up in the larger cities of the Continent.

Special Agent H. R. Burrill,[b] at Brisbane, suggests a direct trade between the merchants of the United States and Queensland business houses in opal instead of having the stone imported through other countries, thereby increasing its cost. Such a trade is very much

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[a] U. S. Daily Cons. Repts., February 6, 1906.
[b] U. S. Daily Cons. Repts. No. 2870, May 15, 1907.

desired in Queensland, and would doubtless lead to a more extended use of the opal in American jewelry. The opal of Queensland is of particularly fine quality, and the variety called black opal makes a fascinating gem. Its beauty is not at first very apparent, but on closer inspection is better realized when its "hidden fire" and varied colors are observed. According to a report in the Jeweler's Circular Weekly for May 22, 1907, a firm in Los Angeles, Cal., is at present cutting a stock of the Australian black opal.

ROSE QUARTZ.

CALIFORNIA.

The Fano Kunzite-Tourmaline Company owns an undeveloped ledge of rose quartz, reported to be from 4 to 6 feet thick, in the Coahuila Mountains of Riverside County, Cal.

It is reported that at a locality 10 miles northeast of Lemon Cove, Tulare County, rose quartz of beautiful color and quality has been found. There is said to be a vein 3 feet wide whose length has not been determined. Specimens from this locality have attracted considerable attention by reason of their beauty.

NEW YORK.

The quarries operated for feldspar and quartz near Bedford village, Westchester County, N, Y., were visited in 1906 by Mr. Edson S. Bastin,[a] of the United States Geological Survey. The deposits consist of pegmatite in which the quartz is, in part at least, rose colored. In the Kinkle quarry, about three-fourths of a mile southeast of Bedford village, the quartz is mostly white, though here and there it assumes a beautiful rose tint. At the hobby quarry, about 1½ miles southeast of Kinkle's, and in the town of North Castle, the quartz is in part white and in part a beautiful rose color. The proportion of rose-colored quartz to the white was much greater in this quarry than in the Kinkle quarry. None of the rose quartz produced at these quarries has as yet been used for ornamental purposes, though the color is very good and in places the stone is translucent and even transparent.

RUBY.

NORTH CAROLINA.

The company owning gem mines in Cowee Valley, Macon County, N. C., claims to have discovered rubies in the matrix on its property. According to reports, the crystals were found in white chalky limestone pockets, similar to the associations at Burma, and were considered to be very promising by Mr. William Earl Hidden. The discovery was made in October, 1906, and no development work was possible until spring; accordingly, no statement of the probable value of the deposit can be made at this time.

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[a] Contributions to economic geology, 1906: Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, pp. 394–399.

BURMA.

A very primitive system for obtaining rubies is employed by the native miners of Burma.[a] Shafts about 2 feet square are sunk 50 or 60 feet deep, the sides being held up by posts at the corners and branches of small trees, secured by short sticks. The miner squats down in one corner of the shaft and digs in the opposite corner. The ruby-bearing earth, as fast as excavated, is hauled to the surface in buckets and baskets. The latter are attached by bamboo rods and cane to a long bamboo pole pivoted on an upright pole on the surface, about 20 feet high and at such a distance from the hole that one-eighth of its length projects from the pivot away from the mine. Stones on the short arm help to counterbalance the weight.

When sufficient gravel is accumulated it is washed in a stone-paved circular inclosure, where it is shoveled about until the mud and clay are washed away. The clean gravel is then sifted and sorted, the rubies and sapphires being placed in cups of water until the wash is finished. The stones are then placed in calico bags and given to dealers to be sold on bazaar days. The production[b] of rubies in Upper Burma, including small quantities of sapphire and spinel, for the year ending February 28, 1906, amounted to 266,584 carats, valued at £88,340, as against 265,901 carats, valued at £90,612, in 1904. The royalty received by the Ruby Mines Company from native miners amounted to £12,129, as against £17,441 in 1904. The production now comes only from the Mogol area.

According to Consul-General William H. Michael,[c] of Calcutta, the quantity of ruby earth washed during the year 1905–6 was 1,773,129 trucks, or 130,000 trucks less than 1904. The reported decrease was due to the exhaustion of the Choungzone mine, where the material was at the last obtained from corners of crevices in the rocks. Work was to be started on the Myntada mine adjoining, and the same washing machinery was to be used without the necessity of moving it.

The ruby deposits of Burma are controlled by a few persons, who limit the output and thereby hold the price of the ruby 50 per cent higher than it ought to be.

SIAM.[d]

The Navong mine, southeast of Chantobun, about halfway from Krat, produces both rubies and sapphires, the former in the larger quantity. There was much development in mining at this place during 1906, and the year closed with about 3,000 miners at work. The best known gem mine in the south of Siam is the Pailinh sapphire mine, which employs about 4,000 workmen.

TRANSVAAL.

According to Mr. S. M. Tweddill, curator of the museum, in a note in the Annual Report of the Transvaal Geological Survey, a ruby-bearing rock has been discovered at Leydsdorp. The essential con-

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[a] New York Commercial, July 25, 1906.
[b] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 60.
[c] U. S. Daily Cons. Repts. No. 2675, October 26, 1906.
[d] Mining Jour. (London), December 22, 1906.

stituents of the rock are a ferromagnesian mineral and granular ruby-colored corundum. The occurrence of this ruby-bearing rock in northern Transvaal, with the discovery of fairly large pebbles of ruby still farther north, points to the probability of this gem being found in the colony in the not distant future.

SAPPHIRE.

IDAHO.

The occurrence of gem sapphire in Idaho has been announced by Dr. Robert N. Bell, State inspector of mines. The sapphire was first found in the concentrates from the Rock Flat placer gold mine, near Meadows post-office, in Washington County. The possible gem value of the stones was first recognized by Doctor Bell, who sent specimens to Dr. George F. Kunz for confirmation. The deposit is located on a high plateau divide between the Salmon and the North Payette rivers. The occurrence is thus described by Doctor Bell:[a]

> The general formation of the district is gneiss, and the corundum crystals, which include some of excellent gem quality, seem to be derived from a wide dike of basaltic clay formation with a peculiar spheroidal structure. The gem stones are found associated with a great array of pyrope garnets in the clean-up boxes of an old placer pit.
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> Some beautiful gems have been found. They occur in a variety of colors, the oriental amethyst shades predominating. Most of them have an opalescent silky sheen and are not of high value, but would cut into excellent cat's-eyes and star sapphires. Some bronze crystals would also make handsome tiger-eye sets. Some small stones, however, of fine quality have been found, which, when cut, are as large as one-half to 1 carat and have a beautiful clear cornflower blue color. Others make brilliant pink stones as large as 1½ carats in weight after cutting. The crystals also include some of poor red quality, but nothing as yet approaching a true ruby color.

Doctor Bell placed the value of sapphires from this locality sold in 1906 at about \$300. The highest price stone was a brilliant pink gem weighing about 1½ carats and valued at \$20.

Development work has been started on the dike formation and consists of a drainage tunnel to cut the dike at a depth of 80 feet. Connection will doubtless be made with the surface and the working of the deposit be greatly facilitated.

Since basaltic dikes, similar to the ones at Meadows, are common near the placer deposits found in the eruptive granites of central Idaho, other sapphire discoveries are likely to be made in placer mining, especially in those places where opaqure corundum has already been found. For this purpose it would be well for the miners to examine their concentrates for sapphires around Resort, in Idaho County; along the Gold Fork and other tributary streams of the North Payette River, in Boise County; in the Stanley basin, in Custer County; and at Pierce City, in Nez Perce County.

NORTH CAROLINA.

A few sapphire crystals were reported from the western counties of North Carolina during 1906, though just what their value was has not been learned.

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[a] Min. World, April 6, 1907, p. 449.

MONTANA.

The operations of the New Mines Sapphire Syndicate on the sapphire deposit in Yogo Gulch, Montana, have been retarded by an injunction served against the company forbidding the emptying of tailings into the Judith River. The waste from the mill was formerly turned into the river above the intake to the irrigating ditches of the ranches around Utica. Some of the débris was washed out and deposited on the ranches, resulting, it is said, in considerage damage.

The problem of disposing of the waste is being taken up by Mr. Hamilton Walker, a member of the syndicate, who previously managed the mine for the company. Reports state that the mine was worked during the winter with a large force of men, removing vein matter, preparatory to washing in the spring, after the question of the disposition of the tailings is settled.

The latest progress of the American Sapphire Company, operating on another portion of the same vein as the New Mines Sapphire Syndicate, has not been reported to the Survey. It is said there is a mill in operation producing sapphires, though with what success is not known. As late as the first half of 1907 the company seems to have been selling stock, probably to secure capital for improving its plant.

Mr. W. H. Emmons, of the United States Geological Survey, furnishes the following note:

> The American Gem Syndicate continued to work its sapphire placers on Rock Creek, about 20 miles southwest of Philipsburg, Mont. A considerable quantity of sapphires was produced. This company has a factory in Switzerland, where the stones are cut to be used as watch jewels and for other bearings.

INDIA.

Kashmir.—The Kashmir sapphire mines, situated 14,000 feet above sea level, are being reopened after an idleness of sixteen years. The Kashmir Mineral Company (Limited) operated in the district in 1906 from the middle of July to the middle of October, when snows necessitated cessation of work. The plan was to cause a landslide, which it was hoped would expose the deposits. The same scheme was tried in 1887 without much success. The gems occur in hard rock at these mines, and the quality is good, though not the finest. Many of the stones, though beautiful in daylight, are nearly black under artificial light.

AUSTRALIA.[a]

NEW SOUTH WALES AND QUEENSLAND.

Sapphires are found in all the Australian States, though chiefly in Queensland and New South Wales. In the latter State they are associated with alluvial deposits containing gold or tin. Most of the stones have a greenish-blue or bottle-green color, while many—abundant in some localities—that are pure blue by transmitted light are nearly black by reflected light. Stones of indifferent quality are abundant in the Inverell tin-mining district, in the northern part of the State.

[a] Plummer, John, Australian sapphire: Min. World, March 10, 1906.

In Queensland the sapphire is found near the central part of the State, around Anakie. The deposits occur over a wide area, but are confined chiefly to the granite country. A quartzite rock, locally known as "billy," is generally associated with the sapphires. It occurs in large and small bowlders and is sometimes called sapphire gravel, its presence being considered a favorable sign.

The sapphire wash varies from a few inches to several feet in thickness and usually rests on decomposed schists and slates. The bottom of the wash is generally composed of clay, and there is sometimes more than one layer of gravel, with clay interbedded. Sometimes the deposits are extremely thick, but the large size of the bowlders makes it unprofitable to sink through them without hoisting machinery. The sapphires are extracted from the wash by simple methods. The gravel is either washed in sieves or is put through a dry jigger when a dry deposit is being worked. In the wet washing the clean gravel is generally thrown out on a table of bark and the sapphires are picked out; in the dry method the stones are picked by hand out of the sieves.

The output of sapphires for 1904 was estimated at 14,100 ounces, valued at £10,575, or 15s. per ounce. There is much discontent among the miners at the low prices received for their sapphires. Attemps to establish a regular trade with Europe and America failed, as the dealers said there was no market for the Australian stones at the prices demanded. Special agent H. R. Burrill,[a] however, claims that the Queensland sapphires are of fine quality, especially the limpid yellow stones and some of the green ones, which approach the emerald in color.

According to Consul F. W. Goding (New South Wales), also, sapphires of yellow and green color are found in Queensland equal to those of any locality. Recently $1,250 was offered for a rough yellow sapphire, and a large blue one with a yellow center, weighing 2½ ounces, brought $2,500. True rubies of good color, though small, have been found also.

SODALITE.

CANADA.

Sodalite is not only used for ornamental purposes, but is sometimes found in smaller masses with a color rivaling that of the lapis lazuli, and it is then cut as a gem. The deposits near Bancroft, county of Hastings, Ontario, have been developed, and a quantity of material has been taken out for decorative purposes.

SPODUMENE.

MAINE.

Mr. F. G. Hillman, of New Bedford, Mass., has reported the discovery of lilac-colored spodumene, or kunzite, as well as some with a greenish color, called hiddenite by the informant, at Andover, Oxford County, Me. A cleavage specimen sent to the Survey measured 12 by 10 by 3½ millimeters, and had a very pretty clear lilac color. It

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[a] U. S. Daily Cons. Repts. No. 2870, May 15, 1907.

was not entirely without cleavage cracks, however. The greenish material had a pale aquamarine color, nearly clear, though rather badly fractured. This spodumene was obtained near the surface, and it is hoped flawless material will be found with depth.

Hiddenite has also been reported from the Pala Chief Mining Company mines near Mesa Grande, San Diego County, Cal. The quality was not described, and, since no specimens were seen, it is not known whether this was the genuine emerald-green material, such as was found in North Carolina, or spodumene of a paler color, similar to that found in other gem mines of San Diego County.

TOURMALINE.

CALIFORNIA AND MAINE.

The tourmaline deposits of California and Maine are described in the notes on the gem stones and industry of these States (pp. 27–33).

COLORADO.

Some of the tourmaline deposits near Canyon, in the vicinity of Royal Gorge, Colorado, have been opened by Mr. C. A. Beghtol, of Canyon. The developments consist chiefly of open cuts, though a shaft is being sunk at one place. Some very fine pink, green, and lavender colored tourmaline crystals are reported to have been found along with other minerals of interest as specimens if not as gems. Among the latter are tourmalinated quartz, beryl, some of aquamarine variety, and amazon stone. The mines only commenced to produce stones of value toward the close of 1906 and during the first part of the present year.

CONNECTICUT.

Dr. S. Ward Loper, of Wesleyan University, reports a new discovery of green tourmaline near the north line of Portland County, Conn. About 50 large crystals of a rich deep-green color, along with about 50 of inferior quality, were obtained from the prospect. The stones were not clear enough for use as gems, and were valued at about $15. Most of the material was secured for the Wesleyan Museum. Some 200 specimens of pink, green, and yellow tourmalines, valued at about $50, were received from the Haddam Neck locality. This represents nearly the whole production of Haddam during the year.

INDIA.

Tourmaline is mined in Upper Burma,[a] south of the ruby mines district. The production in 1905 amounted to 161 pounds, valued at £1,500.

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[a] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 66.

PRICES.

Consul McFarland,[a] of Reichenberg, reports the prices of rough tourmaline in Austria, as given early in the year by a reliable manufacturing jeweler, as follows:

Prices per pound of rough tourmaline in Austria in 1906.

Small pink, green, and blue	$32
Green, larger size	160
Very large green and blue	320
Very large pink, extra	640

These values are given as approximate, since the price varies with the demand, especially in America, and was rather low at the time mentioned.

TURQUOISE.

ARIZONA AND NEW MEXICO.

Some of the turquoise deposits near Mineral Park, Ariz., were visited during the year by Mr. F. C. Schrader, of this Survey, who furnished the material for the following notes:

Turquoise was discovered near Mineral Park about 1885 by James Haas. As in New Mexico, the deposits had been worked by the Aztecs, as evidenced by the old tunnels and drifts in which were found stone axes and other tools.

The mines are located on both Ithaca Peak, nearly a mile southeast of Mineral Park, and on Turquoise Mountain, about a mile southwest of the town. The turquoise occurs in an altered quartz porphyry in veins and in solid rock, mostly in kidneys or globular bodies from 1 to 6 or 8 inches in diameter. The lumps are in places connected by mere seams or stringers or are entirely isolated in solid rock.

Two Los Angeles companies and the Aztec Turquoise Company, of New York, are interested in the Mineral Park turquoise deposits. They all own claims on either Ithaca Peak or Turquoise Mountain or on both. The Aztec Company owns nine claims, which it has operated intermittently during the last five years.

Some of the mines are located on the east slope of Ithaca Peak, about 150 feet below the top, at an elevation of about 4,700 feet above sea level, or 800 feet above Mineral Park. They are reached by a burro trail from the camp at the foot of the mountain, and there is a good wagon road from Mineral Park to the camp. The workings consist mostly of open pits and cuts, rarely over 25 feet deep, and a few short tunnels.

The turquoise occurs sporadically in the rock, with a tendency to follow veins, fissures, seams, etc. The country rock is a highly altered feldspathic rock whose nature has not been definitely determined, consisting, in its present condition, chiefly of quartz. The latter mineral occurs in interlacing veinlets and stringers with pea-sized balls, probably original phenocrysts, in a finer matrix. Kaolinization of the original feldspar of the rocks has been extensive, with an accompanying production of sericite or some silvery mica and the liberation of much silica. This has left the rocks porous in places and more compact in others, where much secondary quartz has been deposited.

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[a] Jew. Cir. Weekly, April 4, 1906.

Much of the turquoise appears to have been deposited from solutions in crevices and cavities both in quartz and in other matrix, and some seems to be a replacement of another mineral, probably the feldspar or the kaolin formed from the feldspar. The rock is considerably stained with copper, and in places the kaolin takes on the color of turquoise.

The monthly output from the Aztec Company mines is stated to be between 1 and 2 cubic feet. This is shipped to New York, and the bulk of it is sold in the rough, though the company also elaborates some of its own material and works it up into jewelry. The sizes obtained vary from particles too small for use to pieces 2 or 3 inches through. The best color is considered to be the pigeon blue. The dark blue, though very fine, appears greenish under electric light. The greater part of the product is partly off color, and it is very difficult to btain turquoise of the correct shade.

The home production of turquoise reported to the Survey came from New Mexico and Arizona. The large decrease in value was due to the closing down of many mines by some of the hitherto large producers. In New Mexico the Porterfield Turquoise Mines Company operated its deposits in the Burro Mountains, Grant County, about 12 miles southwest of Silver City, opening new ground during the year.

PERSIA.

According to Maj. R. L. Kennion,[a] the turquoise mines near Nishapur (concessions for which are sold annually by the Shah's Government) are the most important mines of the Khorassan. The mines are worked in an unscientific and reckless way, each concessionaire trying to get a maximum production from his mine for the year. If leases of greater duration could be obtained, systematic working would doubtless be undertaken. The present profits are large, but can not be estimated.

UTAHLITE.

The production of utahlite was again entirely from Utah and from the localities already described by Doctor Kunz in these reports.[b] According to Mr. Don Maguire, of Ogden, the value of the output from Clay Canyon, Utah County, and from the Mercur locality, Tooele County, was about the same.

GEM MINERALS OF MAINE.

The following notes on the occurrence of the gem minerals of Maine have been abstracted from a manuscript report by Mr. Edson S. Bastin on the feldspar, quartz, mica, and gem deposits of that State, to be published as a bulletin by this Survey:

The gem minerals described are tourmaline, topaz, quartz, and beryl. They occur as accessory minerals in pegmatite. The latter is composed of feldspar, quartz, and mica in coarse-grained aggregates, and occurs as intrusive masses in closely folded slates and schists. These intrusive masses follow, in general, the bedding planes and schis-

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[a] Mining Jour. (London), November 3, 1906.
[b] Mineral Resources U. S. for 1904 and 1905, U. S. Geol. Survey, 1905 and 1906.

tosity of the inclosing rocks. The latter with the interbedded pegmatite dip at high angles in some places, while in others they are but gently inclined. The dip of the formations has much to do with the regularity of the surface outcrop. The latter is more regular and the deposits are more easily followed where the dip is at a high angle than where it is low. Other deposits have no definite direction, but resemble stocks in form.

These pegmatites represent one phase of the granitic intrusions, of late Silurian or Devonian age, so abundant in southern and southeastern Maine. They are intruded into metamorphic slates and schists, with which are associated igneous gneiss, diorite, diabase, etc. Dikes of fine-grained granite are generally associated with the pegmatites and have been found grading into them. The texture of pegmatite varies greatly in different deposits and in different parts of the same deposits. Only those with coarser texture are worked for their valuable minerals, such as feldspar, quartz, mica, and gem minerals. Some of the deposits are worked for more than one of these. The gem tourmalines are usually obtained from pockets in the pegmatite, while the beryl is nearly always embedded in solid pegmatite.

The color and quality of the gem minerals found are often very fine. The tourmaline ranges from white or colorless through various shades of blue, green, and red. One or more of these colors often appear in the same crystal, either in more or less clearly defined layers across the crystal or with one color as a core and others surrounding it. The topaz varies from colorless to amber color, and some specimens from Stoneham, Oxford County, have been described by Doctor Kunz as of beautiful quality, transparent in parts and colorless or faintly tinted with green or blue. Besides clear varieties of quartz, rose and amethystine-colored varieties are found. Beryl in opaque crystals is common, and some of gem quality is encountered, either aquamarine, golden beryl, or rarely emerald. A colorless to bluish or pinkish-white variety containing a small percentage of cæsium is also found. These stones, when not used for museum specimens, are generally cut by Maine lapidaries and sold within the State, where they command a higher price than they would in the open market. Most of the cut tourmalines sold are under 3 carats in size. The Maine stones, like the tourmalines from other localities, generally have to be cut with the table parallel to the longer axis of the crystal, since the absorption of light is so strong in colored stones in the direction of this axis that a stone with a table at right angles to it appears dull and dark. The cæsium beryl makes a stone well adapted for evening wear, rivaling some diamonds in brilliancy.

The following table represents the prices of flawless cut stones as sold in Maine:

Prices, per carat, of Maine gem stones.

Tourmaline:		Beryl:	
Rubellite	$12 to $30	Aquamarine	$4 to $15
Emerald-green	8 to 20	Golden beryl	10 to 25
Indicolite	6 to 18	Cæsium beryl	5 to 20
Olivine-green	6 to 18	Emerald, very rare.	

Tourmaline was first found in Maine at Mount Mica, near Paris in Oxford County, in 1820, by two students, Messrs. E. S. Hamlin and E. Holmes. Exploratory work disclosed a deposit of large size, containing pockets with beautiful stones in them. The deposit was worked in an intermittent way by mining companies and mineral collectors until 1890, when Mr. Loren B. Merrill obtained control; he has since operated it successfully. The present dimensions of the quarry are about 150 feet long by 100 feet wide and 20 feet deep in the deepest part. Work is facilitated by a derrick operated by a horse windlass to remove the waste. Drilling is done by hand, and black powder is used in order not to shatter gem material more than necessary. The pegmatite is in a general way conformable with the schistose country rock, which strikes N. 50° to 60° E., with a dip of 20° to 30° SE., and is overlain by schists on the southern side of the quarry to a depth of about 15 feet. It is probable that tunneling will soon be necessary to avoid the expense of removing a heavy overburden of schist. The thickness of the pegmatite exposed in the quarry is about 20 feet, though the total is probably somewhat greater. The principal constituent minerals of the pegmatite are quartz, orthoclase, and microcline, muscovite, biotite, and black tourmaline. The mode of association of these minerals and the texture of the rock are very irregular. The feldspar crystals attain dimensions of several feet in places, and mica of merchantable size is sometimes found. Other interesting minerals beside tourmaline are granular lepidolite, beryl, and spodumene. The beryl occurs both in pockets and in the solid pegmatite. That in the pockets is the pale-pinkish cæsium gem beryl, and that in the solid rock is generally opaque and pale green, though small clear portions are sometimes found which yield aquamarines.

Gem tourmaline is found almost entirely in pockets in the pegmatite. These pockets seem to be confined to a zone from 6 inches to 7 feet wide, which is not readily distinguished in appearance from the pegmatite above it but is underlain by a narrow garnetiferous layer, beneath which the rock is finer grained and apparently barren of gem minerals. The pockets are sometimes very irregular in shape, and range in size from about a pint in capacity to dimensions of several feet. In all, about 430 pockets have been opened. Out of 350 opened by Mr. Merrill, only 50 were of much value. The walls of these cavities are usually lined with lepidolite, clevelandite, amblygonite, and quartz crystals; and the bottoms of the cavities are generally covered with a sandy or clayey mass, consisting of the decomposition products and fragments of the minerals forming the walls. The tourmalines are embedded in this decomposed matter. Some, whose form and color as they lie thus embedded in the pockets seem to be perfect, crumble away when handled, often leaving a rounded nodule of perfectly fresh mineral, which is generally beautifully transparent. These nodules often yield the finest and most perfect gems.

Most of the gem tourmalines range in color from olivine green through emerald green to blue green and nearly colorless. Beautiful pink tints are also found. One shade usually predominates in a given cavity, though this is not always the case. Single crystals in some cases shade from white at one termination to emerald green, then light green, pink, and finally colorless at the other termination. Green crystals tipped with pink are especially common. Generally these transitions of color are very gradual, but in other specimens the colors are not mingled in the least and the crystals seem to be composed of several distinct sections, though crystallographically they are continuous throughout.

The total value of gems and cabinet specimens obtained from Mount Mica to date is estimated at over $50,000.

The Noyes gem mine is near the summit of a hill about three-fourths of a mile east of Hicks Pond, in the southern part of the town of Greenwood, Oxford County. It has been worked by a small open cut, the southern wall of which consists of schist with a strike of N. 50° W. and a nearly vertical dip. The pegmatite, which can be traced a little way beyond the cut, contains numerous pockets, some measuring several feet in size. Good gem tourmaline, suitable for cutting, was obtained while the mine was worked.

At the Black Mountain mica mine, in the town of Rumford, Oxford County, greenish-black and opaque pink tourmalines have been found. There are no pockets in the pegmatite, however, and no gem material has ever been obtained.

The Dunton mine, in the northeast corner of the town of Newry, Oxford County, was worked a little for gem tourmaline and beryl in 1903 and 1904. The pegmatite, which is extremely coarse grained, has been exposed in the mine in a face about 20 feet high. In a space 5 or 6 feet across, near the center of the pegmatite as exposed in the quarry, much lepidolite, pink and white opaque spodumene, and tourmaline are associated with the feldspar. Some of these minerals are very coarsely crystallized, for spodumene crystals 2½ inches long and 3 inches wide, and tourmaline 2 feet long and 4 or 5 inches in diameter, have been found.

The tourmalines range in color from black to dark indigo blue to grass green, emerald green, red, and pink. They are generally found in solid pegmatite, which makes their extraction without breaking difficult. The blue-green varieties are usually opaque, while the green and pink crystals are transparent. The larger crystals are generally not sufficiently transparent for gems. Beryls are found occasionally, and one seen was of a beautiful grass-green color.

GEM MINERALS OF SOUTH CAROLINA.

In a "Catalogue of the Mineral Localities of South Carolina" (in press), prepared by Earle Sloan, State geologist, the occurrence of several gem minerals is noted. Among these are emerald, aquamarine, beryl, sapphire, amethyst, and rutilated quartz, with some garnet, zircon, green tourmaline, amber, and chalcedony. None of these gem minerals, however, have been worked, nor have commercial deposits been proved as yet.

Beryl, in some cases of gem quality, has been found in a belt running through Anderson and Spartanburg counties and is generally associated with pegmatite. Some beryl, however, also of gem quality, has been obtained during the washing of monazite-bearing gravels. The best specimens have come from Anderson County, among which were green crystals whose color rivaled that of the oriental emerald.

Scattered crystals of corundum, with a few of gem quality, have been found in Cherokee County in monazite deposits. A valuable oriental emerald is said to have been found in the Bowen River section, and a blue sapphire from the same region sold for $75.

Amethyst has been found at several localities in Cherokee, Anderson, and Abbeville counties. Some was of superior quality.

Rutilated quartz has been found in connection with the monazite belt running through Anderson and Spartanburg counties.

The quartz gem stones mentioned above, as well as the crystal and smoky varieties, are found with rutile and other interesting minerals in the continuation of the monazite belt in North Carolina.

GEM MINERALS OF SOUTHERN CALIFORNIA.

The following notes on the gem-mining industry of San Diego and Riverside counties in southern California have been furnished by Mr. Fred M. Sickler, of Pala, San Diego County, Cal.:

SAN DIEGO COUNTY.

The principal gem minerals mined are tourmaline of many colors, pink and lilac colored spodumene, aquamarine and pink beryl, topaz, essonite, epidote, and axinite. These minerals are found in pegmatite veins cutting diorite and gabbro. The latter rocks are inclosed in large areas of granite. The gem-bearing region is bounded on the east and west by sedimentary and eruptive rocks (largely basalt). The sedimentary rocks contain limestone, near the contact of which with the intrusive rocks essonite garnets are found. The gem belt probably nowhere exceeds 40 miles in width, measured in an east-west direction, and extends from the San Jacinto Mountains in Riverside County southward through San Diego County into lower California. The region has been the seat of considerable activity, both in the development of old mines and in the discovery of new prospects, during the year 1906.

PALA.

At Pala work on the tourmaline King mine was pushed energetically for a part of the year, and tourmaline of great beauty and large size was obtained along with some beryl and "water sapphire." On account of litigation with a neighboring claim, however, the work was stopped about the middle of the year. Work on the tourmaline Queen mine was continued, stones of a variety of colors and of unsurpassed quality being produced. Messrs. Gordon and Goodwin have sunk about 50 feet on a new prospect and report the finding of beryl and kunzite. Messrs. Lobaugh & Co. sank an incline shaft to a considerable depth on an extension of the Stewart ledge. Lepidolite, large quartz crystals, and other evidence of a good gem formation were encountered, but no information was given concerning the production. The Pala Chief mine was active during the year and produced a large quantity of kunzite and tourmaline. Messrs. Magee & Co. did a large amount of tunneling on their new property and obtained considerable aquamarine beryl and indicolite. Mr. Ben Hubert reported a good find of gems on a new claim. Messrs. Hiriart and Teilitch mined a quantity of pink kunzite and beryl from their claims. The Caterina mine, which they own in partnership with Mr. M. M. Sickler, has proved to be the equal of any kunzite mine in southern California. They found a very large pocket of gems and have traced the mineralized portion of the ledge several hundred feet beyond its former supposed limit. The Sickler Gem Mining Company produced considerable kunzite, as well as excellent tourmaline and some beryl. The green tourmaline from its properties more nearly rivals the emerald in color than that from any other locality in the State.

RINCON.

At Rincon the Victor Gem Mining Company has been exploiting a new field. In one deposit beryl of fine aquamarine color was obtained in large quantity. In another deposit good kunzite was found for the first time in this district, along with beryl and tourmaline. Some of the tourmaline from this locality has a green core and shell, with a yellowish ring between and has been cut so as to show the combination of colors with pleasing effect.

MESA GRANDE.

The Himalaya Mining Company has directed its energies mainly to deep mining, which involved a large amount of dead work. It is thought, however, that even if the production was small there was a sufficiently large stock on hand from the preceding year to meet requirements, since the mine has been unequaled in the production of tourmaline. The San Diego Tourmaline Mining Company has completed hundreds of feet of tunnels and is in a position to make a large production. The company reports a large sale of gems in Germany at good prices. The Native Gem Mining Company produced principally pink and aquamarine beryl, with tourmaline of several colors. Its specimens of quartz crystals and beryl from the Esmeralda mine attracted much attention when exhibited in San Diego, and one of the pink beryls sold for $600 toward the close of the year. The Mesa Grande Tourmaline Mining Company drove a tunnel more than 100 feet at a new mine and obtained some pink and green tourmaline. Work had to be suspended, however, as the wet weather caused a cave in.

OTHER DISTRICTS IN SAN DIEGO COUNTY.

Mr. Havis drove a tunnel on a new prospect near Banner and reported the discovery of much lepidolite and some indicolite. Mr. Freeman has developed his property near Vista by tunnels and crosscuts and has obtained some gem tourmaline, chiefly of yellow and green color, with some of a fine pink color. The Ramona gem district did not make much progress, as there have been many lawsuits and much disagreement among the mine owners. The district has, however, produced fine topaz and pink beryl, besides spessartite, essonite, green tourmaline, and aquamarine.

The southern portion of the gem region in San Diego County has been exploited by the San Diego Gem Mining Company and the Mesa Grande Consolidated Gold and Gem Mining Company. Essonite garnet, sold as hyacinth, is the principal stone produced, and the demand for large, clear, yellow stones has exceeded the production.

RIVERSIDE COUNTY.

Mr. Bert Simmons has spent much time developing his claim at Oak Grove, from which he obtained some pink and blue colored tourmalines. At his new and promising claim at Chihuahua fine specimens of beryl and indicolite have been found included in coarse albite. At Coahuila the Mesa Grande Tourmaline Company and the Fano Kunzite-tourmaline Company have been operating on new prospects, and have produced some green beryl and tourmaline. Mr. Robert Magee also has been successful in working several deposits containing beautiful rubellite and beryl of remarkable clearness.

The following notes abstracted from an article on The Pegmatite Veins of Pala, San Diego County, by Mr. G. A. Waring,[a] are added to give further light on this interesting region:

The gem district of San Diego County lies in a region of crystalline rocks between the nearly level Mesa country on the west and the desert on the east. The Palomares and higher mountains included in this area are composed chiefly of mica schists, while the lower-lying hills and mountains are of granite and diorite or gabbro. The relations seem to be "intrusive diorite dikes and later granite intrusions within the main granite mass." The gem minerals are found in pegmatite veins cutting the diorite. The pegmatitic structure is well developed to the northeast of Pala, where there is a gabbro boss about 1½ miles wide and 4 miles long inclosed in granite. The veins in this locality dip rather uniformly to the southwest at an angle of about 30°. They have a uniform banded structure, due to the presence of one band each of graphic granite, coarse pegmatite, pay streak, and garnet quartzite. The latter makes about half of the thickness of the vein. The pay streak, which is composed of lepidolite, albite, muscovite, and black tourmaline, contains pockets lined with crystals and partly filled with clay. The minerals of the pockets are clear and smoky quartz crystals (often showing a development of rare faces), and, in some cases, rose quartz and hyalite; albite in tabular crystals; orthoclase in individual crystals embedded in the clay; greenish muscovite; lepidolite, often containing green tourmaline and kunzite. In some cases the crystals attain large size in these pockets, although one mineral may do so to the exclusion of another. Kunzite and tourmaline are rarely found in the same pocket, though they occur in the same vein. The clay of the pockets is found to consist of quartz,

[a] Am. Geol., June, 1905, pp. 356-369.

feldspar, and muscovite, with spodumene, lepidolite, and tourmaline in smaller quantities. A soft, unctuous-feeling, pink clay, called halloysite, apparently derived from rubellite, occurs in many of the pockets.

At Rincon gem minerals are found in pegmatites of similar structure to those of Pala, though inclosed in badly decomposed granite. The hard pegmatite contains black tourmaline, massive almandine garnet, large beryl, and greenish muscovite; and the pockets contain crystals of quartz, orthoclase, and beryl of gem quality (tourmaline and kunzite have since been found in the pockets also, according to Sickler). The crystals of the pockets have been corroded and partly dissolved by alkaline waters, leaving the faces rough and scarred.

GEMS OF CEYLON.

An interesting article, by Mr. Ralph Stokes,[a] appeared in 1906 on the gems of Ceylon. It seems to be very difficult to obtain reliable information about the gem industry from the natives or elsewhere. The output is handled almost exclusively by a small ring of Mohammedans in Colombo. The merchants obtain their supplies through Moorman dealers from the smaller villages nearest the gemming districts, to which the miners bring their stones for disposal. The Moorman dealers are generally lapidaries and take all the risk incident to the loss of material in cutting. The methods of cutting employed by the lapidaries are primitive, and the tendency is to sacrifice everything for size. The quality of the cutting is otherwise often excellent.

The more common gem stones of Ceylon are sapphire, ruby, star sapphire, chrysoberyl, cat's-eye, and moonstone, with some green, blue, and red spinel, topaz and oriental topaz, green, yellow, and colorless zircon, garnet cinnamon stone, aquamarine, and tourmaline. These stones are obtained almost entirely from alluvial deposits derived from the denudation of crystalline rocks.

According to Dr. A. K. Coomeraswamy,[b] the natives of Ceylon appear to have located nearly all of the deposits valuable for gems. In the gem districts themselves the richer places are pretty well known and generally partly worked out. In some cases only the deeper "illam" or gravels remain. Gem mining probably can never be profitably undertaken by Europeans. Even for the Ceylonese it is usually a lottery. Several unsuccessful attempts have already been made by gemming companies and it is not likely others will succeed, since the gem lands are owned by scattered landowners, who apparently claim all the beds except in the larger rivers, and all operations would require careful supervision. The gemmers fall into three classes: Illicit gemmers; fairly prosperous men who work their own lands, occasionally employing help; and rich men who have their pits worked for them or rent out the land. In the latter case the lessees dig a pit down to the "illam," when the owner or other responsible man attends the work to see that nothing is stolen. The gems are divided, three-fourths to the owner or lessee and one-fourth among the men along with their food, but with no wages.

In the gemming region of Sabaragamuwa the Cingalese employ a crude system of dredging to obtain gems and sometimes gold. A

[a] Min. World, April 28, 1906, pp. 523–524.
[b] Administration Repts., Ceylon Min. Survey, pt. 4, 1905 p. E 11.

convenient place in a river is selected where there is a good current, not too deep, and where, if possible, there are no large bowlders. A low fence or dam is generally built from the sides part way across the stream to increase the flow of water. The men—half a dozen or more are needed—stand in a row facing upstream and rake up the gravel above them with a special long-handled "mamoty" (sort of hoe or rake). They work as far up as their "mamoties" will reach, and eventually scoop a large hole under water in front of them. By this process the overlying layers of sand and clay are removed and the illam exposed. This gravel, along with that underneath, is then worked up and allowed to drop in the water near the men's feet, where the current washes away the lighter material. The gravels thus partly concentrated are washed in the usual way in baskets.

SIMPLE METHOD OF TESTING PRECIOUS STONES.

Mr. Meyer D. Rothschild[a] has suggested a simple test, applicable to a number of stones, that can be made by any jeweler who will exercise care in its execution. Hydrofluoric acid or "white acid" (a mixture of ammonia and hydrofluoric acid) is used. The acid should never be allowed to come in contact with the skin, as it is very poisonous and highly corrosive, producing painful sores and ulcers. The stone to be tested is handled with forceps and immersed one minute in the acid; then it is removed and the acid is washed off. The test is applicable only to diamond, ruby, sapphire, spinel, emerald, aquamarine, precious topaz, tourmaline, garnet, and kunzite, which are unaffected by the hydrofluoric acid. The test is not applicable to turquoise and opal, which are rapidly etched or eaten away by this acid, nor to peridot and the quartz gems, as amethyst, false topaz, crystal, agate, etc., which have their surfaces dimmed and require repolishing. The genuine reconstructed and artificial ruby is also unaffected, while all imitations made of paste, as imitation ruby, sapphire, emerald, etc., are rapidly attacked.

PRODUCTION.

It has been found next to impossible to obtain definite figures showing the production of many varieties of gem minerals in 1906. There has doubtless been a production of several gem minerals not recorded in the table, but since no information could be obtained concerning them, they have not been listed. There are several causes combining to make the collection of statistics for precious stones difficult. In many cases the production is made up of a number of small lots and scattered finds which are brought in at different times and disposed of to different people. Often the persons interested in mining gems do not care to furnish figures showing the production, which has then to be either estimated or omitted entirely. There have been, however, a great many producers and men interested in minerals who have generously assisted in every way possible toward the compilation of statistics of production and have furnished information concerning the progress of the industry.

It has been deemed advisable, for several reasons, to make a change in the form of table showing the production of precious stones. First,

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[a] Jew. Circ. Weekly, January 16, 1907.

the list of those gems for which figures were obtained directly from producers or persons closely associated with the production was very much smaller than usual. Furthermore, it is the aim of the Survey to give the value of all material in the rough, and the basis chosen for estimation is therefore, in many cases, not like that previously used, and hence, it has not been found possible for one not closely connected with the trade, as Doctor Kunz has been for many years, to give estimates of production on a basis similar to that formerly used. Though Doctor Kunz has very kindly offered to supply the necessary information and has furnished assistance in many other ways, it has seemed best to rearrange the table of production to fit the information as furnished to this Office. In order that the changes made may be readily understood and a partial comparison be made with the production of precious stones in previous years, the table as printed in the report for 1905 by George F. Kunz is herewith reprinted in part.

In the table for 1906 some large changes from 1905 have been recorded in the production of certain precious stones. These have been caused in part by changes in the basis of estimation and in part by changes in production. The largest changes, where the same minerals appear in both tables, have been in sapphire, turquoise, chrysoprase, tourmaline, and kunzite. In the case of sapphire, turquoise, and chrysoprase, the changes are due in part to the basis of estimation and in part to changes of production; in the case of tourmaline and kunzite, the changes probably result entirely from increased production.

Production of precious stones in the United States in 1906.

Precious stone.	Value.	Remarks.
Amazon stone	$100	Colorado.
Amethyst	700	Scattered lots.
Beryl (aquamarine, etc)	7,800	Mostly gem material; California, Colorado, North Carolina, Massachusetts, New Hampshire, Maine.
Beryl (pink)	1,200	Chiefly from a few large crystals; California.
Chiastolite	25	Massachusetts.
Chrysoprase	32,470	3,250 pounds in the rough; California.
Diopside	5	10 carats in the rough; Kentucky.
Garnet, almandite	100	Few scattered finds; chiefly North Carolina.
Garnet, essonite	400	1,000 carats in the rough; California.
Garnet, pyrope	2,500	Scattered lots; Utah, Arizona, Kentucky.
Moss agate	800	8,000 pounds in the rough; Wyoming.
Peridot	2,400	Scattered lots; Arizona, Kentucky.
Phenacite	250	Gem crystals; Maine.
Prase	50	Colorado.
Quartz, crystal	900	6,000 pounds in the rough; California, North Carolina, New York.
Quartz, rose	4,000	40,000 pounds in the rough; South Dakota, Colorado, Maine.
Quartz, rutilated	50	Scattered finds; North Carolina.
Quartz, smoky	2,000	1,500 pounds in the rough; California, Maine, North Carolina.
Quartz, tourmalinated	100	Colorado.
Ruby	600	Scattered finds; North Carolina, Idaho.
Sapphire	39,100	404,150 carats in the rough; Montana, North Carolina, Idaho.
Spodumene, lilac or kunzite	12,500	75 pounds, rough gem stock; California.
Spodumene, green or hiddenite (?)	1,500	5 pounds, rough gem stock; California.
Topaz	1,550	Maine, Utah, California.
Tourmaline	72,500	1,450 pounds, rough gem stock; California, Maine, Colorado, Connecticut.
Turquoise	22,250	556,500 carats, partly picked; Arizona, New Mexico.
Utahlite	2,000	Utah.
Wood, silicified and opalized	150	3,000 pounds, rough material; Colorado.
Total	208,000	

In the following table is given a statement of the production of precious stones in the United States in 1904 and 1905:

Production of precious stones in the United States, 1904–1905.

Precious stone.	1904.	1905.	Precious stone.	1904.	1905.
Diamond	None.	None.	Garnet (almandite)	None.	None.
Sapphire	$100,000	$125,000	Rhodolite	None.	None.
Ruby	None.	None.	Garnet (pyrope)	$3,000	$5,000
Topaz	None.	500	Topazolite	None.	None.
Beryl (aquamarine, etc.)	5,000	6,000	Amazon stone	500	1,000
Beryl (pink)	100	1,000	Oligoclase	None.	None.
Emerald	None.	None.	Moonstone	None.	None.
Phenacite	None.	None.	Turquoise	100,000	65,000
Tourmaline	40,000	50,000	Utahlite (compact variscite)	200	500
Peridot	5,000	10,000	Chlorastrolite	2,000	3,000
Kunzite	10,000	5,000	Mesolite (thomsonite, so called)	500	500
Quartz, crystal	10,000	10,000	Prehnite	None.	None.
Smoky quartz	2,000	3,000	Diopside	None.	None.
Rose quartz	1,000	1,000	Epidote	None.	None.
Amethyst	3,000	2,000	Pyrite	3,000	2,000
Prase	None.	None.	Malachite	None.	2,000
Gold quartz	5,000	5,000	Rutile	None.	None.
Rutilated quartz	None.	None.	Anthracite (ornaments)	2,000	2,000
Dumortierite in quartz	None.	100	Catlinite (pipestone	2,500	2,000
Tourmalinated quartz	None.	None.	Fossil coral	None.	250
Agate	2,000	2,000	Arrow points	None.	1,000
Moss agate	1,500	1,500	Miscellaneous	15,000	10,000
Chrysoprase	6,000	5,000			
Silicified wood (silicified and opalized)	5,000	5,000	Total	324,300	326,350
Opal	None.	None.			

IMPORTS.

The importation of precious stones into the United States in 1906, as reported by the Bureau of Statistics, again shows a substantial increase over that of the preceding year. This increase was chiefly in unmounted cut diamonds, though there was also a substantial increase in the importation of rough diamonds. The importations of glaziers' points and pearls were also larger than 1905; diamond dust or bort and miscellaneous precious stones showed a slight decrease. Almost the whole imports of precious stones came through the port of New York, the figures obtained for other ports amounting to only $28,988.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1903 to 1906, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1903–1906.

Year.	Diamonds.					Diamonds and other stones not set.	Pearls.	Total.
	Glaziers'.	Dust or bort.	Rough or uncut.	Set.	Unset.			
1903	$10,634	$720,150	$10,275,800	$675	$13,022,367	$2,494,897	$2,414,524	$28,939,047
1904	73,054	445,621	10,234,587	559	13,439,023	1,893,969	1,142,150	27,228,963
1905	6,851	190,072	10,281,111	741	20,375,304	4,144,434	1,847,006	36,845,519
1906	104,407	150,872	11,676,529	305	25,268,917	3,995,865	2,405,581	43,602,476

PEARL INDUSTRY IN THE UNITED STATES.

Each year there is an unrecorded production of pearls from fresh-water mussels of many of the rivers of the United States. The principal yield comes from the Mississippi Valley region, where beds of pearl-bearing mussels are found in many of the tributary rivers. Along the Atlantic Coast States pearls have been found from Maine to Florida, and in the Gulf States from Florida to Texas.

The season for gathering pearls and mussels is from May to November, when buyers and dealers travel from one locality to another where there are pearl fisheries. Often the mussels are gathered in large quantities and opened simply in search of pearls, and then thrown away with no thought of their value for manufacturing pearl buttons. In other cases the shells are saved for this purpose, but much useful material is wasted at the button factories. With the reckless destruction of millions of mussel shells for pearls and button manufacturing, the beds of these shells are being rapidly depleted, and unless some steps are taken for their preservation it will not be long before the deposits will be exhausted. Laws passed to prohibit the gathering of shells and pearls on certain portions of the rivers for a period of years, after once being fished over, would give the mussel beds a chance to restock themselves, and thus a permanent industry would be established instead of one rapidly working out its own destruction. It is said the Fish Commission will undertake the investigation of the life and history of the pearl mussel shells of the Mississippi Valley in connection with the zoological department of the University of Missouri. This work is to be carried on for the ultimate purpose of devising a method to stop the extermination of the pearl mussels.

Many pearls are desirable for their even qualities and the ease with which they can be matched, while American pearls[a] exhibit the greatest number of variations in color and tint, and it is difficult to match exactly a number of them for necklaces and other jewelry. On the other hand, the exquisite coloring and the fine luster of our pearls more than offset the disadvantages due to such irregularities, and make them much desired in the gem market. A list of publications on American pearls and pearl shells is given in the bibliography at the end of this chapter for the convenience of persons who desire further information on the subject.

Very curious-shaped pearls and baroques are often found. Among those found in 1906 in the Mississippi region are three, which have been described and illustrated in the Jeweler's Circular Weekly. One of these was in the shape of a crowned head which much resembled that of Queen Victoria.[b] Another was rounded, and also looked like a human head.[c] Still another, a baroque, resembled the head of an old man with flowing beard and hair.[d] The color of this pearl was an exquisite pink, shading in places from dark to light tints, which appear to give light and shadow to the face.

The pearl industry is carried on in such a way that it is not possible to collect statistics showing the production. Buyers and dealers, not only from New York and other eastern cities, but even from Paris, visit the Mississippi region in the pearl-gathering season, travel from point

[a] American Jeweler, October, 1906.
[b] Jew. Circ. Weekly, April 25, 1906.
[c] Idem, October 12, 1906.
[d] Idem, May 1, 1907.

to point, and at the end of the season return to their places of business. Many small dealers sell to larger ones on the spot; others send their product off to be marketed. In many cases parcels of pearls change hands two or three times before appearing in the gem markets. Pearls amounting to many thousands of dollars in value are exported annually, which apparently have not been reported to the Bureau of Statistics of the Department of Commerce and Labor.

Since it has not been possible to collect figures of production it has been thought well to give the estimates of those most familiar with the industry, in order that the size of the latter may be appreciated. In giving these estimates, kindly furnished by the persons named, it must be remembered that each one probably sees the industry in a different aspect, according to his connection with it.

ESTIMATES OF THE PRODUCTION OF PEARLS IN THE UNITED STATES.

Mr. Frank Koeckeritz, one of the largest pearl dealers in the Mississippi Valley region, places the value of pearls and slugs in 1906 at $381,000, with prices ranging from $1 to $2,000 and up each, and slugs from $1.50 to $60 an ounce. The colors are white, cream, pink, purple, blue, and rarely black. The various shapes found are round or ball shape, half round or button shape, pear shape, drop shape, oval, and irregular or baroques, and their occurrence is estimated as follows:

Approximate proportion (percentage) of each shape of pearls found.

Drop	5	Round	15
Pear	5	Button	25
Oval	10	Irregular	40

Mr. Koeckeritz places the production of button shells at 43,500 tons, valued at $348,000 at points of production, or at $556,625 after shipment to the factories.

The value given for pearls and slugs represents the first cost, or prices paid to the pearl fishers. By the time the stones reach the consumer, after passing through the hands of the large dealer, the jobber, the manufacturer, and the jeweler, the value is easily four times that originally paid. The demand for American fresh-water pearls is strong, both in the domestic markets and abroad, especially in Paris, whither many pearls are taken directly from the pearl region.

The production of pearls from the Wabash River alone in 1906 is conservatively estimated at from $100,000 to $150,000 by Mr. W. D. Burd, of St. Louis, a large pearl dealer in the Mississippi region. The Wabash River and its tributaries were probably more actively worked last season than any other rivers in the country.

An estimate of the United States Fish Commission places the value of the production of pearls in the United States in 1906 at about $500,000. The only year statistics were collected by the Commission was 1903,[a] when the value was placed at $213,451, with $316,647 worth of button shells.

[a] Bowers, G. M., Statistical bulletin No. 188, Bur. of Fisheries, Department of Commerce and Labor.

Mr. J. F. Boepple, of Davenport, Iowa, estimates the annual production at about $2,000,000 worth of pearls for the last eight years in the Mississippi region, and states that for the Wabash River alone in 1906 it is reported that about $1,000,000 worth were gathered. Mr. Beopple was the pioneer manufacturer of pearl buttons in the Middle West and was instrumental in establishing both the pearl-button industry and the pearl industry.

OCCURRENCE OF DIAMONDS IN ARKANSAS.

By George F. Kunz and Henry S. Washington.

In Pike County, Ark., there is a small area of peridotite which enjoys the distinction of being the first locality in North America where diamonds have been found in place, and not in river gravels or glacial deposits. In the present paper we purpose to give a brief preliminary account of the locality, of the history of the recent discovery of the diamonds, and of their occurrence, reserving fuller details for a subsequent paper.

The igneous area, which lies about 2½ miles southeast of Murfreesboro, the county seat, just east of the junction of Prairie Creek with Little Missouri River, was first noticed by W. B. Powell as far back as 1842, later by C. U. Shepard in 1846, and was subsequently described in considerable detail by J. C. Branner and R. N. Brackett,[a] from whose description, supplemented by our own observations, the following geological and petrographical data are taken.

The mass of igneous rock forms a small stock, which has cut through massive Carboniferous sandstones and quartzites, somewhat indistinctly bedded at rather steep angles. Unconformably overlying these are horizontally bedded Cretaceous sandstones, themselves overlain by coarse, post-Tertiary conglomerates, the pebbles of which consist of jasper, chert, and flint, and which much resemble some of the Brazilian cascalhos. A small dike of peridotite cuts the Cretaceous sandstone in the bed of Prairie Creek, but does not penetrate the conglomerate above, thus establishing the date of the intrusion as post-Cretaceous but prior to the deposition of the conglomerates.

The igneous area itself is roughly elliptical in shape, with a longer diameter of about 2,400 feet and a shorter of 1,800 feet, the former lying about northeast-southwest, and the latter at right angles to this. The northwest edge of the area is marked by a ridge with three summits, of which the southwestern is composed chiefly of Carboniferous quartzite, as is part of the northeastern one, while the central hill is composed of a dense, dark, rather fresh peridotite, which is split by joints into massive blocks. South and southeast of this ridge, the summits of which lie from 60 to 80 feet above its base, the surface slopes gently down toward the cotton-planted bottom lands on the left bank of Little Missouri River. This portion of the area consists of very much decomposed peridotite, covered in places by a thin stratum of soil and many pebbles derived from the post-Tertiary conglomerate. There is little evidence of alteration of the surrounding sandstones by the igneous intrusion, and, judging from its form and from the petrographic character of the rock, the stock appears to be the neck of a small volcano, the upper part of which has been removed by erosion.

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[a] Branner and Brackett, Am. Jour. Sci., vol. 38, 1889, p. 50, and Ann. Rept. Geol. Survey Arkansas or 1890, vol. 2, 1891, p. 377.

The peridotite has been so well described by Branner and Brackett that a few words of description will suffice here. In the hand specimen the freshest peridotite is very dark, brownish or greenish black, and porphyritic with an aphanitic groundmass. The phenocrysts, which make up about one-quarter of the rock, are mostly of olivine, the color of which is commonly black, but in some specimens of the rock is yellow or brown, especially in the less fresh specimens. With these are fewer, small, glistening plates of a bronzy biotite.

In thin section the olivine phenocrysts are seen to be well-formed, from 0.5 to 5.0 mm. long, some of them colorless and fairly fresh in the interior, but most of them largely altered to serpentine. The biotite phenocrysts are seen as irregular brownish-yellow patches, highly pleochroic. The groundmass shows very numerous, small, stout prisms of colorless augite, and many small grains of magnetite and of transparent, yellow, isotropic perofskite, embedded in a vitreous base, which is either colorless or yellow. This is usually isotropic, but may exhibit faint aggregate polarization through decomposition.

The fresh peridotite was analyzed chemically by Brackett, and in its general features it does not differ widely from that found at some other localities, and his figures accord well with the mineral composition shown by the microscope. Ferric oxide predominates over ferrous, which may be ascribed to the somewhat weathered condition of the rock, and potash is rather high, this being connected with the presence of biotite.

As is true of almost all peridotites, the Pike County rock weathers readily, two stages of decomposition being observable here. The first consists of the mechanical disintegration of the mass into an aggregate of small, angular fragments, which still preserve nearly their original hardness, though the olivines are almost wholly altered. This passes into the stage which is of most interest in connection with the occurrence of diamonds, the solid rock being reduced to a soft, friable mass. This is either of a yellowish or, more characteristically, of a yellowish-green or light bluish-green color, the two varieties having been called locally the yellow and green earths. In these the outlines of the original olivines are still well seen, but the mineral is reduced to a soft, yellow substance, while the biotites are comparatively little changed. From the preservation of the form of the olivines it is clear that the decomposition of the rock has gone on in place, and that the yellow and green earths have not been transported from a distance.

These peculiar decomposition products occupy by far the greater portion of the igneous area, occurring just beneath the thin surface soil covering all that portion which lies south of the ridge of three hills mentioned above, while a considerable portion is laid bare and cut into deep gullies by surface erosion. Apparently the yellow earth overlies the green and represents the last stage of decomposition, while both overlie the less decomposed, fragmental, weathered form, though this last reaches the surface in places. The exact depth to which the green earth extends has not yet been ascertained throughout the area, but drill holes sunk to a depth of 30 feet still show the green earth in places, while elsewhere it is less deep and the solid peridotite is struck below it.

The first diamond was discovered on August 1, 1906, by Mr. John M. Huddleston, who had purchased the land lying south of the ridge and including the greater part of the decomposed portion of the igneous area, largely on account of its peculiar character, as he suspected that it contained some "mineral." Mr. Huddleston was searching, on his hands and knees, for indications of copper or lead ores and his attention was attracted by the luster of the stone, which he recognized immediately as differing widely from the somewhat abundant small quartz crystals which are scattered over the area. The diamond, which is a white stone weighing 4½ carats, was lying among the pebbles on the surface of the thin layer of soil which overlies the green earth near the southern edge of the igneous area where the decomposed peridotite is much cut up by small gullies.

The afternoon of the same day, while riding on horseback into Murfreesboro and carefully scrutinizing the ground, he saw a second diamond lying in the ruts of the road, about 500 feet north of the first and also within the igneous area. This stone is likewise white and weighs 3 carats.

Although he and his family searched the area over very carefully, no more diamonds were found until September 8, when Mr. Huddleston found the third, also lying among the pebbles on the surface of the soil, above the green earth, about 400 feet northeast of the place where the first was found. This stone is yellow, a flattened, triangular hexoctahedron, and weighs one-half carat.

The stones were sent by Mr. Huddleston to persons in Little Rock, who, recognizing the probably great importance of the discovery, immediately secured options on Mr. Huddleston's land and on considerable territory in the vicinity, including the greater part of the igneous area. They then came on to New York and conferred with one of the authors (Mr. Kunz), who was, naturally, deeply interested in the discovery. The junior author (Mr. Washington) was called in and was intrusted with the geologic and petrologic examination of the locality, where he spent some time during the month of October. Pits were sunk in various places over the igneous area, the green and yellow earth was screened and panned, and a careful search was made for more diamonds on the surface, but none were discovered. Various considerations, which need not be discussed here, precluded the possibility of the ground having been "salted." The points of similarity, as well as of dissimilarity, with the South African pipes were recognized, and the conclusion was reached that the diamonds were probably derived from the peridotite; though, in view of the fact that all three had been found among the surface pebbles, which had come from the conglomerate, the possibility that this may have been their source was not excluded from consideration, and further extensive prospecting was recommended. This was subsequently done to some extent, though interfered with by bad weather, and several more diamonds were found by Mr. Huddleston and members of his family, as well as by other persons, all on the surface of the ground but within the igneous area.

In January, 1907, the two authors visited the locality together, and made a careful study of the igneous area and its surroundings. While the resemblance of the conglomerate to the diamond-bearing Brazilian cascalho was recognized, the facts that careful examination and panning of this and of the river gravels led to negative results, and that up to the time of the authors' visit as many as 26 diamonds had been found, all within the igneous area, though all likewise on the surface of the ground, in addition to the petrographic and other evidence, rendered the presumption in favor of their derivation from the peridotite almost a certainty.

Subsequent to this visit extensive prospecting has been undertaken according to plans suggested by the authors, large amounts of the green earth (which disintegrates in water to a fine, impalpable mud) being washed and screened in Little Missouri River. This work was done under the supervision of Mr. Theodore Hartman, a civil engineer of Little Rock. In the course of these operations two small diamonds were found in the concentrates. This would have settled definitely the question of their source had not some doubt existed through the possible accidental admixture of small amounts of the surface soil with the underlying green earth, as Mr. Hartman's careful precautionary measures to guard against this were not followed by some of the men.

But final and absolutely definite proof that the diamonds occur in the peridotite and that those found have been derived from it was furnished by the discovery, about the middle of March, of a diamond embedded in the green earth, about 3 feet below the surface, while this was being excavated for washing, a careful watch being also kept by the men for just such a discovery. This specimen was brought to New York by one of the parties interested, and was carefully examined by both of the authors. The stone is white, apparently a flattened octahedron, firmly embedded in the decomposed peridotite, so that only a portion of it is visible, this being about 12 mm. long by 2 to 4 mm. wide. The most careful scrutiny failed to reveal any evidence that it had been artificially inserted, and no other conclusion was possible than that it was actually in situ. Taking all the facts into consideration, therefore, the occurrence of diamonds in the peridotite of Murfreesboro may be regarded as unquestionable.

The number of diamonds found up to the date of writing is 130, the weights varying from one thirty-second of a carat up to 6½ carats. The majority are distorted octahedrons, a few being flattened and triangular, and a small number are almost perfect octahedrons. No cubes have been found. Most of the stones are white, a large proportion being of good water and the white of exceptional purity, finer than most African stones. A smaller number are brown; some are yellow, and several small individuals are of bort.

The mass is now being examined with the diamond drill, and fresh and solid peridotite is found beneath varying depths of green earth, the greatest depth yet reached being 186 feet.

As this is the only place outside of South Africa where diamonds have been found in peridotite, a brief comparison of the two localities will be of interest, a more detailed statement being reserved for the future. While, petrographically and chemically, the rocks around Kimberley and near Murfreesboro are much alike, there are some decided differences. The Murfreesboro rock is a true porphyritic lava, although the portion now visible had not reached the surface, and it was evidently ejected through a volcanic vent as a relatively quiet liquid flow, while the peridotite of the South African pipes seems to be uniformly an igneous breccia and to have been ejected by explosive eruptions in a more or less fragmentary condition and probably mingled with a considerable proportion of water. At Murfreesboro inclosed fragments of the rocks traversed by the lava are wholly lacking, not a piece of sandstone, quartzite, shale, or other nonigneous rock having been observed, so far as the authors know, during the extensive diggings. In South Africa, on the other hand, as is well known, such foreign material is abundant in the "blue ground," and includes quartzite, sandstone, shale, diabase, eclogite, and other rocks.

Such fresh peridotite as occurs at the Pike County locality does not seem to have been observed in South Africa, but the green earth of the former much resembles the blue ground of the latter, both in color and in being composed predominantly of highly serpentinized olivine, with smaller amounts of decomposed augite, and a little biotite, perofskite, and magnetite, although the Arkansas material is much softer than is the African. Similarly, at both localities the upper portions of the decomposed rock are yellow, through oxidation and hydration of the ferrous iron.

On the other hand, garnets, which are very abundant at the African pipes, are extremely rare and of very small size at Murfreesboro, though of the same red color, but their chemical composition is unknown as yet. Furthermore, chrome-diopside, hypersthene, zircon, kyanite, chromite, and ilmenite, which are such common ingredients of the African blue ground, are unknown at the Arkansas locality. While the blue ground of Kimberley is compact, and must be exposed for a long time to the weather before it disintegrates sufficiently to permit the extraction of the diamonds, the Arkansas green earth is soft and friable when first excavated, hardens somewhat on drying, but on exposure to the weather soon disintegrates to a fine mud, as it readily does on agitation with water. This, at least, is true of the upper portions, so far as they have been penetrated, but the harder fragmental material of the first stage of decomposition shows much less tendency to disintegrate and remains to be further investigated.

The question of the origin of the diamonds falls outside of the scope of this preliminary paper, but it may be noted here that no carbonaceous shales are known to occur in the vicinity of the igneous mass, nor were they observed as inclusions, as they are at Kimberley. This would indicate that Lewis's view of the derivation of diamonds by the metamorphism of carbonaceous shales does not apply here, and points to the probable truth of the view of Cohen, Hatch, and Corstorphine, that they are original constituents of the igneous rock. At the same time, in view of the occurrence of deposits of asphalt at Pike City, 10 miles northeast of Murfreesboro, and of the occurrence in the post-Tertiary conglomerate immediately north of Murfreesboro of some asphalt which may be supposed to be derived from underlying organic material, the question must, for the present, be left open.

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QUARTZ (FLINT) AND FELDSPAR.

By Edson S. Bastin.

QUARTZ (FLINT).

INTRODUCTION.

Quartz, the most abundant of all minerals, occurs in a great variety of forms and is utilized commercially in many different ways. Certain transparent colored varieties, such as rose and smoky quartz and amethystine quartz, have a gem value and are discussed in the chapter on precious stones. Sand used for building, molding, and in glass and pottery manufacture is also discussed in other parts of this volume, as are sandstone and quartzite used for building purposes, although all these materials are nearly pure quartz. This chapter deals only with massive crystalline quartz (often called vein quartz), with flint, and with quartzite, which is used for other than building or paving purposes.

MASSIVE CRYSTALLINE QUARTZ.

Quartz of this variety is usually white, though occasionally rose colored or smoky. It occurs either in vein or dikelike masses, unmixed with other minerals, or as a constituent of pegmatite. In the latter occurrence it is produced as an accessory in the mining of feldspar. The States now producing massive crystalline (vein) quartz in commercial quantity are Connecticut, New York, Maryland, and Virginia. Small quantities were formerly marketed from Maine, all being obtained from pegmatite deposits. Quartz is even now saved in stock piles at some of the feldspar quarries, though it finds only a sporadic sale, the Maine quarries being too far from the markets to make the mining profitable even as accessory to the mining of feldspar. In New York white and rose colored quartz is produced as an accessory in feldspar mining in Westchester County. In Connecticut and Maryland some is obtained in feldspar mining, but the bulk of the material comes from mines operated for quartz alone, these localities being near enough to the markets to render the mining profitable. In Virginia massive quartz is quarried for use in the manufacture of metallic silicon and ferrosilicon.

QUARTZITE.

This rock may be described as a sandstone in which the spaces between the quartz grains have been completely or almost completely filled, either through a further deposition of quartz between the grains or through a recrystallization of the quartz of the original grains. The result is a solid mass of quartz. In Cherokee County, N. C., a hard, vitreous quartzite of Cambrian age is extensively quarried by the North Carolina Flux Company for use as a flux in copper smelting.

FLINT.

The name flint is properly applied only to quartz of exceedingly compact texture, dull surface, and perfectly conchoidal, splintery fracture. It commonly occurs in the form of more or less irregular nodules in limestones, and in such cases is almost certainly of concretionary origin. Chert is another name applied to flint occurring in this way. Flint or chert nodules occur abundantly at several localities in the United States, notably in the Cretaceous limestones of central Texas, a locality in the west portion of the city of Austin being the most accessible. So far as known very little domestic flint has ever been commercially utilized except as road metal, though its quality appears to be equal to that of the imported flint. All the true flint consumed in this country comes from France, Greenland, Norway, and England and is imported cheaply as ballast. Many of the smaller round or oval nodules are used in ball mills, but much of the material is fired in kilns and then ground for use in the pottery trade. The flints, which are usually gray to nearly black in their natural condition, become perfectly white on burning, and fracture somewhat, so that grinding is facilitated.

USES.

Quartz of the kinds dealt with in this report is used for a great variety of purposes. A large proportion of the massive quartz from the pegmatite deposits of New York, Connecticut, and Maryland is ground and utilized in the manufacture of a wood filler. Vein quartz and flint are extensively used in pottery manufacture, where they serve to diminish shrinkage in the body of the ware. Quartz is used also in the glaze. Sand and ground sandstone are, however, steadily gaining ground as a substitute for the more massive forms of quartz in the pottery trade. Quartz of any variety, to be suitable for pottery use, must be free from iron-bearing minerals. In general the analysis should show less than one-half of 1 per cent of iron oxide. Massive quartz, crushed and graded to various degrees of fineness, is extensively used in the manufacture of sandpaper, sand belts, etc., as a scouring agent with sand-blast apparatus, and in the manufacture of scouring soaps and polishes. The qualities which render it particularly serviceable for these purposes are its hardness (No. 7 in the Mohs scale), which is slightly greater than that of steel, and its conchoidal fracture and absence of definite cleavage planes, causing it to crush to fragments with sharp, angular edges and corners. For these abrasive purposes massive quartz is far superior to sand or crushed sandstone, since the grains of the latter are likely to be more or less rounded. Blocks of massive quartz are used in the chemical industry as a filler for acid towers and to some extent as a flux in copper smelting. Much ground quartz is used in filters, and some of the finest grades are used in place of pumice as a cleaner by dentists. Within recent years quartz has been used to some extent in the manufacture of metallic silicon and ferrosilicon by electrolytic processes, these materials being used largely in steel manufacture to increase the toughness of the product. Because of its high electrical resistance silicon is also finding use in the manufacture of rheostats, electric heaters, etc. The filament of a new electric lamp, known as the "Helion" lamp, is a compound rich in silicon and is said to give a white light at a current density at which a carbon filament would show only red. It is also claimed that the filament will stand 100 per cent overload without giving out and that ordinary variations of current have but little effect on the light. Though not metallic, the filament has the property of fusing together when broken.

METHODS OF GRINDING.

In the grinding of the massive forms of quartz two general processes are used, which may be called the "wet process" and the "dry process."

In the wet process the quartz is usually first crushed in a jaw crusher and then still further reduced in size in chaser mills. After this it is ground in "wet pans" provided with a pavement of flat-faced quartz blocks over which move several large quartz blocks, the crushed quartz being pulverized between these blocks and the pavement. The grinding in the wet pans usually occupies about twenty-four hours, the load ground in a single pan varying from 1,200 to 1,800 pounds. From the wet pans the pastelike mass of quartz and water is drawn into settling troughs, the first settlings being in some cases returned to the pans for further grinding. From the settling troughs it is shoveled into a drier heated by steam or hot air. The dried material is then bolted to various degrees of fineness and packed in bags for shipment, or it may be shipped in bulk without bolting.

In the dry method of treatment the quartz is usually crushed first in a jaw crusher and then between steel rollers, though in some cases it goes from the jaw crushers to a gyrating crusher before passing to the rolls. Quartz to be used for filters and for abrasive purposes is then screened to various degrees of fineness, usually on revolving screens, and is packed in bags for shipment. In the manufacture of the finer grades for use in pottery, wood fillers, scouring soaps, etc., the material after leaving the roll crushers is ground in ball mills, either of the continuous or of the intermittent type. It is graded to various sizes either by bolting or by a pneumatic process whereby the quartz powder is carried by a strong air current through a series of tubes and receptacles, the distance to which the material is carried being dependent on its fineness.

PRODUCTION.

The production of quartz in the United States in 1906 amounted to 41,314 short tons of crude quartz, valued at $37,632, and 25,383 short tons of ground quartz, valued at $205,380, a total of 66,697 short tons, valued at $243,012. The average value of the crude material was 91 cents per ton and the ground material was valued at $8.09 per ton.

Production of quartz (flint) in the United States in 1906, by States, in short tons.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Connecticut and New York	7,504	$20,375	4,200	$51,000	11,704	$71,375
Pennsylvania, Maryland, and New Jersey	1,693	3,779	21,183	154,380	22,876	158,159
Virginia and North Carolina	32,117	13,478			32,117	13,478
Total	41,314	37,632	25,383	205,380	66,697	243,012

Production of quartz (flint) in the United States, 1902–1906, in short tons.

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	41,314	37,632	25,383	205,380	66,697	243,012

The apparent increase in the quantity and value of ground quartz in 1906 does not represent a corresponding increase in production, but is due mainly to the more complete returns received this year as compared with 1905.

Imports.—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 flint pebbles. The value of these imports in 1906 was $272,607, as against $146,463 in 1905.

FELDSPAR.

CHEMICAL AND PHYSICAL CHARACTERS.

The feldspars are compounds of alumina and silica with one or more of the bases potash, soda, and lime; rarely barium is present. They fall into two principal groups—the potash-soda feldspars and the lime-soda feldspars.

POTASH-SODA FELDSPARS.

The principal representatives of the potash-soda feldspar group are orthoclase and microcline, which have the composition $KAlSi_3O_8$ or $K_2O.Al_2O_3.6SiO_2$. These two varieties not only have the same chemical composition but they are similar in their crystal form and in most of their physical properties. Indeed, a single crystal which to the unaided eye seems to be homogeneous throughout may be in part orthoclase and in part microcline. The principal difference between the two varieties lies in the fact that microcline shows, when examined under the microscope in polarized light, a minute grating structure, probably the result of intimate twinning of the crystals. Soda may partially or completely replace potash in these feldspars. If it dominates over potash, the feldspar is called anorthoclase. The theoretical percentage composition of pure orthoclase or microcline is shown in column 1 of the following table. No. 2 is an analysis of commercial feldspar from Norway, and No. 3 of feldspar from Bedford, Ontario, which is largely imported into the United States and used in pottery manufacture. Analyses 3 to 8 and analysis 11 are of potash-rich feldspars from various points in eastern United States, used commercially in pottery manufacture and for other purposes.

Analyses of feldspars.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Silica (SiO_2)	64.7	64.98	65.40	65.23	69.63	63.11	65.95	65.33	64.62	63.50	65.96	68.60	48.25
Alumina (Al_2O_3)	18.4	19.18	18.80	20.09	12.30	21.65	18.00	20.96	20.57	22.39	19.53	19.10	34.11
Ferric oxide (Fe_2O_3)	......	.33	Tr.	.71	......	......	.12	.71	Tr.	.36	.24	.14	......
Lime (CaO)	......	Tr.	None.	None.	.95	......	1.05	None.	.14	2.15	.18	Tr.	15.63
Magnesia (MgO)	......	.25	None.	None.	None.	......	Tr.	None.	2.36	None.	......	.28	......
Potash (K_2O)	16.9	12.79	13.90	11.60	14.96	14.10	12.13	10.65	1.94	3.40	12.92	9.03	......
Soda (Na_2O)	......	2.32	1.95	2.00	.79	1.46	2.11	1.37	10.27	6.27	1.13	2.09	1.98
Loss on ignition	......	.48	.60	.36	.43	.40	......	......	......	1.00	......	......	......
Total	100.0	100.33	100.65	99.99	99.06	100.72	99.36	99.02	99.90	99.07	99.96	99.24	99.97

1. Theoretical composition of pure orthoclase or microcline.
2. Norwegian feldspar, used at the Royal Porcelain Works at Charlottenburg, Sweden.
3. Pink orthoclase-microcline feldspar from quarry of Richardson & Sons, Bedford, Ontario. Analysis by Heinrich Ries, Ph.D., Cornell University.
4. Cream-colored orthoclase-microcline feldspar; quarry of Golding & Sons Company, Georgetown, Sagadahoc County, Me. Analysis by Pittsburg Testing Laboratory, Ltd.
5. White orthoclase-microcline; quarry of Eureka Mining and Operating Company, South Glastonbury, Hartford County, Conn.
6. Pearl-gray orthoclase-microcline feldspar; quarry of Claspka Mining Company, near Batchellerville, Saratoga County, N. Y. Analysis by Office of Public Roads, U. S. Department of Agriculture.
7. Pink orthoclase-microcline feldspar; quarry of P. H. Kinkle's Sons, Bedford village, Westchester County, N. Y. Analysis by John C. Wiarda & Co.
8. Light-yellow orthoclase-microcline feldspar; quarry operated by Otto Buresch on property of Albert Hobby, town of North Castle, Westchester County, N. Y.
9. Soda feldspar from quarry of Sparvetta Mining Company, Chester County, Pa.
10. White feldspar from Embreeville, Chester County, Pa. Analysis by Pittsburg Testing Laboratory, Ltd.
11. Potash feldspar from quarry of Guilford and Waltersville Granite Company, Woodstock, Howard County, Md. Partial analyses of other specimens from the same quarry made at the Maryland Agricultural Experiment Station show respectively 13.2 per cent potash with 1.8 per cent soda, and 13.5 per cent potash with 1.6 per cent soda.
12. Potash-soda feldspar; quarry of Walter F. Patterson, jr., Henryton, Carroll County, Md. Analysis by Pittsburg Testing Laboratory, Ltd.
13. Lime-soda feldspar (bytownite) from Point Corundum, near Duluth, Minn. It is not used in pottery manufacture, but is ground for use as an abrasive and in filters, etc.

The feldspars of the potash-soda group mined in the United States are mostly cream colored to nearly white, though the rock from Bedford, N. Y., is pink and that from near Batchellerville, N. Y., a pearl gray. The potash spars from Norway and from Bedford, Ontario, are pink in color. The cause of the pink color is not definitely known, but it seems in some cases to be due to the presence of small quantities of finely divided iron oxide. In many cases, however, as may be seen from the preceding table, the percentage of iron oxide is smaller in the pink feldspars than in those of lighter color. All the pink spars burn perfectly white, and the iron percentage is too small to be in the least detrimental in pottery manufacture. The hardness of the fresh feldspar is such that only with difficulty can it be scratched with a knife blade.

As found in the quarries the potash-soda feldspars seldom show true crystal faces, but when perfectly fresh break readily into angular pieces bounded in part by smooth cleavage faces. There are three directions of cleavage, intersecting at definite angles, which are identical for orthoclase and microcline and change only slightly with an increase in the soda content. Only two of these cleavages are well defined, and these always intersect approximately at right angles. Both of these principal cleavage surfaces show a high luster, comparable to that exhibited by a plate of glass, though one cleavage face is a trifle less brilliant than the other. The hardness and the two lustrous cleavage planes intersecting at 90° are usually sufficient to identify the mineral as belonging to the group of monoclinic potash-soda feldspars.

Recent experiments[a] have shown that the potash-rich feldspars do not possess a definite melting point, as do the metals, for example, but pass gradually from the solid state to that of a very stiff fluid. In most of the determinations that have been made, complete fusion has taken place in the dry state at temperatures below Segar cone No. 9, which fuses at 1,310° C. or 2,390° F. The soda-orthoclases and soda-microclines are slightly more fusible, and the presence of water vapor in the kiln or furnace tends still further to reduce the melting point.

LIME-SODA FELDSPARS.

The lime-soda group of feldspars, or plagioclases, as they are called, form a continuous series ranging from the pure soda feldspar, albite, at one end to the pure lime feldspar, anorthite, at the other end. The chemical composition of albite is represented by the formula Na $AlSi_3O_8$ (designated Ab) or $Na_2O.Al_2O_3.6\,SiO_2$, being similar to orthoclase except that the alkali is soda instead of potash. The composition of anorthite is represented by the formula $CaAl_2Si_2O_8$ (designated An) or $CaO\ Al_2O_3\ 2\ SiO_2$. The intermediate members of the series are mixtures in varying proportions of the two molecules designated above Ab and An, and have been divided arbitrarily, as shown in the following table:

Lime-soda series of feldspars.

Albite	$Ab_1\ An_0$ to $Ab_6\ An_1$	Labradorite	$Ab_1\ An_1$ to $Ab_1\ An_3$
Oligoclase	$Ab_6\ An_1$ to $Ab_3\ An_1$	Bytownite	$Ab_1\ An_3$ to $Ab_1\ An_6$
Andesine	$Ab_3\ An_1$ to $Ab_1\ An_1$	Anorthite	$Ab_1\ An_6$ to $Ab_0\ An_1$

The following table shows the percentages of the various oxides corresponding to each feldspar variety:

Percentage weights of the oxides in the feldspars in the lime-soda series.

	SiO_2.	Al_2O_3.	Na_2O.	CaO.
Albite, $Ab_1\ An_0$	68.7	19.5	11.8	0.0
$Ab_6\ An_1$	64.9	22.1	10.0	3.0
$Ab_3\ An_1$	62.0	24.0	8.7	5.3
$Ab_1\ An_1$	55.6	28.3	5.7	10.4
$Ab_1\ An_3$	59.3	32.6	2.8	15.3
$Ab_1\ An_6$	46.6	34.4	1.6	17.4
Anorthite, $Ab_0\ An_1$	43.2	36.7	.0	20.1

The field and microscopic studies made by the writer, and the few available analyses, indicate that most of the plagioclase present in feldspar deposits worked for pottery purposes is of the soda variety, albite, though some of the more calcic varieties are probably also

[a] Day, A. L., and Allen, E. T., The isomorphism and thermal properties of the feldspars: Am. Jour. Sci., vol. 19, February, 1905, pp. 98-100.

present in a few localities. Albite is usually pure white, though some from Auburn, Me. (not used commercially), is of a dirty green color. In its commonest form it shows, as do the feldspars of the potash-soda group, two principal cleavage faces with brilliant lusters, but they intersect not at 90°, as in orthoclase and microcline, but at about 86°. This difference in angle is not readily recognizable without careful measurements, and in the field the albite and others of the lime-soda group are most readily distinguished from the potash-soda feldspars by the presence of faint, perfectly straight striations on the most brilliant of the cleavage faces. These are the result of repeated twinning of the crystal, and are best seen by holding the crystal in the sunlight so as to catch the reflection from the principal cleavage face. By turning the crystal slightly one way or another the striations, if present, are readily recognized. A second form of albite, especially common in the gem-bearing pegmatite deposits, goes by the name of clevelandite. It is pure white in color and occurs in clusters of thin blades, the latter usually between 2 and 4 inches in length. As indicated by analysis No. 10 of the table (p. 9), which shows 2.15 per cent of lime, lime-soda feldspar is an important constituent at a few quarries.

Pure soda spar or albite ($Na_2O.Al_2O_3.6\ SiO_2$), like orthoclase and microcline, has no fixed melting point, but passes gradually from the solid to the liquid state. It seems to be completely fused, however, at a temperature near 1,300° C. (2,372° F.), or about the melting point of Segar cone No. 9. Certain feldspar grinders mix soda feldspar with potash feldspar before grinding. The resulting product has a somewhat lower melting point, that is, is a "softer" spar than the pure potash feldspar. With increase in the percentage of calcium the melting point rises, pure anorthite ($CaO.Al_2O_3.2\ SiO_2$) melting only at 1,532° C. (2,790° F.).[a]

MODE OF OCCURRENCE.

The feldspars are among the most widely distributed minerals and occur as constituents of most igneous and metamorphic rocks, as well as of the sediments derived from these rocks. In these occurrences, however, the feldspar is usually in too small grains and too intimately associated with other minerals to be of commercial importance. Commercial feldspar usually occurs as a constituent of pegmatites. Most of these are essentially very coarse granites, their principal constituents being the granitic minerals quartz, feldspar, and mica. They occur in most areas of crystalline rocks, usually as dikelike masses following whatever planes of foliation or easy fracture may be present in the surrounding rocks, though in some cases cutting across these and often forming irregular bodies of considerable size. Different pegmatite masses even in the same region often differ considerably in coarseness, and even a single mass may vary considerably in coarseness from point to point. In general only a small part of the pegmatitic material of a region is sufficiently coarse grained or sufficiently free from iron-bearing minerals to be of commercial value. The geologic evidence generally supports the view that the pegmatite is really but one type of igneous intrusion, the molten magma being characterized by the presence of large quantities of gases or water vapor which facilitated the formation of large crystals. The relative proportions and

[a] Day and Allen, op. cit., p. 107.

the quality of the different pegmatite constituents vary in different deposits, some being valuable chiefly for their mica, others for their quartz, and others for their feldspar. In some, two or all three of these minerals can be exploited. In a few cases the pegmatite is exploited principally for its gem minerals and its compounds of the rare metals.

The potash feldspars, orthoclase and microcline, which are commercially the most important varieties, nearly always form component parts of the same crystal. They may occur as large crystals, occasionally 15 to 20 feet across, unmixed with other constituents, or they may be intergrown with quartz or rarely with other minerals. When the intergrowth of feldspar and quartz is fine grained the material is not usually used for pottery manufacture; but the coarser intergrowths of feldspar and quartz contain a higher percentage of feldspar and form one of the principal sources of commercial spar. The intergrowth is in some cases irregular; but in most cases it consists of crystals of quartz and feldspar, from several inches to several feet across, which penetrate one another in such a manner that on certain cleavage faces of the feldspar the quartz forms peculiar patterns somewhat resembling the cuneiform inscriptions on ancient monuments. To such intergrowths the name "graphic" granite has been given, from the Greek verb *graphein*, meaning to write.

In many of the mines worked for feldspar, especially those of Maine and Connecticut, the soda variety albite constitutes only a fraction of 1 per cent of the whole amount of feldspathic material, and occurs mainly in irregular crystals, seldom more than 2 to 3 inches across, associated with quartz and potash feldspar. In the quarries at Bedford, N. Y., it constitutes a much larger percentage of the material, though still subordinate to the orthoclase-microcline feldspar. In certain of the quarries of Pennsylvania and Maryland, especially in those near Sylmar, Md., it is the principal feldspar mined. (See analysis 9, p. 9.)

METHODS OF MINING.

The methods of mining feldspar are very simple. The excavations are nearly always open pits, usually of rather irregular form, the valueless portions of the pegmatite being avoided in the mining work. In Maine, Connecticut, and New York the pegmatite is usually firm and undecomposed, even in the surface outcrops, and it is necessary to sink drill holes and to blast most of the material with powder or dynamite. In Pennsylvania and Maryland, however, the pegmatite is in most cases much decayed at the surface, and the materials can frequently be excavated with the aid only of picks, shovels, and crowbars. In a few of these quarries kaolin produced by the decay of the feldspar has been found in the past in sufficient quantities to be of commercial importance, though none is now produced. This difference in the character of the pegmatite deposits in the two regions is due to the fact that the Pennsylvania-Maryland region is unglaciated, while in the more northerly region glacial ice planed off most of the products of rock decay.

In the smaller quarries the drilling is usually done by hand, but in some of the larger quarries steam drills are used. The large masses are then broken with sledges into pieces less than 6 or 8 inches in diameter, the more micaceous and quartzose portions and the portions carrying iron-bearing minerals being at the same time sorted out and discarded. In some of the larger and deeper quarries derricks and drags are used in hoisting the spar to the surface. The material is then usually loaded into wagons and hauled either to the railroad for shipment or to the mills for grinding.

COMMERCIAL AVAILABILITY OF DEPOSITS.

The question whether it will pay to work a given feldspar deposit depends upon a number of different factors, chief among which are (1) distance from the principal markets, (2) distance from the railroad, (3) quality and quantity of the material, and (4) market conditions. Favorable conditions with respect to some of these factors may counterbalance unfavorable conditions with respect to others. The deposits of Maine are at a very considerable disadvantage when compared with those of Connecticut, New York, Pennsylvania, and Maryland in being much farther from the markets. Because of this advantage, hauls by team of 6 or 8 miles from the mines to the railroad are permissible in certain of the southern districts, while under present conditions in Maine a deposit to be worked profitably must usually be within 3 miles of a railroad or of navigable water.

The requirements of the potter's trade demand that in general the percentage of free quartz associated with the feldspar shall not exceed 15 or 20 per cent in the ground product, and certain potters demand a spar which is nearly pure, containing probably less than 5 per cent of free quartz. In order to be profitably worked, in most feldspar mines between one-fourth and one-half of the total material which is quarried must contain less than 15 to 20 per cent of free quartz.

A factor of the utmost importance is the quantity of iron-bearing minerals, black mica, hornblende, garnet, or black tourmaline which is present and the manner in which these minerals are associated with the other constituents. The requirements of the pottery trade demand that the spar be practically free from these minerals, which if present produce brown discolorations in white wares. In order that a deposit may be workable commercially these minerals must be so rare or so segregated in certain portions of the deposit that they can be separated from the spar without much more hand sorting and cobbing than is necessary in the separation of the highly feldspathic material from that which is highly quartzose or rich in muscovite. A number of deposits of coarse grain with feldspar of excellent quality are rendered worthless for pottery uses by the abundance of one or more of these iron-bearing minerals. The presence here and there of minute flakes of white mica (muscovite) can hardly be avoided even in the highest grades of commercial feldspar, and chemically this mineral is not injurious. It is, however, exceedingly difficult to pulverize the thin, flexible plates of mica to a fineness equal to that attained by the feldspar, and it is therefore necessary in mining to separate carefully the muscovite from the spar.

METHODS OF GRINDING.

The methods used for grinding the feldspar are similar in all of the Eastern States and are very simple. The spar as it comes from the mines is crushed in a chaser mill consisting of two buhrstone wheels about 3 to 5 feet in diameter and from 1 to 1½ feet thick, attached to each other by a horizontal axle, as are the wheels of a cart. The horizontal axle is attached at its center to a rotating vertical shaft, which causes the buhrstone wheels to travel over a buhrstone bed. The feldspar is crushed between the wheels and the bed. In a few mills the spar before going to the chaser mills is crushed in a jaw crusher.

The material as it comes from the chasers is screened, the tailings being returned to the chaser mills for recrushing, while the fines go to ball mills for their final grinding. The ball mills consist of steel cylinders revolving on a horizontal axis. They are usually lined either with hard-wood blocks or with blocks made of siliceous brick, and are charged with pebbles 2 to 3 inches across, of Norway or French flint. Feldspar for pottery purposes is usually ground for from four to six hours, and in that time is reduced to a fineness of at least 200 mesh. Some of the poorer grades of feldspar used in glass manufacture are ground only for from two to three hours, great fineness not being required in such material. The type of ball mill used by most feldspar grinders is about 6 feet in length, and it grinds from 2 to 3 tons of spar at one charging. Certain millers, however, claim to effect a considerable saving in power by the use of larger mills. which grind from 4 to 6 tons at one charge.

After this grinding the spar is ready for shipment either in bulk or in bags. The red spars from Bedford, N. Y., and Bedford, Ontario, have a faint pinkish tint when ground, but the cream-colored and white spars grind to a pure white.

In a few mills the ground spar is allowed to settle slowly in water, so as to separate the finer from the coarser material, but this method is now rarely employed. In certain mills where feldspar of the lower grades is ground for use in glass making in which very fine grinding is not required, the material as it comes from the chaser mills is sent, after the usual screening, to a vibration separator provided with a screen of the desired mesh. Only that portion which fails to pass through the separator screen is sent to the ball mills for further grinding.

Two hundred mesh to the inch is the figure usually given as the fineness required by pottery manufacturers, and it is probable that most of the material placed on the market comes within this limit. Microscopic examination by the writer of a No. 1 ground spar now on the market showed the coarsest particles to be only one two hundred and fiftieth of an inch in diameter, while the bulk of the material was under one one thousandth of an inch. In two other samples of ground commercial spar examined the largest particles were respectively one one hundred and forty-fifth and one two-hundredth of an inch in diameter, while the bulk of the material in both samples was under one five hundredth of an inch.

USES.

The principal consumers of feldspar are the pottery and enamel-brick manufacturers, its main application being as a constituent part of both body and glaze in true porcelain, white ware, and vitrified sanitary ware, and as a constituent of the slip (underglaze) and glaze in so-called "porcelain" sanitary wares and enameled brick. The proportion of feldspar in the body of these wares usually falls between 10 and 35 per cent, though sometimes less and sometimes more. Its melting point being lower than that of the other constituents, it serves as a flux to bind their particles together. A typical white-ware body used in one of the Pennsylvania potteries has approximately the following composition:

Composition of typical Pennsylvania white ware.

Quartz (flint)	35
Kaolin	35
Plastic or ball clay	16
Feldspar	14
	100

In glazes the percentage of feldspar usually lies between 30 and 50.

The trade demands that feldspar for pottery purposes be practically free from iron-bearing minerals (biotite, garnet, hornblende, tourmaline, etc.) and contain little if any muscovite. In regard to the percentage of free quartz, the requirements vary with different potters, being dependent largely on the nature and proportions of the other constituents of the ware. Some demand less than 5 per cent of free quartz, and may even grind the spar themselves so as to be sure of the quality of the material. Other potters get satisfactory results with spar carrying 15 to 20 per cent of free quartz, and it is certain that in some cases the percentage runs even higher. In the ground mixture as it comes from the mills it is very difficult to separate the quartz from the feldspar by physical methods, on account of the extreme fineness of the material. Chemical analysis seems to be the readiest means of determining whether its percentage is high or low.

Small quantities of feldspar are used in the manufacture of opalescent glass. The feldspar used for this purpose is ranked as No. 3 by the miners; it usually contains more free quartz and muscovite than that used for pottery purposes, and in most cases also contains fragments of iron-bearing minerals. The spars known to the writer which are used for opalescent glass are notably richer in soda than in potash. They are usually ground only to a fineness of 50 to 60 mesh.

Small quantities of carefully selected pure feldspar are used in the manufacture of artificial teeth, and some is used in the manufacture of scouring soaps and metal polishes slightly less abrasive than those in which ground quartz is used (see p. 6). One firm in New York State crushes pegmatite for poultry grit and for a covering for tarred surfaces, to give the appearance of granite.

Much interest has recently been aroused in the use of potash feldspar for fertilizing purposes. Potash is an important plant food, which, in fertilizers, has usually been applied in the form of wood ashes or of easily soluble potash salts (sulphate, carbonate, or chloride) imported from Germany.

The Department of Agriculture has recently conducted preliminary experiments to determine the availability of finely ground potash feldspar as a substitute for the more soluble potash salts. The following statement is quoted from the report on these tests:[a]

The evidence so far obtained appears to indicate that under certain conditions and with certain crops feldspar can be made useful if it is ground sufficiently fine. On the other hand, it is highly probably that under other conditions the addition of

[a] Cushman, Allerton S., The use of feldspathic rocks as fertilizers: Bull. No. 104, Bureau of Plant Industry, U. S. Dept. Agriculture, 1907, p. 31.

ground feldspar to the land would be a useless waste of money. At the present stage of the investigation it would be extremely unwise for anyone to attempt to use ground rock, except on an experimental scale that would not entail great financial loss.

If further experimentation shows that ground feldspar has a wide efficiency as a fertilizer it will undoubtedly lead to a utilization of many of the pegmatite deposits which, because of insufficient coarseness, too large a percentage of quartz, or too great an abundance of iron-bearing minerals, are not valuable as a source of pottery material. Deposits of this kind, favorably situated with respect to the railroads, are very numerous, especially in the vicinity of the active feldspar quarries. An equally important result will be the utilization of much of the material which is discarded at the present feldspar quarries.

PRICES.

Most dealers recognize three grades of commercial spar: No. 1, carefully selected, free from iron-bearing minerals, largely free from muscovite, and containing little or no free quartz, usually less than 5 per cent; No. 2, moderately free from iron-bearing minerals and muscovite, but often containing, when ground, from 10 to 20 per cent of free quartz; No. 3, not carefully selected, and usually containing somewhat higher percentages of free quartz, muscovite, and iron-bearing minerals. For Maine feldspar, nearly all of which may be ranked as No. 2, the prices of the crude material, free on board at the mines, range from about $2.75 to $3 per long ton, and the price of the ground product, free on board at the mills, usually lies between $8.50 and $9 per short ton. The prices in New York, Connecticut, Pennsylvania, and Maryland, so far as data are available, are given below. The variations are due in part to differences in the quality of the spar rated as No. 1, No. 2, or No. 3, but principally to differences in the distances of the mines and mills from the markets.

Prices of feldspar, free on board at mines or mills, in New York, Connecticut, Pennsylvania, and Maryland.

No. 1: Crude, per long ton, $3.60 to $6.00; ground, per short ton, $8.50 to $10.00.
No. 2: Crude, per long ton, $2.50 to $4.50; ground, per short ton, $6.50 to $8.50.
No. 3: Crude, per long ton, $1.70 to $2.50; ground, per short ton, $5.50 to $6.00.

Very pure, carefully selected potash feldspar for use in the manufacture of artificial teeth usually sells at from $6 to $8 per barrel of 350 pounds.

LOCALITIES.

MAINE.[a]

There are at the present time 7 active feldspar quarries in Maine, only 3 of which, however, are of any considerable size. All are situated in the southwestern part of the State, the most important localities being Georgetown and Topsham, in Sagadahoc County, and Auburn, in Androscoggin County. Recently a small quarry with favorable prospects has been opened at Hebron, in Oxford County. Most of the feldspar quarried in Topsham is ground at the mill of the Trenton Flint and Spar Company, at Cathance Station, Topsham,

[a] For a detailed description of the feldspar and quartz deposits of Maine, see Bull. U. S. Geol. Survey No. 315, 1907, pp. 383-393.

Me., while that produced in Auburn is ground at the mill of the Maine Feldspar Company, at Littlefield, in the same town. The feldspar quarried by Golding and Sons Company at Georgetown is carried up the Kennebec River on flatboats 9 miles to Bath, where it is transferred to railroad cars for shipment to the mills of this company at Trenton, N. J., and East Liverpool, Ohio.

Practically all of the spar mined in Maine is firm, buff-colored orthoclase-microcline. It is mostly free from iron-bearing minerals, though usually containing sufficient quartz to throw it into the class of No. 2 spar, much of the commercial material being a coarse graphic granite. In the past, considerably larger quantities of pure No. 1 spar have been obtained than are now mined, and at some of the present quarries the supply of material suitable for the pottery trade seems to be approaching exhaustion. In other quarries the supply seems to be sufficient for many years to come. It seems certain that further prospecting, especially in Oxford County, will reveal other valuable deposits.

NEW YORK.

The most important quarries producing feldspar for pottery manufacture in New York are located near Bedford village, and also 2 miles to the south in the town of Northcastle, in Westchester County.[a] They can be reached in a 6 to 8 mile drive from Mount Kisco, a station on the Harlem division of the New York Central Railroad, 38 miles north of New York City. The rocks of the region are a mica schist—the Hudson schist—and occasional masses of crystalline limestone—the Stockbridge dolomite. Both of these rocks have been shown to be of sedimentary origin, though extensively altered by metamorphic action. These rocks now lie in a series of closely compressed folds, whose general trend in the region here described is northeast and southwest.

In the vicinity of the feldspar and quartz quarries and along much of the road between Bedford village and Mount Kisco the Hudson schist has been injected by granite, pegmatite, and dark-colored basic igneous rocks, so as to show locally a gneissic or coarsely banded texture. Here and there, as along the road from Bedford village to the Hobby quarry in Northcastle, small masses of typical granite occur. There can be little doubt that the pegmatite deposits which are of commercial importance in this region are simply one phase of the granitic intrusion and injection of the Hudson schist and associated rocks.

The largest quarry in this region is operated by P. H. Kinkle's Sons and is situated on the eastern and northeastern slopes of a small hill about three-fourths of a mile southeast of Bedford village. The excavations consist of four open pits, three closely adjacent ones on the upper part of the hill slope and one at a lower level. All the pits are elongate in a northeast-southwest direction, which probably represents the trend of the pegmatite dikes. The lower pit exposes the downward and northeastward continuation of the same pegmatite mass revealed in the southernmost of the upper-level pits.

Most of the rock exposed in the central one of the upper pits is

[a] These deposits have been briefly described in Bulletin 102 of the New York State Museum, and the writer is indebted to this publication for a part of the material of this report. They are described in more detail by the present writer in Bull. U. S. Geol. Survey No. 315, 1907, pp. 394-399.

quartz, which is mainly white, but here and there assumes a very beautiful rose tint. Some black tourmaline occurs in single crystals or radiating crystal aggregates in the quartz, and there has been some coating of fracture planes in the quartz with thin layers of black tourmaline. The quartz seems to be associated with the feldspar in a wholly irregular manner. It forms most of the northwestern and southwestern walls of the pit, but is abundant only at the base of the southeastern wall, the upper parts of the wall being feldspathic. The feldspathic constituents of the pegmatite are best exposed in the other three pits, where they constitute a large proportion of the whole rock. The feldspar is of two principal varieties—a pink or flesh-colored feldspar and a white feldspar. When examined under the microscope the pink variety is shown to be orthoclase-microcline. The analyses of the pink spar (see No. 7 of the table, p. 9) all show small quantities of soda and lime, but no soda feldspar or lime-soda feldspars were observed associated with the microcline in the specimens examined. It is probable that part of the soda is chemically united with the potash in the orthoclase-microcline and that the feldspar is in reality a soda-microcline-orthoclase.

The pink feldspar, pure or in intergrowth with quartz, usually occurs in somewhat irregular but sharply bounded areas within the general pegmatite mass. In the southernmost of the upper quarries these constitute about one-half of the whole pegmatite mass. The larger masses are usually inclosed partly by pure quartz and partly by an irregular association, in varying proportions, of white quartz and white feldspar, with a little pink feldspar, biotite, black tourmaline, beryl, etc. The white feldspar is shown by microscopic examination to be largely the soda feldspar, albite, and it constitutes the second important feldspar variety characteristic of this quarry. The parts of the pegmatite characterized by its presence are seldom graphic granite, but usually show a very irregular texture and varying proportions of feldspar and quartz from point to point.

The mica of these quarries is mainly muscovite, which is usually associated with the feldspathic portions of the deposit. The mica "books" seldom exceed 4 to 5 inches in diameter and almost always show the A structure and much "ruling;" no "plate mica" was seen. Being mainly confined to rather definite bands in the pegmatite, most of the muscovite can be readily separated from the highly feldspathic portions.

Biotite (black mica) occurs in long, thin, lath-shaped crystals, some of which reach a length of several feet, though most are much smaller. Black tourmaline is associated mainly with the quartz, though occasionally present in the feldspathic parts of the pegmatite. Magnetite and garnet are seldom present.

Three grades of feldspathic material are obtained from these quarries. No. 1 is selected from the purer portions of the pink feldspar masses and will probably run considerably less than 5 per cent of free quartz. Analysis 7 of the table (p. 9) is of the nearly pure pink spar and may be assumed to represent quite closely the composition of the No. 1 spar which is placed on the market. All of this grade is shipped in bulk. The No. 2 feldspar produced at this quarry includes the coarser graphic intergrowths of pink feldspar and quartz, and also includes pegmatitic material rich in the white soda feldspar, albite. This grade is therefore higher in free quartz and in soda than is the No. 1. Both the No. 1 and No. 2 grades are used in the manufacture of pottery and must be very free from black mica, black tourmaline, garnet, and other iron-bearing minerals. The No. 2 spar is not shipped in the crude state, but is ground at the quarries. A No. 3 grade, made up mainly of the albite-quartz mixture with some of the finer grained pink graphic granite, is ground at Bedford for use in glass manufacture. It is somewhat higher in quartz and soda than the No. 2, and muscovite, biotite, and black tourmaline are not as carefully eliminated as in the No. 1 and No. 2 grades, these constituents not being as injurious in glass as in pottery manufacture.

The quartz of this quarry is all shipped in the crude state to the Bridgeport Wood Finishing Company at New Milford, Conn., where it is ground and used in the manufacture of a wood filler.

The grinding mill of Kinkle's Sons is located at the quarries and is similar in equipment to most feldspar mills elsewhere, except that the spar as it comes from the "chasers" goes to a vibration separator, only the tailings being sent to the ball mills. For pottery spar this separator is provided with a very fine-mesh screen, but in the preparation of spar for glass manufacture only a 60-mesh screen is required. The ground spar is shipped in bags. All of the material from this quarry and mill is hauled by team 5 miles to Bedford Station, on the New York Central Railroad.

A small quarry, owned by Mr. Albert Hobby, of Bedford, N. Y., and operated by Mr. Otto Buresch, has recently been opened in the town of Northcastle, near the west side of the Mianus River and about 1½ miles southeast of Kinkle's quarries. The quarry is situated on a steep eastern hill slope and is about 100 feet wide, 150 feet long, and 40 feet in maximum depth. No exposures of the surrounding rocks were observed near the quarry. The pegmatite shows masses of pure feldspar 8 to 10 feet across, associated with masses of pure quartz sometimes 15 feet across. The latter is in part white and in part a beautiful rose tint. There is almost no intergrowth of quartz and feldspar. The latter is buff colored and is shown by microscopic examination to be microcline (potash feldspar, sometimes containing a little soda). Its analysis is No. 8 of the table. Small and very thin plates of muscovite occur along some of the cleavage planes in the feldspar, but they are not abundant enough to materially affect the quality of the spar. Muscovite in larger plates is mainly segregated in somewhat irregular bands in association with black tourmaline in prismatic crystals sometimes 1½ inches in diameter.

The quarry differs from Kinkle's quarry in the fact that the feldspar is practically all buff-colored microcline, and also in the more complete separation of quartz and feldspar, graphic granite being apparently wholly absent. The present exposures cover only a small area and it is impossible to predict the extent or the uniformity of the deposit. The Mianus River is capable of furnishing ample water power for operating a grinding mill and the materials could be carried by gravity down the hill slope to the mill. The material must be hauled by teams 8 miles to Bedford Station, and it is very unfortunate that this property is located so far from transportation lines. Little material has as yet been marketed.

A feldspar quarry near Batchellerville, in Saratoga County, is now being opened by the Claspka Mining Company, of Trenton, N. J. Some feldspar was mined in 1906, but very little of this was placed on the market. The spar is orthoclase-microcline of a pearl-gray color, and is said to occur in crystals up to 6 feet across. Its analysis is No. 6 of the table.

A pegmatite mass near Ticonderoga is worked by the International Mineral Company, of New Haven, Conn. None of the material from this quarry is used in pottery manufacture, but all the materials of the pegmatite—feldspar, quartz, and mica—are crushed together and graded to various sizes. The smaller sizes are used for poultry grit, while the coarser grades are used as a covering for tarred surfaces, thus giving the appearance of granite.

CONNECTICUT.

Feldspar has been mined in Connecticut intermittently since about 1835 and the State is still one of the leading producers. The spar occurs in pegmatite dikes similar to those found in Maine and southern New York and is associated in an irregular manner with quartz, muscovite, biotite, black tourmaline, garnet, etc. The pegmatite is in the form of dike-like or irregular masses which have been intruded into the surrounding metamorphosed sedimentary rocks. They seem to be connected in origin with other granitic rocks of the region. The principal feldspar quarries now being operated are in the southern part of Hartford County and in Middlesex County. An important feldspar mill is located at South Glastonbury, Hartford County.

PENNSYLVANIA.[a]

Feldspar is extensively mined in Chester County, in the southeastern part of the State, and a small quantity is obtained in Delaware County. It occurs[b] as a constituent of pegmatite dikes of various degrees of coarseness, which were intruded in a molten condition into metamorphosed sedimentary rocks (crystalline limestone, quartzites, and mica schists) and into intrusive gabbro and serpentine. The great majority of the dikes trend northeast and southwest, parallel to the general trend of the surrounding rocks. The pegmatite constituents are, in most cases, similar to those characteristic of the pegmatites of other States and are without regular arrangement. Fine-grained graphic granite is sometimes present and is utilized commercially in pottery manufacture, though in Maine material of similar fineness is discarded.

The feldspar deposits worked by the Keystone Feldspar Company, the Brandywine Summit Kaolin and Feldspar Company, and the Sparvetta Mining Company, in the extreme southwestern part of Chester County, are entirely different in character from those of other States or of other parts of Pennsylvania. Like other feldspar deposits they form dike-like masses intruded in a molten condition into the surrounding sediments, which in many places show the effects of contact metamorphism. The feldspar, however, is nearly all of the soda variety, albite, and quartz is almost entirely absent. The principal iron-bearing mineral is not biotite or black tourmaline, as in most pegmatites, but is green hornblende, though garnet occasionally occurs. The texture also differs from that of most feldspar deposits, and in many places it is granitic rather than pegmatitic. As a rule, the feldspar crystals do not exceed an inch in diameter, and some portions of the rock

[a] Hopkins, T. C., Feldspars and kaolins of southeastern Pennsylvania: Jour. Franklin Inst., vol. 148, 1899, pp. 1-31.

[b] The writer is indebted to Miss Florence Bascom, of the United States Geological Survey, for much information in regard to these deposits.

are even finer grained. The largest feldspar crystals observed were 8 to 10 inches across, but these are of very rare occurrence. It is probable that the molten magma from which these deposits were derived was of a wholly different character (possibly dioritic or gabbroic) from the granitic magmas which were the source of most of the pegmatite deposits. The feldspar deposits of Pennsylvania are much decayed near the surface, and some of the quarries have in the past yielded kaolin, produced as a result of feldspar decomposition.

MARYLAND.[a]

The feldspar deposits which are now being worked are confined to Baltimore County and adjacent parts of Howard and Harford counties, and to Cecil County. The vicinity of Woodstock, in Howard County, and adjacent portion of Baltimore County is the principal producing center. The feldspar occurs in intrusive dikes similar in most ways to those of southeastern Pennsylvania. The crystalline rocks which they intrude are a continuation of the same belt which forms the country rock in the Pennsylvania feldspar region.[b] The feldspar belongs partly to the soda and partly to the potash varieties. None of it is ground within the State.

TEXAS.

A deposit of potash feldspar apparently of excellent quality is reported[c] to occur at Barranger Hill, in Llano County. The feldspar occurs as a constituent of a large pegmatite dike, which has been worked to some extent for its rare earth minerals. White quartz occurs in masses up to 40 feet in thickness and feldspar in masses up to 30 feet. Both of these constituents are remarkably free from other minerals. Almost the only iron-bearing mineral is biotite, which is found in plates reaching a breadth of 30 inches or more. So far as observed this mineral does not occur in small plates, and it is easily separated from the feldspar and quartz. The feldspar is of a brownish-rose, with some lighter-colored mottlings. Graphic granite occurs near the periphery of the dike, some of the masses being 5 or 6 feet across. Its texture is rather fine, the quartz blades being seldom over one-sixteenth of an inch in thickness. No attempt has been made to utilize the feldspar and quartz, and large quantities are now on the dumps and could be moved to the railroad at a comparatively small expense.

The occurrence of flints in the Cretaceous chalks over much of central Texas has been known for a long while, and recently deposits of kaolin, which are said to be of excellent quality, have been reported from Leakey, in Edwards County. The occurrence within a comparatively short distance of one another of all of these pottery materials should direct the attention of pottery manufacturers to this region.

MINNESOTA.

A considerable quantity of feldspar is quarried at Point Corundum, near Duluth, Minn., and ground at Duluth mainly for abrasive purposes and use in filters. None is used for pottery purposes. The

[a] For a brief description of the feldspar deposits of Cecil County see Maryland Geological Survey, Cecil County, 1902, pp. 96–97, 217.
[b] The writer visited the principal feldspar localities of Maryland and Pennsylvania in May, 1907, and the results of these field studies will be published in a later report.
[c] Oral communication from Mr. Frank L. Hess, United States Geological Survey.

rock is yellowish gray in color, and the samples examined by the writer are composed entirely of lime-soda feldspar in crystals from one-half to 1 inch in length. The composition seems to vary from labradorite to bytownite. Analysis 13 of the table (p. 9) shows the sample to have the composition of bytownite.

PRODUCTION.

The production of feldspar in 1906 amounted to 39,976 short tons of crude feldspar, valued at $132,643, and 32,680 short tons of ground feldspar, valued at $268,888, a total of 72,656 short tons, valued at $401,531. The production for the different States is given in the table below. To avoid revealing the figures of individual producers it was necessary in some cases to group the productions of two States. The ground material includes only that ground by the producers.

Production of feldspar in the United States in 1906, by States, in short tons.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Maine and Minnesota	2,589	$6,405	11,317	$103,853	13,906	$110,258
New York and Connecticut	22,554	74,036	7,500	50,500	30,054	124,536
Maryland	10,229	34,507	....	....	10,229	34,507
Pennsylvania	4,604	17,695	13,863	114,535	18,467	132,230
Total	39,976	132,643	32,680	268,888	72,656	401,531

The average value of the crude feldspar was $3.32 per short ton ($3.71 per long ton), free on board at the mines, and of the ground feldspar $8.23 per short ton, free on board at the mills.

The production of feldspar from 1902 to 1906 is given in the following table:

Production of feldspar, 1902–1906, in short tons.

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1906	39,976	132,643	32,680	268,888	72,656	401,531

The market conditions during 1906 in all the feldspar-producing districts were reported to be good. The use of the mineral is increasing, and the domestic supply is supplemented by large importations of spar from Ontario, Canada, which is ground at Trenton, Rochester, East Liverpool, and East St. Louis. The imports of feldspar are not reported separately by the Bureau of Statistics. The marked increase in the figures of production for 1906 over those for previous years is due principally to the more complete returns which have been received and also to the fact that feldspar used for abrasive purposes and for imitation stonework, etc., is included in the list. It is probable, however, that there was also an actual increase in the quantity produced.

SELENIUM.

By Frank L. Hess.

Selenium is one of the rare and little-known elements, closely related in many ways to tellurium and sulphur, with both of which it often occurs in nature.

Recently selenium has obtained some prominence from its use in various forms of electrical apparatus, which make use of its peculiar property of being almost a nonconductor of electricity in the dark, while under the influence of light its conductivity immediately becomes immensely increased. This characteristic has led to its use in instruments designed to light and extinguish gas buoys automatically; for guiding and exploding torpedoes by a ray of light; for telephoning along a ray of light; for transmitting sounds and photographs or other pictures to a distance by means of a telephone or telegraph wire; and for measuring the quantity of Roentgen rays in therapeutic applications. Should any of these instruments become of general or practical use, there will be more or less demand for selenium.

At present it is variously quoted from $13.33 per kilogram (2.2046 pounds) to $2 per ounce, as there is no steady market and prices vary with different dealers.

No selenium is known to be produced commercially in this country, but during 1906 one copper refinery made some in an experimental way, and it is possible that it was produced at other refineries also. In the case mentioned the selenium was obtained from the anode slimes or mud, where it is left with gold, silver, and other residues in the electrolytic refining of copper.

The occurrence of minerals containing selenium is rare in the United States, but a demand for it could probably be supplied by utilization of the small quantities found in the copper-refinery slimes.

TALC AND SOAPSTONE.[a]

By Arthur J. Collier.

OCCURRENCE.

Talc and soapstone are found in nearly all the Atlantic slope States, and in many of them the deposits are so favorably located as regards transportation and markets as to make their development profitable. During the year 1906 such quarries were operated in Georgia, North Carolina, Virginia, Maryland, Pennsylvania, New York, New Jersey, Rhode Island, Massachusetts, and Vermont. New York, which formerly enjoyed the distinction of being the largest producer of talc in the United States, was in 1906 succeeded by Virginia, whose product represents about 41 per cent of the total value.

Deposits of talc and soapstone also occur in several of the Western States, but the conditions as regards transportation and markets are not favorable enough at the present time to justify development, since the industries in which they would be used have not yet been established.

Small quantities of talc were quarried in California and Washington during 1904 and 1905, but no production was reported from either State in 1906.

The product of the quarries varies from pure foliated talc to harder steatite or soapstone. For use in the arts, it is either powdered or sawed into slabs or manufactured into various articles. The powdered or flour talc is used in the manufacture of a great variety of articles, such as fireproof paints, electric insulators, covering for steam pipes, foundry facings, dynamite, paper, toilet powder, leather lubricators, and soap. The soapstone, not powdered, is used in the manufacture of hearthstones, furnace linings, laboratory tables, laundry tubs, ovens, foot warmers, and many other articles of everyday use. Some of the purer varieties are manufactured into pencils and gas tips, the talc suitable for this purpose bringing a higher price than any other produced in this country.

PRODUCTION.

The total production of talc and soapstone during 1906 amounted to 120,644 short tons, valued at $1,431,556, an increase of 24,010 tons in quantity and $349,494 in value as compared with the production in 1905. This increase is distributed over nearly all the States of the Atlantic slope, North Carolina alone showing a decreased production.

Nearly all the talc and soapstone quarries are operated or controlled by the manufacturers, and only a small part of the output is

[a] The tables in this report were prepared by Mrs. H. L. Bennit of this office.

sold in the crude state. The talc and soapstone production is classified in the following four groups: Rough or crude, sawed into slabs, manufactured articles, and ground. The crude product, represented in the first group, is usually sold to factories and is probably again included in the estimates of manufactured articles represented in the other three groups. The relative quantities and values of these varieties from 1903 to 1906, inclusive, are shown in the following table:

Production of talc and soapstone in the United States, according to varieties, 1903–1906.

Condition in which marketed.	1903.			1904.		
	Quantity (short tons).	Value.	Average value per ton.	Quantity (short tons).	Value.	Average value per ton.
Rough	2,908	$23,704	$8.15	1,815	$9,270	$5.11
Sawed into slabs	2,027	33,800	16.67	3,850	64,276	16.70
Manufactured articles [a]	12,219	274,978	22.50	11,990	283,373	23.63
Ground [b]	69,747	507,578	7.28	73,534	583,812	7.94
Total [c]	86,901	840,060	9.67	91,189	940,731	10.32

Condition in which marketed.	1905.			1906.		
	Quantity (short tons).	Value.	Average value per ton.	Quantity (short tons).	Value.	Average value per ton.
Rough	1,625	$10,483	$6.45	15,211	$40,337	$2.65
Sawed into slabs	4,779	80,879	16.92	4,980	83,563	16.78
Manufactured articles [a]	14,665	403,660	27.53	23,575	631,342	26.78
Ground [b]	75,565	587,040	7.77	76,878	676,314	8.80
Total [c]	96,634	1,082,062	11.20	120,644	1,431,556	11.87

[a] Includes bath and laundry tubs; fire brick for stoves, heaters, etc.; hearthstones, mantels, sinks, griddles, slate pencils, tailor's pencils, gas tips, burner blanks, crayons, and numerous other articles for everyday use.
[b] For foundry facings, paper making, lubricators for dressing skins and leather, etc.
[c] Exclusive of the quantity used for pigment, which is included among mineral paints.

The total production of talc and soapstone in the various States during 1905 and 1906 is shown in the following table. In some cases where the whole production of a State is by one or two operators, it has been necessary under the usage of the United States Geological Survey to include its production with that of some other State or States.

Production of talc and soapstone, 1905, 1906, by States, in short tons.

State.	1905.		1906.	
	Quantity.	Value.	Quantity.	Value.
Maryland	(a)	(a)	2,956	$23,310
New Jersey and Pennsylvania	5,796	$38,241	13,981	52,961
New York	56,500	445,000	61,672	557,200
North Carolina	4,035	74,690	4,009	66,729
Vermont	8,978	65,525	10,413	101,057
Virginia	17,665	425,090	23,624	590,800
Other States [b]	3,660	33,516	3,989	39,499
Total	96,634	1,082,062	120,644	1,431,556

[a] Included in "Other States."
[b] California, Georgia, Maryland, Massachusetts, and Washington in 1905; Georgia, Massachusetts, and Rhode Island in 1906.

PRODUCTION IN NEW YORK.

The talc produced in New York, which is nearly all of the fibrous variety, is ground and used principally in the manufacture of paper. The production in the years from 1903 to 1906, inclusive, are given in the following table:

Production of fibrous talc in New York in 1903–1906, in short tons.

Use.	1903.		1904.		1905.		1906.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Paper filling, Paint, Wall plasters	60,230	$421,600	64,005	$507,400	56,500	$445,000	61,672	$557,200

TOTAL PRODUCTION.

The quantity and value of talc and soapstone products in New York, as compared with the total from all the other States during the years from 1880 to 1906, inclusive, are given in the following table:

Production of talc and soapstone in the United States, 1880–1906, in 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
1906	61,672	557,200	58,972	874,356	120,644	1,431,556

IMPORTS.

The imports of talc into the United States have never been large, though the prices obtained are usually somewhat higher than for the American product. The imports since 1901 are shown in the following table:

Talc imported into the United States, 1901–1906.

1901	short tons	2,386	$27,015	1904	short tons	3,268	$36,370
1902	do	2,859	35,366	1905	do	4,000	48,225
1903	do	1,791	19,677	1906	do	5,643	67,818

CANADIAN PRODUCTION.

There has been a small production of talc in Canada for several years, but the tonnage and values have been exceedingly variable.

In 1906 the talc produced amounted to 1,234 short tons, which is more than twice the quantity produced in 1905. The production of talc in Canada from 1902 to 1906, as reported by the Canadian Geological Survey, are given in the following table:

Production of talc in Canada, 1902–1906.

1902	short tons	689	$1,804	1905	short tons	500	$1,800
1903	do	688	2,064	1906	do	1,234	3,030
1904	do	840	1,875				

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