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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1912

PART II—NONMETALS

WASHINGTON
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MINERAL RESOURCES OF THE UNITED STATES FOR 1912—PART II.

COAL.

By Edward W. Parker.

INTRODUCTION.

GENERAL STATEMENT.

The present report begins the fourth decade in which the statistics of coal production have been published annually by the United States Geological Survey, the first report, which was published in 1883, covering the calendar year 1882. In the three years that the census statistics were collected, 1889, 1900, and 1909, the work was carried on jointly by the United States Geological Survey and the Bureau of the Census under cooperative arrangements. In 1882, the first year covered by this series, the total coal production of the United States was 103,551,189 short tons. In 1912, the year covered by the present report, the production of bituminous coal alone in the State of Pennsylvania exceeded that figure by nearly 60 per cent, and the combined production of bituminous coal and anthracite in Pennsylvania in 1912 was about 2¼ times the total production of the United States in 1882. West Virginia produced in 1912 a tonnage equivalent to more than 60 per cent of the total output 30 years earlier, and Illinois fell only a little short of that percentage. The total coal production of the United States in 1912 was 5.2 times that of 1882. In 1882 the United States was a poor second among the coal-producing countries of the world, Great Britain having at that time an output exceeding that of this country by nearly 70 per cent. The United States supplanted Great Britain as the premier coal-producing country in 1899, and in 1912 exceeded its former superior by a larger percentage than Great Britain exceeded the United States in 1882. The United States at the present time is contributing 40 per cent of the world's supply of coal and is consuming over 96 per cent of its own production.

Aside from the marked increase in production over the preceding year, which increase was general throughout the country except in the anthracite region of Pennsylvania, the principal feature of the coal-mining industry in 1912 was a general advance in values, every coal-producing State of any importance but two (New Mexico and Utah) showing a gain in value larger in proportion than the increase in tonnage.

Mining in the anthracite region of Pennsylvania was suspended for a period of about six weeks, beginning April 1, pending the adjustment of the wage scale. This created a shortage of about 10,000,000 long tons in the possible production and resulted in an actual decrease of 5,448,633 long tons, when compared with the preceding year. As the year under review is an "even" year, the usual suspensions, until agreements were made, occurred in the organized States, but the periods of idleness were not of long duration and did not affect the production for the year. Except in certain local districts, notably the Paint Creek and Cabin Creek districts of West Virginia, in the latter part of the year, there were no serious disorders because of labor troubles in the bituminous fields.

The report for 1910 contained sectional maps of the coal fields of the United States, with brief descriptions prepared by geologists of the Survey. Copies of that report are still available and can be secured free of charge upon application to the Director of the United States Geological Survey. A special feature of the chapters on coal production in 1911 and 1912 is a statement in each of the extent to which shooting off the solid is practiced in the bituminous coal mines of the several States, from which statement some instructive conclusions may be drawn. The more frequently that practice is condemned by writers and speakers and the more widely it is prohibited by law and by company rules, the better it will be for the industry and for the safety of the miners.

ACKNOWLEDGMENTS.

The statistics of coal production, as of other branches of the mining industry, are compiled from direct returns by the operators. They could not be secured in the completeness in which they are presented without the hearty good will and cooperation of the corporations, firms, and individuals engaged in the industry, and the author desires to reiterate and emphasize his appreciation of the assistance received from these sources. Acknowledgments are also due to the State geological surveys of Alabama, Georgia, Iowa, Kansas, Kentucky, Maryland, Oregon, Pennsylvania, Virginia, and Washington for efficient cooperation in the collection of coal-mining statistics in those States, and to the secretaries of boards of trade or other local authorities for contributions on the coal trade of some of the principal cites. Recognition of these contributions is also given in connection with their contributions under the caption "Coal trade review." Not the least of the writer's acknowledgments are due to his faithful and efficient clerical and stenographic assistants in the United States Geological Survey.

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. Hence, when the production of Pennsylvania anthracite is considered, the long ton is used. 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 where any statement of quantity is made in the text.

SUMMARY OF STATISTICS IN 1912.

Total production in 1912, 534,466,580 short tons; spot value, $695,606,071.

Pennsylvania anthracite.—Total production in 1912, 75,322,855 long tons (equivalent to 84,361,598 short tons); spot value, $177,622,626.

Bituminous coal and lignite.—Total production in 1912, 450,104,982 short tons; spot value, $517,983,445.

Increase and decrease.—In 1912 the production of coal in the United States not only surpassed all previous tonnage records, but the average value per ton exceeded that of any normal year in the 33 years for which statistics are available. In fact, with respect to the latter, there has been only one year in which coal prices generally were higher than in 1912. This was in 1903 when, because of the fuel famine produced by labor troubles in the anthracite region of Pennsylvania and in the organized bituminous States, prices were advanced above any figures reached in recent history. The higher values in 1903 were notably exhibited in the bituminous regions, anthracite companies as a rule holding to the circulars, which maintained the prices of the previous year plus the increased cost due to the advance in wages and the reduced working time granted in the strike settlement. The average value per ton for anthracite in 1912 was higher than in 1903, and was again due to further advances in wages.

The total production of coal in the United States increased from 496,371,126 short tons, valued at $626,565,211, in 1911 to 534,466,580 short tons, valued at $695,606,071, in 1912. The gain in quantity was 38,095,454 short tons, or 7.67 per cent, and the increase in value was $69,040,860, or 11.02 per cent. All of the increase in tonnage, but not in value, was in the production of bituminous coal. The output of anthracite in Pennsylvania decreased from 80,771,488 long tons (90,464,067 short tons) to 75,322,855 long tons (84,361,598 short tons), a loss of 5,448,633 long tons (6,102,469 short tons), or 6.75 per cent, but the value increased from $175,189,392 to $177,622,626, a gain of $2,433,234, or 1.39 per cent. The production of bituminous coal increased from 405,907,059 short tons to 450,104,982 tons, a gain of 44,197,923 tons, or 10.89 per cent, with an increase of $66,607,626, or 14.76 per cent, in value—from $451,375,819 in 1911 to $517,983,445 in 1912.

The decreased production of anthracite was due entirely to the suspension in April and May, when practically the entire region was idle. Except for that idleness, the output of anthracite would have amounted to about 85,000,000 long tons, or over 4,000,000 tons more than that of 1911, the year of maximum production. The factors which contributed to the increased output of bituminous coal were (1) the revival in the iron and steel industry, which stimulated production in the Eastern States, the coal made into coke showing, alone, an increase of nearly 6,000,000 tons; (2) bumper crops of grain and other agricultural products which gave prosperity to the farming communities of the Middle West; (3) decreasing supplies of natural gas and fuel oil in the Mid-Continent field, which have removed that competition from coal in the Southwestern States; (4) increased consumption by railroads and in nearly all lines of manufacturing; (5) activity in the mining and smelting of the precious and semiprecious metals in the Rocky Mountain and Pacific States. These, combined, made the year 1912 one of the rather rare fat years in bituminous coal mining. The only drawbacks to an otherwise almost entirely satisfactory record were inadequate transportation facilities and a shortage of miners and mine laborers. There were fewer men employed in the bituminous mines in 1912 than in 1911, notwithstanding the considerable increase in tonnage. In some places the labor shortage was attributed to the migration of miners on account of the Balkan War, in others to the demand for labor in more attractive and less exacting lines of employment; and some operators complain that advances in wages have resulted in a falling off in the "intensity of labor," averring that the mine workers are more inclined to the acquirement of a certain total in earnings with fewer hours of labor than to the improvement of their condition by increased incomes.

As in 1911, coal was produced commercially in 30 States and the District of Alaska in 1912. A small quantity of "Rhode Island anthracite" was produced in that State in both years, but the output can not be published without disclosing confidential information, and as it was mined principally in the effort to redevelop the old mines at Portsmouth, it is not included in the commercial production. Another item not included in 1912 is about 900 tons of coal mined in Alaska under the direction of the United States Bureau of Mines for testing purposes. The production in California, Idaho, Nevada, and North Carolina, and the commercial output in Alaska, aggregated a little over 14,000 tons, two-thirds of which was in California. One other State, Oregon, produced less than 50,000 tons. Of the 27 States, including California and Oregon, in which coal mining may be considered to be conducted on a commercial basis, there were 22 in which the output of 1912 showed an increase over 1911, and in all but two of the important States the increase in value was greater than the increase in tonnage. These two exceptions were public-land States, New Mexico and Utah. Five States which showed decreased production recorded an increase in value, namely, Arkansas, California, Iowa, North Dakota, and Oregon, and in the only two States, Michigan and Washington, where both output and value decreased, the percentage of decrease in value was less than the percentage of decrease in tonnage.

In 1911 the principal decrease in production was in the States producing coking coal, Pennsylvania and West Virginia showing the largest losses, and these two States showed the largest gains in 1912. The decrease in anthracite production has already been referred to. In the production of bituminous coal Pennsylvania, in 1912, showed an increase of 17,304,231 short tons or 11,343,962 tons more than the decrease shown in 1911 and consequently an excess by that figure of the previous maximum tonnage of 1910. West Virginia's increase in 1912 was 6,955,107 tons, overcoming the decrease in 1911 by more than 5,000,000 tons. Illinois increased its production in both years, the gain in 1912 being 6,206,108 tons, which added to the increase in 1911, shows a gain in two years of nearly 14,000,000 tons. The other noteworthy gains in 1912 were in Ohio (3,768,741 tons), Kentucky (2,440,818 tons), Indiana (1,084,363 tons), Alabama (1,079,179 tons), Virginia (981,971 tons), Colorado (820,441 tons), and Kansas (807,454 tons).

Men employed.—As previously stated, notwithstanding the increase of more than 10 per cent in the production of bituminous coal, there were fewer men employed in those mines in 1912 than in 1911, the statistics presented in this report bearing out the complaints of shortage of labor in that branch of the coal-mining industry. Conditions were reversed in the anthracite region of Pennsylvania where production decreased and the number of employees increased somewhat more than the decrease among the bituminous miners. The total number of men employed in the coal mines of the United States in 1912 was 722,662, against 722,360 in 1911. The anthracite mines gave employment to 174,030 men, an increase from 172,585 in 1911, and the bituminous mines employed 548,632 men, a decrease from 549,775 in 1911. Owing to the suspensions in the spring of 1912, however, the working time in the anthracite mines decreased to 231 days, from 246 days in 1911, while in the bituminous mines the average working time increased from 211 days to 223 days. The conditions in the anthracite region provide steadier employment for the miners throughout the year than obtain in the bituminous fields. In 1901 the anthracite operators adopted the policy of allowing discounts on coal sold during the spring and summer months, the idea being to encourage consumers to lay in their winter supplies at a time when transportation is not hampered by unfavorable weather and when otherwise a large number of men would be idle. The effect of this has been to give much steadier employment through the year and to prevent to a large extent congestion of orders and traffic in the fall and winter months. The fluctuations in the number of days worked from year to year in the anthracite region since the discount policy was put into effect have been due principally to suspensions pending adjustments of wage agreements. Anthracite, being almost entirely a domestic fuel, is not affected to the same extent as bituminous coal by trade conditions. The effect of the suspension in the spring of 1912 on the men employed in the anthracite region is shown in the decreased output by each employee, from 524 short tons in 1911 to 484.8 tons in 1912. The average production per man per day decreased from 2.13 to 2.1 tons. The average production per man in the bituminous mines, on the other hand, increased from 738 tons in 1911 to 820 tons in 1912, with a gain in the daily production per man from 3.5 tons to 3.68 tons. These averages for the bituminous workers in 1912 were the highest ever made. The average production per man in the anthracite region for the year 1912 was lower than the average of the preceding five years and the lowest daily average since 1896.

Mining machines.—The tonnage per employee in the bituminous mines has shown a markedly increasing tendency during the last 20 years, which can only be attributed to the equally marked increase in the use of labor-saving machinery, which has had its chief expression in the development of mechanical means for mining the coal. In fact, the great tonnage records made by the bituminous mines in recent years could not have been attained with the supply of labor available except by the use of machinery. The quantity of bituminous coal mined by machines in 1912 was 210,538,822 short tons, or 46.8 per cent of the total, against 178,158,236 tons, or 43.9 per cent in 1911. In evidence of the extent to which machine mining has progressed during the last 20 years it is necessary only to cite that in 1902 the quantity of coal mined by machines was 69,611,582 tons and in 1892 it was less than 10,000,000 tons.

The prevailing types of machines are punchers, chain-breast, longwall, and short-wall machines for relatively flat-lying beds, and radially actuated punching machines for beds of steeper inclination. The first and the last types, as the names imply, cut the coal by a chopping action; in the other three the action is that of sawing. A machine recently brought out combined both actions. The total number of machines reported in use in 1912 was 15,298, against 13,829 in 1911. The average production by each machine was 13,763 tons in 1912, and 12,854 in 1911.

The practice of "shooting off the solid," that is, of blasting down the coal without previously mining it, either by hand or machine—of "making the powder do the work," is still indulged in to a reprehensible degree in several States, particularly those of the Mississippi Valley, and in some it has been encouraged by legislation enacted supposedly for the benefit of the miners. It is a practice generally condemned by authorities on the subject as dangerous to the mine workers, injurious to the mines and the product, and essentially anticonservational. The report for 1911 contained the first published statement of the quantity of coal produced in this way, 69,054,500 short tons, of which 60 per cent was in the States of the Mississippi Valley. In 1912 the "powder-mined" coal amounted to 76,241,575 tons, of which 61.5 per cent were produced in the Mississippi Valley States.

Labor troubles.—The second 3-year extension of the awards of the Anthracite Coal Strike Commission terminated March 31, 1912, with the determination on the part of the miners to suspend work until certain modifications in the agreements were made. In consequence mining in the anthracite region was practically at a standstill from April 1 to May 15, and it was nearly the first of June before the mines were in full operation. For convenient reference the awards of the Anthracite Commission and the modifications which have since been made are given in the section devoted to anthracite in this report. When mining was resumed in May, 1912, an additional advance of 10 per cent in wages had been granted. In those bituminous districts in which the miners are organized and the operations are conducted under agreements with the mine workers' union, the compacts have heretofore been extended from April 1 to March 31 of the "even" years. As 1912 was one of the even years, there was a general suspension of operations in the bituminous mines of the Middle West where the organization is strongest. The suspensions were not, however, of extended length, and the improved trade conditions seemed to warrant the operators in granting the demand for increased wages, which was approximately 5½ per cent over those paid in 1910 and 1911. That the relatively brief idleness in the bituminous regions did not affect production is evinced by the fact that the bituminous output increased nearly 11 per cent and the mines were operated 5 per cent more days in 1912 than in 1911. In the anthracite region, on the other hand, production decreased 6¾ per cent and the net loss in working time was 15 days. In the anthracite region there were 151,958 men idle for an average of 45 days, the idle time being equivalent to 17 per cent of the total time during which the mines and the breakers were in operation. In the bituminous districts the total number of men idle was 159,098 and the average time lost by each man was 35 days. The anthracite miners made up about two-thirds of the actual time lost, and the bituminous workers more than made up for all of the idleness due to labor troubles. In the anthracite region, and with one exception in the bituminous fields, there was practically no disorder nor bloodshed. The only exception was in the Paint and Cabin Creek mines of the Kanawha district of West Virginia where for more than a year a condition bordering on warfare prevailed. During part of the time martial law was in effect in that district, and the trouble has been made the subject of State and Federal investigation.

Accidents.—Statistics compiled by the United States Bureau of Mines show that there was a marked decrease in the number of fatal accidents in the coal mines of the United States in 1912 when compared with both 1911 and 1910, the number of fatalities having declined from 2,840 in 1910 to 2,719 in 1911, and to 2,360 in 1912. Of the fatal accidents which occurred in 1912, 584 were in the anthracite mines of Pennsylvania, and 1,776 in the bituminous and lignite mines of the country. As usual, the most prolific cause of death was falls of roof and coal, the deaths from that cause numbering 1,151, or 48.77 per cent of the total in 1912. In 1911 the deaths due to falls of roof and coal were 48.6 per cent of the total. There was a notable decrease in the number of fatalities due to explosions of gas and dust—from 371 in 1911 to 301 in 1912, the latter being 12.8 per cent of the total. The most serious explosion of gas in 1912 was in Oklahoma, where 73 men were killed in one disaster, and West Virginia recorded the largest number of men killed (81) by explosions of dust. The deaths due to haulage-way accidents in 1912 numbered 362, against 393 in 1911. Premature blasts and powder explosions killed 134 in 1911 and 133 in 1912. The death rate per 1,000 employees in the anthracite region was 3.35; in the bituminous regions it was 3.24; and for the entire country it was 3.28. In 1911 the death rate per 1,000 was 3.76 and in 1910 it was 3.92. The quantity of anthracite mined for each life lost in 1912 was 144,455 short tons (128,978 long tons), against 127,414 short tons (113,762.5 long tons) in 1911; and the quantity of bituminous coal mined for each fatality in 1912 was 253,437 short tons, against 202,044 tons in 1911. The total of anthracite and bituminous coal mined for each life lost in 1912 was 226,469 short tons, against 182,556.5 tons in 1911.

Washed coal.—The production of anthracite in Pennsylvania includes an appreciable quantity of usable fuel recovered from the old culm banks by washeries, and the unsightly monuments to the wasteful methods of early times are disappearing from the landscape in the anthracite region. The quantity of coal recovered in the 23 years since the first washery was constructed (in 1890) has amounted to about 55,000,000 long tons, considerably more than the total production of anthracite at the beginning of the period. In 1912 the washery product amounted to 4,165,288 long tons. In addition to the coal recovered from the culm banks, 85,722 long tons in 1912, and 94,647 long tons in 1911, were recovered from the bottom of Susquehanna River by dredges.

In the bituminous regions the principal use of washeries is to improve the quality of the slack coal used in the manufacture of coke by reducing the ash and sulphur, although considerable quantities, particularly in Illinois, are washed in the preparation of sized coal for household use. The quantity of bituminous coal washed at the mines in 1912 was 19,844,517 short tons. The washeries yielded 17,538,572 tons of cleaned coal and 2,305,945 tons of refuse.

Consumption.—Practically the entire output of both anthracite and bituminous coal in the United States is consumed within the country. The effort on the part of some of the operators in the Eastern States to build up an export trade has resulted in a considerable expansion of business along this line of some importance in itself but of comparative insignificance when considered with the total production. The total quantity of coal exported in 1912 was 20,326,619 short tons, or 3.8 per cent of the production. The consumption of coal of domestic production—that is, the total production less the quantity exported—of 1912 was 514,139,961 short tons. The imports amounted in 1912 to 1,800,448 short tons, which, added to the consumption of domestic coal, made the total consumption in that year 515,940,409 short tons, which is equivalent to 96.5 per cent of the domestic production. In this statement no account is taken of the stock on hand at the beginning and the end of the year. The coal-mining industry is at best of a hand-to-mouth character, and stocks do not figure in the trade.

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 this 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.

The statistics of coal production presented in 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 item 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 statements 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 1912 was 47,958,332 short tons, against 42,029,769 short tons in 1911, an increase of 5,928,563 short tons, or 14.1 per cent, as compared with an increase of 10.89 per cent in the total production of bituminous coal, and of 7.67 per cent in the increase of anthracite and bituminous coal combined. The coal shipped to market, used in the manufacture of coke, and sold locally, amounted in 1912 to 514,318,429 short tons, as compared with 476,825,954 tons in 1911. This is usually considered the marketable product. The colliery consumption, which represents the difference between the marketable product and the total output, amounted in 1912 to 20,148,151 short tons. The colliery consumption in the anthracite region, consisting almost entirely of culm or waste material, averages something over 10 per cent of the total anthracite production. In 1912, out of a total output of 75,322,855 long tons, 7,979,696 long tons were used at the mines for steam and heat. The colliery consumption in the bituminous regions amounts to about 2.5 per cent of the total output, and in 1912 was 11,210,891 short tons out of a total production of 450,104,982 tons.

PRODUCTION.

STATISTICS FOR 1911 AND 1912.

The statistics of the production of coal in the United States in 1911 and 1912, by States, with the distribution of the product for consumption, are shown in the tables following.

Coal production of the United States in 1911, by States, in short tons.

State.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
Alabama	11,135,563	141,191	615,335	3,129,332	15,021,421	$19,079,949	$1.27	227	22,707
Arkansas	1,996,803	16,560	93,426		2,106,789	3,396,849	1.61	133	5,657
California and Alaska	4,981	5,986	680		11,647	23,297	2.00	265	60
Colorado	8,104,712	303,473	324,947	1,424,251	10,157,383	14,747,764	1.45	207	14,316
Georgia and North Carolina	86,161	1,007	5,485	72,677	165,330	246,448	1.49	277	514
Idaho and Nevada		1,791	30		1,821	4,872	2.68	228	13
Illinois	49,163,827	2,806,197	1,623,319	85,775	53,679,118	59,519,478	1.11	188	76,600
Indiana	13,134,954	657,978	408,423		14,201,355	15,326,808	1.08	182	21,182
Iowa	6,594,899	532,519	204,230		7,331,648	12,663,507	1.73	203	16,599
Kansas	5,872,417	131,299	174,437	575	6,178,728	9,473,572	1.53	190	11,357
Kentucky	12,988,064	614,937	331,204	115,498	14,049,703	14,008,458	.99	201	21,921
Maryland	4,547,600	72,050	66,145		4,685,795	5,197,066	1.11	243	5,881
Michigan	1,347,144	70,127	58,803		1,476,074	2,791,461	1.89	218	3,323
Missouri	3,290,119	467,641	78,347		3,836,107	6,603,066	1.72	182	10,259
Montana	2,739,529	80,985	155,844		2,976,358	5,342,168	1.79	220	3,866
New Mexico	2,308,462	27,264	45,324	767,108	3,148,158	4,525,925	1.44	230	4,007
North Dakota	359,075	130,655	12,898		502,628	720,489	1.43	229	640
Ohio	28,114,734	1,961,939	682,777	536	30,759,986	31,810,123	1.03	179	46,035
Oklahoma	2,840,002	47,274	186,966		3,074,242	6,291,494	2.05	156	8,790
Oregon	22,407	10,216	14,038		46,661	108,033	2.32	179	189
Pennsylvania, bituminous	107,055,318	3,612,732	3,261,068	30,632,139	144,561,257	146,154,952	1.01	233	168,199
Tennessee	5,751,404	97,643	122,146	461,963	6,433,156	7,209,734	1.12	232	10,703
Texas	1,877,901	56,912	39,780		1,974,593	3,273,288	1.66	226	5,353
Utah	2,004,892	27,797	98,790	381,696	2,513,175	4,248,666	1.69	236	3,060
Virginia	5,230,894	82,349	181,660	1,369,764	6,864,667	6,254,804	.91	261	7,392
Washington	3,230,991	155,932	138,140	47,752	3,572,815	8,174,170	2.29	225	6,498
West Virginia	54,171,423	1,045,547	1,073,907	3,540,703	59,831,580	53,670,515	.90	221	66,730
Wyoming	6,386,936	83,932	273,996		6,744,864	10,508,863	1.56	230	7,924
Total bituminous	340,361,212	13,243,933	10,272,145	42,029,769	405,907,059	451,375,819	1.11	211	549,775
Pennsylvania anthracite	78,894,589	2,296,451	9,273,027		90,464,067	175,189,392	1.94	246	172,585
Grand total	419,255,801	15,540,384	19,545,172	42,029,769	496,371,126	626,565,211	1.26	220	722,360

Coal production of the United States in 1912, by States, in short tons.

State.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
Alabama	13,372,521	147,586	664,019	1,916,474	16,100,600	$20,829,252	$1.29	245	22,613
Arkansas	1,996,822	15,111	88,886		2,100,819	3,582,789	1.71	157	4,536
California and Alaska	3,748	3,960	3,625		11,333	26,441	2.33	184	52
Colorado	9,527,149	331,570	352,551	766,554	10,977,824	16,345,336	1.49	227	13,000
Georgia and North Carolina	108,135	1,504	6,141	111,923	227,703	338,926	1.49	254	450
Idaho and Nevada	500	2,414	50		2,964	9,313	3.14	253	20
Illinois	55,304,530	2,793,861	1,786,835		59,885,226	70,294,338	1.17	194	78,098
Indiana	14,179,686	704,229	401,803		15,285,718	17,480,546	1.14	182	21,651
Iowa	6,519,307	590,206	180,016		7,289,529	13,152,088	1.80	188	16,370
Kansas	6,662,834	129,978	192,595	775	6,986,182	11,324,130	1.62	202	11,646
Kentucky	15,159,515	632,629	438,378	259,999	16,490,521	16,854,207	1.02	201	24,304
Maryland	4,836,391	61,507	66,140		4,964,038	5,839,079	1.18	259	6,162
Michigan	1,080,319	62,411	63,500		1,206,230	2,399,451	1.99	183	3,113
Missouri	3,808,332	432,051	99,473		4,339,856	7,633,864	1.76	206	9,704
Montana	2,818,503	82,052	147,940		3,048,495	5,558,195	1.82	220	3,440
New Mexico	2,620,932	25,300	51,328	839,264	3,536,824	5,037,051	1.42	274	3,928
North Dakota	354,895	132,951	11,634		499,480	765,105	1.53	232	622
Ohio	31,710,928	2,197,368	610,566	9,865	34,528,727	37,083,363	1.07	201	45,527
Oklahoma	3,415,958	74,059	185,401		3,675,418	7,867,331	2.14	174	8,785
Oregon	14,361	19,646	7,630		41,637	108,276	2.60	239	222
Pennsylvania, bituminous	116,477,708	3,850,895	3,657,367	37,879,518	161,865,488	169,370,497	1.05	252	165,144
Tennessee	5,802,779	85,654	137,382	447,413	6,473,228	7,379,903	1.14	234	10,309
Texas	2,084,254	41,760	62,598		2,188,612	3,655,744	1.67	230	5,127
Utah	2,528,513	36,509	106,401	344,726	3,016,149	5,046,451	1.67	285	3,328
Virginia	6,027,712	107,657	182,870	1,528,399	7,846,638	7,518,576	.96	251	8,678
Washington	3,041,277	80,295	162,619	76,741	3,360,932	8,042,871	2.39	226	5,519
West Virginia	60,549,194	1,209,142	1,251,670	3,776,681	66,786,687	62,792,234	.94	266	68,248
Wyoming	6,993,263	83,388	291,473		7,368,124	11,648,088	1.58	238	8,036
Total bituminous	377,000,066	13,935,693	11,210,891	47,958,332	450,104,982	517,983,445	1.15	223	548,632
Pennsylvania anthracite	73,056,766	2,367,572	8,937,260		84,361,598	177,622,626	2.11	231	174,030
Grand total	450,056,832	16,303,265	20,148,151	47,958,332	534,466,580	695,606,071	1.30	225	722,662

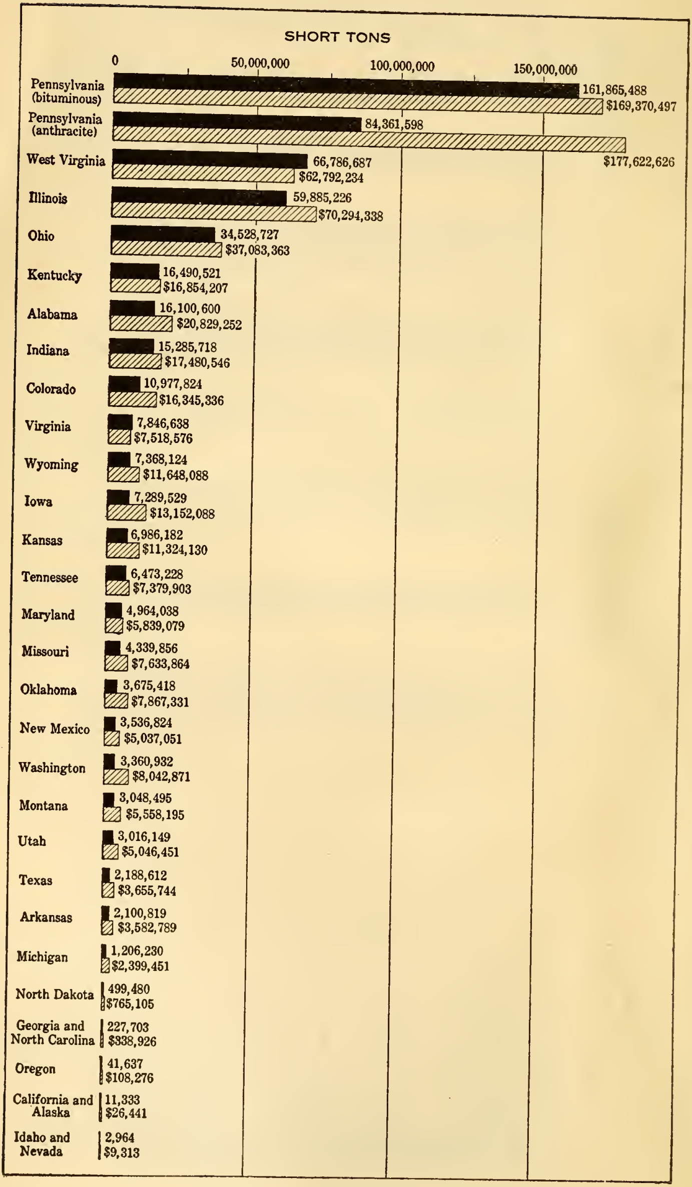

FIGURE 1.—Production of coal in the United States in 1912, by States.

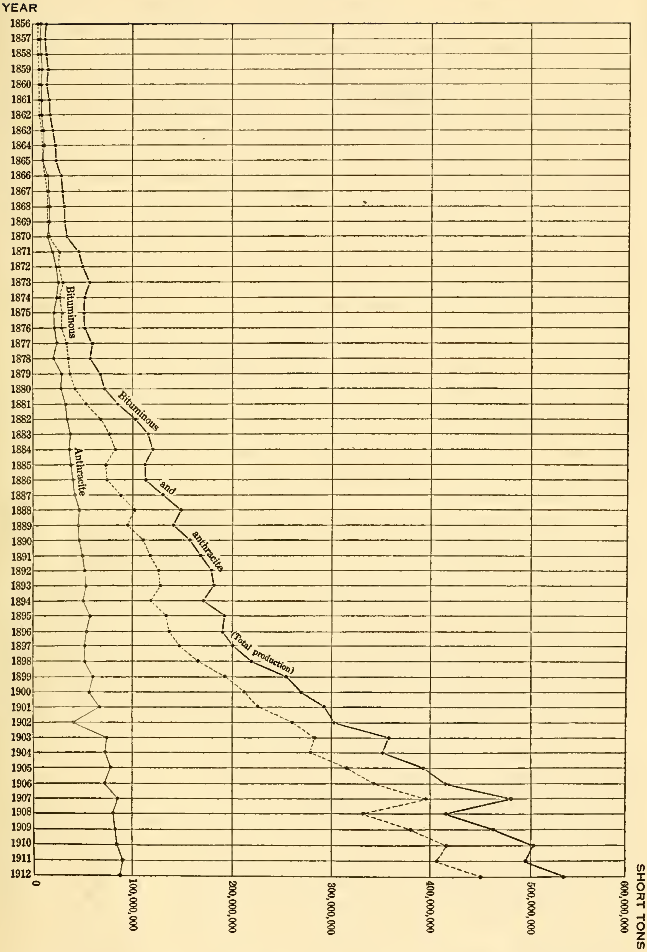

FIGURE 2.—Yearly production of anthracite and bituminous coal from 1856 to 1912, in short tons.

The elimination of Pennsylvania anthracite as a manufacturing fuel, to which reference has already been made, has made increased production of that fuel dependent upon the increase in population in the regions served by it and upon the variations in temperature. It is, of course, subject to fluctuations due to labor troubles (as indicated on the accompanying diagram (fig. 2) in the production in 1902), but is not affected to anywhere near the same extent as is bituminous coal by trade conditions. The increase in the production of anthracite has been fairly regular, while the increase in bituminous coal production, particularly in the last 25 years, with the development of the United States as a manufacturing country, has been by leaps and bounds. The influence of the business depression of 1908 is shown on the diagram by a marked decrease in the production of bituminous coal, while anthracite was scarcely affected. The maximum production of anthracite was reached in 1911 with a total of 80,771,488 long tons, or 90,464,067 short tons. Prior to 1911 the maximum production was that of 1907, when 76,432,421 long tons, or 85,604,312 short tons, were produced. The production of anthracite in 1911 exceeded that of 1891, 20 years before, by nearly 80 per cent, and was almost three times that of 1881. The rate of increase in the anthracite region has compared favorably with that of the total production of coal in Great Britain. Coal production in Germany has increased more rapidly than anthracite production in Pennsylvania, but at a considerably slower rate than the production of bituminous coal in the United States. The rate of increase in France has been about the same as in Great Britain and of anthracite in Pennsylvania.

It is the opinion of many familiar with conditions in the anthracite region that the maximum output has about been reached. Others are of the opinion that a total of 100,000,000 tons, or even more, will be attained before the inevitable period of practical constancy and then decline begins. In 1911 the anthracite mines were worked more days (246) than at any previous time in their history. The 231 days made in 1912 was the nearest approach to the record of 1911. That an annual production of 100,000,000 long tons in the anthracite region is physically possible is evinced by the fact that the daily outturn in 1911 was 328,339 tons. In 1912 it was 326,073 tons. At the rate of production in 1911, had the mines worked full 300 days in the year, their production would have amounted (in round numbers) to 98,500,000 tons. At the rate of production in 1912, had the mines worked the full 300 days, the output would have amounted to approximately 97,822,000 long tons. By the same process of deduction the capacity of the bituminous mines of the United States was 577,000,000 short tons in 1911 and a little over 600,000,000 tons in 1912. It can be considered, therefore, that the annual capacity of the coal mines of the United States at the present time is slightly more than 700,000,000 short tons, or about 30 per cent over and above the actual output in 1912.

Comparisons of the anthracite production in the United States with that of foreign countries has already been made, and it may be well to call attention to the great strides in the output of bituminous coal in the United States, compared with which the increases in foreign countries pale into insignificance. In 1912 the production of bituminous coal alone in the United States exceeded that of Great Britain by 145,586,055 short tons, or over 47.7 per cent. It exceeded that of Germany by over 164,130,243 tons, or 57.3 per cent. The production of bituminous coal in the United States in 1912 was equal to nearly one-third of the total world's output. During the last quarter of a century the increase in the production of bituminous coal has been particularly marked. In 1887 the output was a little more than twice that of anthracite. In 1892, five years later, it was almost two and one-half times as much. A comparison with 1902 would be unfair, for the reason that the anthracite output in that year was less than two-thirds of normal and the bituminous production was more than six times that of anthracite. In 1901, however, the output of bituminous coal was three and one-third times that of anthracite and in 1912 it was five and one-third times as much.

The accompanying diagram (fig. 2) illustrates the comparative growth in the production of anthracite and bituminous coal from 1856 to 1912. Prior to 1870 the larger portion of the production was in Pennsylvania anthracite, but since 1870 the output of bituminous coal has rapidly outstripped that of anthracite. In 1869 the production of Pennsylvania anthracite was 17,083,134 short tons and the production of bituminous coal was 15,821,226 tons. In the census year of 1870 these figures were nearly reversed, and at the following census of 1880 the production of anthracite amounted to 28,649,812 short tons and that of bituminous to 42,831,758 short tons. In 1890 the production of anthracite had grown to 46,468,641 short tons, whereas the bituminous production amounted to 111,302,322 short tons. In the next 10 years the production of anthracite increased 23.5 per cent and amounted to 57,367,915 short tons, and the bituminous production increased 91 per cent, to 212,316,112 short tons. The statistics for 1911 show that the output of anthracite amounted to 90,464,067 short tons, an increase over 1900 of 33,096,152 short tons, or 57.7 per cent. The production of bituminous coal increased 193,440,989 tons, or 91.1 per cent. The production of anthracite coal in 1912 was nearly three times that of 1880 and the production of bituminous was more than ten times that of 1880.

In the table following the production of anthracite and bituminous coal in the United States is given for each five years from 1880 to 1910 and in 1911 and 1912, in both long and short tons.

Production of coal in the United States each five years from 1880 to 1910 and in 1911–12.

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
1885	34,228,548	38,335,974	76,671,948	65,021,715	72,824,321	82,347,648
1890	41,489,858	46,468,641	66,383,772	99,377,073	111,302,322	110,420,801
1895	51,785,122	57,999,337	82,019,272	120,641,244	135,118,193	115,779,771
1900	51,221,353	57,367,915	85,757,851	189,567,957	212,316,112	220,930,313
1905	69,339,152	77,659,850	141,879,000	281,306,058	315,062,785	334,658,294
1910	75,433,246	84,485,236	160,275,302	372,420,663	417,111,142	469,281,719
1911	80,771,488	90,464,067	175,189,392	362,417,017	405,907,059	451,375,819
1912	75,322,855	84,361,598	177,622,626	401,879,448	450,104,982	517,983,445

Year.	Total.		
	Quantity.		Value.
	Long tons.	*Short tons.*	
1880	63,822,830	71,481,570	$100,640,396
1885	99,250,263	111,160,295	159,019,596
1890	140,866,931	157,770,963	176,804,573
1895	172,426,366	193,117,530	197,799,043
1900	240,789,310	269,684,027	306,688,164
1905	350,645,210	392,722,635	476,537,294
1910	447,853,909	501,596,378	629,557,021
1911	443,188,505	496,371,126	626,565,211
1912	477,202,303	534,466,580	695,606,071

Anthracite was at one time an important factor in blast-furnace practice, but its use in that line of industry has now almost entirely ceased, having been supplanted by coke made from bituminous coal. The principal demand for anthracite will be in the future, as it has been in the more recent past, restricted largely to domestic trade, for which such sizes as furnace, egg, stove, and chestnut are required. The breaking down of the lump coal, which was formerly a marketable product, for the preparation of the domestic sizes results in a much larger proportion of the small or undesirable sizes, all of which are sold at less than the cost of production. As shown in the subsequent pages of this report, the percentage of these small sizes has increased from 23.1 per cent in 1890 to 41.9 per cent in 1909, since which year, however, owing to a decline in the recovery from the culm banks, the percentage of the smaller sizes has slowly declined from 41.5 in 1910 to 40.8 in 1911, and 39.4 in 1912. All of the profits in the anthracite trade must be obtained from the prepared sizes as the revenue derived from the smaller sizes which are sold in competition with bituminous coal for steaming purposes serves only to reduce the cost of the domestic coal. In the recent reports of this series attention has been called to the gradually enhancing cost in the production of anthracite and to the close control which is exercised over its production and sale. In the report for 1911 it was stated that no hope could be held out to the consumer that anthracite would be sold in the future at prices lower than those then prevailing; but, on the other hand, there was every reason to believe that prices would advance in accordance with the increasing cost of production. In the section on anthracite it is shown that the margin between the cost and the selling price of anthracite, prior to the advance in wages granted in 1912, was 13 cents per long ton. This margin must provide not only for extraordinary expenses, such as result from accident, etc., but also must provide for selling expenses, amortization, depreciation, interest on capital invested or borrowed, and the profits on the mining operations.

As shown in the following table, there were only two States, Michigan and Washington, where the production in 1912 was materially less than in 1911, and in both the loss in value was smaller proportionately than the decrease in tonnage. The production in Michigan showed a decrease of 269,844 short tons, or 18.28 per cent, in quantity and of $392,010, or 14.04 per cent, in value. The smaller production in 1912 is ascribed to competition with West Virginia, whose output has increased with such rapidity, and also to the small demand for lump coal in Michigan, largely a manufacturing State. Every modern manufacturing plant which is being built, or rebuilt, is equipped with stokers, all of which creates a great demand for slack coal and a correspondingly decreased demand for lump. At the present time the coal fields of Michigan depend almost exclusively upon the domestic trade for lump orders, which, of course, lessens the demand in summer, when the shrinkage in output occurs. During the winter months the demand for lump coal is greater than the supply. The relatively smaller loss in value appears to be attributable to the fact that only the better grade of Michigan coal could meet the competition of the Pennsylvania coals, and the decreased production was in coal of inferior quality and consequently lower value. The decreased production in Washington was due entirely to the growing use of petroleum by railroads, steamboats, and manufactories. Decreased consumption of coal for steam raising, and a relatively larger consumption for domestic purposes, are responsible for the higher value per ton in 1912 compared with 1911. The production in Washington decreased 211,883 tons, or 5.93 per cent, in quantity, and $131,299, or 1.61 per cent, in value. Every State in the Appalachian province showed increased production in 1912, and in all but one the increased production was accompanied by an advance in price, so that the gains in value were, with the one exception, in larger proportion than the increases in production. The output of anthracite in Pennsylvania decreased 6,102,469 short tons, but this was considerably more than offset by an increase of 17,304,231 tons in the production of bituminous coal in the State, and the total coal production of Pennsylvania showed a net gain of 11,201,762 short tons. Two of the Mississippi Valley States, Arkansas and Iowa, showed small decreases in 1912. The only decrease among the States in the Rocky Mountain and Great Plains province was in the lignite production of North Dakota. The decrease was negligible (3,148 short tons), and the value showed a gain of $44,616. Next to Pennsylvania, the State which showed the largest gains in 1912 was West Virginia, with an increase of 6,955,107 tons, followed closely by Illinois, with a gain of 6,206,108 tons. Ohio came next with an increase of 3,768,741 tons, followed in order by Kentucky, with 2,440,818 tons; Indiana, 1,084,363 tons; and Alabama, 1,079,179 tons.

The total production and value in the last five years, by States, with the increase and decrease in 1912, as compared with 1911, are shown in the table following.

Quantity and value of coal produced in the United States, 1908–1912, in short tons.

State.	1908		1909	
	Quantity.	Value.	Quantity.	Value.
Alabama	11,604,593	$14,647,891	13,703,450	$16,306,236
Arkansas	2,078,357	3,499,470	2,377,157	3,523,139
California and Alaska	21,862	69,650	48,636	107,342
Colorado	9,634,973	13,586,988	10,716,936	14,296,012
Georgia and North Carolina	264,822	364,279	a 211,196	a 298,792
Idaho	5,429	21,832	4,553	19,459
Illinois	47,659,690	49,978,247	50,904,990	53,522,014
Indiana	12,314,890	13,084,297	14,834,259	15,154,681
Indian Territory (Oklahoma)	2,948,116	5,976,504	3,119,377	6,253,367
Iowa	7,161,310	11,706,402	7,757,762	12,793,628
Kansas	6,245,508	9,292,222	6,986,478	10,083,384
Kentucky	10,246,553	10,317,162	10,697,384	10,079,917
Maryland	4,377,093	5,116,753	4,023,241	4,471,731
Massachusetts	50	150	....	....
Michigan	1,835,019	3,322,904	1,784,692	3,199,351
Missouri	3,317,315	5,444,907	3,756,530	6,183,626
Montana	1,920,190	3,771,248	2,553,940	5,036,942
New Mexico	2,467,937	3,368,753	2,801,128	3,619,744
North Dakota	320,742	522,116	422,047	645,142
Ohio	26,270,639	27,897,704	27,939,641	27,789,010
Oregon	86,259	236,021	87,276	235,085
Pennsylvania, bituminous	117,179,527	118,816,303	137,966,791	130,085,237
Tennessee	6,199,171	7,118,499	6,358,645	6,920,564
Texas	1,895,377	3,419,481	1,824,440	3,141,945
Utah	1,846,792	3,119,338	2,266,899	3,751,810
Virginia	4,259,042	3,868,524	4,752,217	4,251,056
Washington	3,024,943	6,690,412	3,602,263	9,158,999
West Virginia	41,897,843	40,009,054	51,849,220	44,661,716
Wyoming	5,489,902	8,868,157	6,393,109	9,896,848
Total bituminous	332,573,944	374,135,268	379,744,257	405,486,777
Pennsylvania anthracite	83,268,754	158,178,849	81,070,359	149,181,587
Grand total	415,842,698	532,314,117	460,814,616	554,668,364

State.	1910		1911	
	Quantity.	Value.	Quantity.	Value.
Alabama	16,111,462	$20,236,853	15,021,421	$19,079,949
Arkansas	1,905,958	2,979,213	2,106,789	3,396,849
California and Alaska	12,164	33,336	11,647	23,297
Colorado	11,973,736	17,026,934	10,157,383	14,747,764
Georgia and North Carolina	a 177,245	a 259,122	165,330	246,448
Idaho	4,448	17,426	b 1,821	b 4,872
Illinois	45,900,246	52,405,897	53,679,118	59,519,478
Indiana	18,389,815	20,813,659	14,201,355	15,326,808
Iowa	7,928,120	13,903,913	7,331,648	12,663,507
Kansas	4,921,451	7,914,709	6,178,728	9,473,572
Kentucky	14,623,319	14,405,887	14,049,703	14,008,458
Maryland	5,217,125	5,835,058	4,685,795	5,197,066
Michigan	1,534,967	2,930,771	1,476,074	2,791,461
Missouri	2,982,433	5,328,285	3,836,107	6,603,066
Montana	2,920,970	5,329,322	2,976,358	5,342,168
New Mexico	3,508,321	4,877,151	3,148,158	4,525,925
North Dakota	399,041	595,139	502,628	720,489
Ohio	34,209,668	35,932,288	30,759,986	31,810,123
Oklahoma	2,646,226	5,867,947	3,074,242	6,291,494
Oregon	67,533	235,229	46,661	108,033
Pennsylvania, bituminous	150,521,526	153,029,510	144,561,257	146,154,952
Tennessee	7,121,380	7,925,350	6,433,156	7,209,734
Texas	1,892,176	3,160,965	1,974,593	3,273,288
Utah	2,517,809	4,224,556	2,513,175	4,248,666
Virginia	6,507,997	5,877,486	6,864,667	6,254,804
Washington	3,911,899	9,764,465	3,572,815	8,174,170
West Virginia	61,671,019	56,665,061	59,831,580	53,670,515
Wyoming	7,533,088	11,706,187	6,744,864	10,508,863
Total bituminous	417,111,142	469,281,719	405,907,059	451,375,819
Pennsylvania anthracite	84,485,236	160,275,302	90,464,067	175,189,392
Grand total	501,596,378	629,557,021	496,371,126	626,565,211

a Georgia only. b Includes production of Nevada.

Quantity and value of coal produced in the United States, 1908–1912, in short tons—Con.

State.	1912		Increase (+) or decrease (−), 1912.		Percentage of increase or decrease, 1912.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	16,100,600	$20,829,252	+ 1,079,179	+$1,749,303	+ 7.18	+$9.17
Arkansas	2,100,819	3,582,789	− 5,970	+ 185,940	− 0.28	+ 5.47
California and Alaska	11,333	26,441	− 314	+ 3,144	− 2.70	+13.50
Colorado	10,977,824	16,345,336	+ 820,441	+ 1,597,572	+ 8.08	+10.83
Georgia and North Carolina	227,703	338,926	+ 62,373	+ 92,478	+37.73	+37.52
Idaho and Nevada	2,964	9,313	+ 1,143	+ 4,441	+62.77	+91.15
Illinois	59,885,226	70,294,338	+ 6,206,108	+10,774,860	+11.56	+18.10
Indiana	15,285,718	17,480,546	+ 1,084,363	+ 2,153,738	+ 7.64	+14.05
Iowa	7,289,529	13,152,088	− 42,119	+ 488,581	− 0.57	+ 3.86
Kansas	6,986,182	11,324,130	+ 807,454	+ 1,850,558	+13.07	+19.53
Kentucky	16,490,521	16,854,207	+ 2,440,818	+ 2,845,749	+17.37	+20.31
Maryland	4,964,038	5,839,079	+ 278,243	+ 642,013	+ 5.94	+12.35
Michigan	1,206,230	2,399,451	− 269,844	− 392,010	−18.28	−14.04
Missouri	4,339,856	7,633,864	+ 503,749	+ 1,030,798	+13.13	+15.61
Montana	3,048,495	5,558,195	+ 72,137	+ 216,027	+ 2.42	+ 4.04
New Mexico	3,536,824	5,037,051	+ 388,666	+ 511,126	+12.35	+11.29
North Dakota	499,480	765,105	− 3,148	+ 44,616	− 0.63	+ 6.19
Ohio	34,528,727	37,083,363	+ 3,768,741	+ 5,273,240	+12.25	+16.58
Oklahoma	3,675,418	7,867,331	+ 601,176	+ 1,575,837	+19.56	+25.05
Oregon	41,637	108,276	− 5,024	+ 243	−10.77	+ 0.22
Pennsylvania, bituminous	161,865,488	169,370,497	+17,304,231	+23,215,545	+11.97	+15.88
Tennessee	6,473,228	7,379,903	+ 40,072	+ 170,169	+ 0.62	+ 2.36
Texas	2,188,612	3,655,744	+ 214,019	+ 382,456	+10.84	+11.68
Utah	3,016,149	5,046,451	+ 502,974	+ 797,785	+20.01	+18.78
Virginia	7,846,638	7,518,576	+ 981,971	+ 1,263,772	+14.30	+20.20
Washington	3,360,932	8,042,871	− 211,883	− 131,299	− 5.93	− 1.61
West Virginia	66,786,687	62,792,234	+ 6,955,107	+ 9,121,719	+11.62	+17.00
Wyoming	7,368,124	11,648,088	+ 623,260	+ 1,139,225	+ 9.24	+10.84
Total bituminous	450,104,982	517,983,445	+44,197,923	+66,607,626	+10.89	+14.76
Pennsylvania anthracite	84,361,598	177,622,626	− 6,102,469	+ 2,433,234	− 6.75	+ 1.39
Grand total	534,466,580	695,606,071	+38,095,454	+69,040,860	+ 7.67	+11.02

PRODUCTION OF COAL IN THE UNITED STATES FROM THE EARLIEST TIMES TO THE CLOSE OF 1912.

So far as known, the first mention of the occurrence of coal in the United States is made in the journal of Father Hennepin, a French missionary, who, in 1679, recorded the site of a "cole" mine on Illinois River, near the present city of Ottawa, Ill. The first actual mining of coal was in the Richmond Basin, Va , about 70 years after Father Hennepin's discovery in Illinois, but the first records of production from the Virginia mines were for the year 1822, when, according to one authority, 54,000 tons were mined. Ohio probably ranks second in priority of production, as coal was discovered there in 1755, but the records of production date back only to 1838. The mining of anthracite in Pennsylvania began in the last half of the eighteenth century and interesting legends and anecdotes are extant regarding the attempts to introduce the new fuel. Anthracite was discovered in the Wyoming Valley in 1762 by settlers from Connecticut. The first use of it, so far as known, was made in 1768. It was first used in a forge in 1769. Mining may be said to have begun near Pittston in 1775, and from 1776 to 1780 anthracite was mined on the banks of Susquehanna River near Wilkes-Barre and shipped by barges to Carlisle and Columbia. Anthracite was used in making nails in 1788. All of these incidents occurred in the Wyoming region, the discovery of coal in that region having antedated the discovery in the Schuylkill region by 28 years. Credit for the first shipments of coal from the anthracite region is usually given to the Lehigh region, but the discovery of coal in that region was not made until 1791, and the first anthracite coal company, the Lehigh Coal Mining Co. (now the Lehigh Coal & Navigation Co.) was organized in 1792. The shipments from the Lehigh region began in 1820 and have continued regularly since that date, but 13 years prior to 1820 a shipment of 55 tons of coal had been made by Abijah Smith & Co., from Plymouth (in the Wyoming Valley) to Columbia. In 1814, six years before the Lehigh region was opened, some coal was mined at Carbondale and shipped via the Lackawaxen & Delaware Canal to Philadelphia. In 1820, when the Lehigh region was opened, it was estimated that about 12,000 tons of coal had been shipped from the Wyoming Valley, although, according to the records of the bureau of anthracite statistics, the regular shipments from the Wyoming region did not begin until 1829. Seven years before that the Schuylkill region had been opened. In addition to having the credit for the priority of discovery and the mining of anthracite, the Wyoming region, although the latest of the three large regions to report regular shipments of coal, has contributed considerably more than half of the total quantity of coal sent out of the anthracite fields of Pennsylvania. According to the reports of the bureau of anthracite statistics the total quantity of anthracite shipped, up to the close of 1912, was approximately 1,883,000,000 long tons, of which something over 996,000,000 tons had been sent out from the Wyoming region. The following table shows the total production of anthracite in Pennsylvania, in short tons, since 1814, the total production of bituminous coal since 1820, and the total annual production up to the close of 1912. During the period covered by the table the total production of anthracite in Pennsylvania has amounted to 2,355,160,335 short tons; the country's production of bituminous coal to 6,919,028,630 short tons; and the aggregate production, to 9,274,188,965 short tons. Of the grand total the anthracite mines of Pennsylvania have contributed more than 25 per cent, and all of the bituminous mines of the country a little less than 75 per cent. As the annual production of bituminous coal is, however, more than five times that of anthracite, the percentage of the latter production to the total is decreasing each year and will be less than 25 per cent in 1913. The annual production of coal in each State from the time of earliest record until the close of 1912 is given in connection with the discussion of production in the several States.

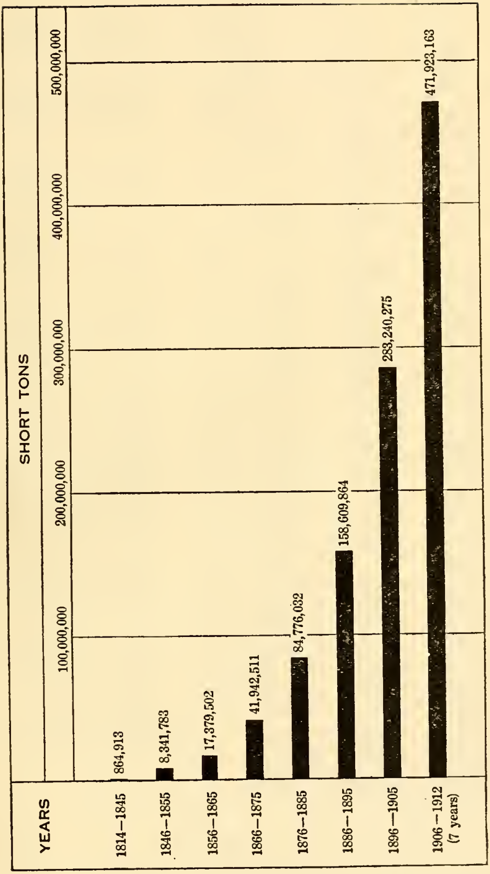

FIGURE 3.—Average yearly production of coal in the United States for each decade since 1814, in short tons.

Production of coal in the United States from 1814 to the close of 1912, in short tons.

Year.	Pennsylvania anthracite.	Bituminous.	Total.
1814	22	....	22
1815	50	....	50
1816	75	....	75
1817	100	....	100
1818	200	....	200
1819	350	....	350
1820	450	3,000	3,450
1821	1,322	....	1,322
1822	4,583	54,000	58,583
1823	8,563	60,000	68,563
1824	13,685	67,040	80,725
1825	42,988	75,000	117,988
1826	59,194	88,720	147,914
1827	78,151	94,000	172,151
1828	95,560	100,408	195,908
1829	138,086	102,000	240,086
1830	215,272	104,800	320,072
1831	217,842	120,100	337,942
1832	447,550	146,500	594,050
1833	600,907	133,750	734,657
1834	464,015	136,500	600,515
1835	690,854	134,000	824,854
1836	842,832	142,000	984,832
1837	1,071,151	182,500	1,253,651
1838	910,075	445,452	1,355,527
1839	1,008,322	552,038	1,560,360
1840	967,108	1,102,931	2,070,039
1841	1,182,441	1,108,700	2,291,141
1842	1,365,563	1,244,494	2,610,057
1843	1,556,753	1,504,121	3,060,874
1844	2,009,207	1,672,045	3,681,252
1845	2,480,032	1,829,872	4,309,904
1846	2,887,815	1,977,707	4,865,522
1847	3,551,005	1,735,062	5,286,067
1848	3,805,942	1,968,032	5,773,974
1849	3,995,334	2,453,497	6,448,831
1850	4,138,164	2,880,017	7,018,181
1851	5,481,065	3,253,460	8,734,525
1852	6,151,957	3,664,707	9,816,664
1853	6,400,426	4,169,862	10,570,288
1854	7,394,875	4,582,227	11,977,102
1855	8,141,754	4,784,919	12,926 673
1856	8,534,779	5,012,146	13,546,925
1857	8,186,567	5,153,622	13,340,189
1858	8,426,102	5,548,376	13,974,478
1859	9,619,771	6,013,404	15,633,175
1860	8,115,842	6,494,200	14,610,042
1861	9,799,654	6,688,358	16,488,012
1862	9,695,110	7,790,725	17,485,835
1863	11,785,320	9,533,742	21,319,062
1864	12,538,649	11,066,474	23,605,123
1865	11,891,746	11,900,427	23,792,173
1866	15,651,183	13,352,400	29,003,583
1867	16,002,109	14,722,313	30,724,422
1868	17,003,405	15,858,555	32,861,960
1869	17,083,134	15,821,226	32,904,360
1870	15,664,275	17,371,305	33,035,580
1871	19,342,057	27,543,023	46,885,080
1872	24,233,166	27,220,233	51,453,399
1873	26,152,837	31,449,643	57,602,480
1874	24,818,790	27,787,130	52,605,920
1875	22,485,766	29,862,554	52,348,320
1876	22,793,245	30,486,755	53,280,000
1877	25,660,316	34,841,444	60,501,760
1878	21,689,682	36,245,918	57,935,600
1879	30,207,793	37,898,006	68,105,799
1880	28,649,812	42,831,758	71,481,570
1881	31,920,018	53,961,012	85,881,030
1882	35,121,256	68,429,933	103,551,189
1883	38,456,845	77,250,680	115,707,525
1884	37,156,847	82,998,704	120,155,551
1885	38,335,974	72,824,321	111,160,295
1886	39,035,446	74,644,981	113,680,427
1887	42,088,197	88,562,314	130,650,511
1888	46,619,564	102,040,093	148,659,657
1889	45,546,970	95,682,543	141,229,513
1890	46,468,641	111,302,322	157,770,963
1891	50,665,431	117,901,238	168,566,669
1892	52,472,504	126,856,567	179,329,071
1893	53,967,543	128,385,231	182,352,774
1894	51,921,121	118,820,405	170,741,526
1895	57,999,337	135,118,193	193,117,530
1896	54,346,081	137,640,276	191,986,357
1897	52,611,680	147,617,519	200,229,199
1898	53,382,644	166,593,623	219,976,267
1899	60,418,005	193,323,187	253,741,192
1900	57,367,915	212,316,112	269,684,027
1901	67,471,667	225,828,149	293,299,816
1902	41,373,595	260,216,844	301,590,439
1903	74,607,068	282,749,348	357,356,416
1904	73,156,709	278,659,689	351,816,398
1905	77,659,850	315,062,785	392,722,635
1906	71,282,411	342,874,867	414,157,278
1907	85,604,312	394,759,112	480,363,424
1908	83,268,754	332,573,944	415,842,698
1909	81,070,359	379,744,257	460,814,616
1910	84,485,236	417,111,142	501,596,378
1911	90,464,067	405,907,059	496,371,126
1912	84,361,598	450,104,982	534,466,580
	2,355,160,335	6,919,028,630	9,274,188,965

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 meant. These fields are included in the counties of Susquehanna, Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, Northumberland, Dauphin, and Sullivan, and underlie an area of about 480 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. A small quantity of coal was produced at Portsmouth, R. I., in 1911 and 1912, as the result of efforts to rehabilitate the industry at that place. The production, however, is not included in the commercial output.

The bituminous and lignite fields are scattered widely over the United States and include an area of something over 496,000 square miles. The previous classification of these coal areas published in earlier volumes of the report Mineral Resources of the United States has been changed as a result of conferences among the geologists working under Marius R. Campbell on the economic geology of coal. The areas are divided, primarily, into six provinces, as follows:

(1) The eastern province, which includes all of the bituminous areas of the Appalachian region; the Atlantic coast region, which includes the Triassic fields near Richmond and the Deep River and Dan River fields of North Carolina, and also the anthracite region of Pennsylvania. (2) The Gulf province, which includes the lignite fields of Alabama, Mississippi, Louisiana, Arkansas, and Texas. (3) The interior province, which includes all the bituminous areas of the Mississippi Valley region and the coal fields of Michigan. This province is subdivided into the eastern region, which embraces the coal fields of Illinois, Indiana, and western Kentucky; the western region, which includes the fields of Iowa, Missouri, Nebraska, Kansas, Arkansas, and Oklahoma; and the southwestern region, which includes the coal fields of Texas. The Michigan fields are designated as the northern region of the interior province. (4) The northern or Great Plains province, which includes the lignite areas of North Dakota and South Dakota, and the bituminous and subbituminous areas of northeastern Wyoming and of northern and eastern Montana. (5) The Rocky Mountain province, which includes the coal fields of the portions of Montana and Wyoming which are in the mountainous districts of those States, and all the coal fields of Utah, Colorado, and New Mexico. (6) The Pacific coast province, which includes all of the coal fields of California, Oregon, and Washington.

The report on the production of coal in 1910 contains brief descriptions of the coal fields of the several States and maps of the known coal areas. The report for 1907 contains a map of the coal fields of the United States on a smaller scale. Copies of both of these reports are still available and may be obtained free of charge upon application to the Director of the United States Geological Survey, Washington, D. C. The earlier report contains a statement showing the character and geologic age of the different coals and the estimated tonnage of the various fields. The estimates of tonnage since the publication of that report have been slightly revised by M. R. Campbell, of the Survey, from more recently collated data. The estimates, as now published, are subject to further revision as the result of the Survey's work in the classification of the coal fields in the public land States. The later revision is not available for publication at the time this report goes to press.

The known coal areas of the United States embrace a total area of 310,296 square miles, to which may be added something over 160,000 square miles of which little is known but which may contain workable coals, and about 32,000 square miles where the coal lies under heavy cover and is not considered available under present conditions. The supply of coal before mining began is estimated to have been 3,076,204,000,000 short tons, of which 1,922,979,000,000 tons were considered to be easily accessible and 1,153,225,000,000 short tons to be either so deep or the beds so thin that they are accessible only with difficulty. Classified according to the character of the coal, the original supply consisted of 21,000,000,000 short tons of anthracite, 1,661,457,000,000 tons of bituminous coal, 650,157,000,000 tons of subbituminous coal, and 743,590,000,000 tons of lignite, the supply of bituminous coal being something more than double that of all other grades combined. The total production at the close of 1912 has amounted to 2,355,160,335 short tons of anthracite and 6,919,028,630 short tons of bituminous coal, an aggregate of 9,274,188,965 short tons. It is usual to consider that for every ton of coal that has been mined and marketed, a half ton has been lost, through necessary waste in mining. In the early history of mining in both the anthracite and bituminous regions the percentage of loss was considerably more than half a ton for every ton mined. In the anthracite region it was estimated by the Anthracite Waste Commission, which made its report in 1893, that the recovery was only 40 per cent, or, in other words, a ton and a half was lost for every ton sold.. At the present time the recovery in the anthracite region is from 60 to 65 per cent, so that conditions are reversed, and for every ton of coal lost a ton and a half is sold or used. In some parts of the bituminous regions the recovery approaches 100 per cent. In other cases it is less than 50 per cent, where the beds are very thick or lie at great depth and it is necessary to leave large quantities of coal in pillars to support the roof. Half a ton of coal lost for each ton mined is doubtless a fair average. The exhaustion in the anthracite region of Pennsylvania is probably equivalent to double the production, that is, for every ton of coal mined 1 ton has been lost, and the exhaustion in the anthracite region consequently amounts to 4,710,000,000 tons. In the mines of the bituminous fields, estimating a half ton lost for every ton produced, the exhaustion is equivalent to about 10,400,000,000 tons; hence the total exhaustion amounts to about 15,000,000,000 short tons, or about 0.5 of 1 per cent of the original supply. In other words, the quantity of coal still remaining to be mined amounts to approximately 3,061,000,-000,000 tons, or a little more than 99.5 per cent of the original supply. Upon the same basis of a two-thirds recovery, something over 2,000,000,000,000 tons of coal are still available, a little less than 4,000 times the rate of production in 1912.

The table following shows the area known to contain coal in the various States, by fields, the estimated original supply, the total production of each State and field in 1912, the total production in each to the close of 1912, and the estimated supply still available.

Areas of the coal fields by States, estimates of original and present supply, and the production to the close of 1912.

	Area.[a]	Estimated original supply.	Production in 1912.	Total production to close of 1912.	Total exhaustion to close of 1912.	Estimated available supply.
ANTHRACITE.	*Square miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	480	21,000,000,000	84,361,598	2,355,160,335	4,710,000,000	16,290,000,000
Colorado and New Mexico	29	(b)	(b)	....	....	(b)
Total	509	21,000,000,000	84,361,598	2,355,160,335	4,710,000,000	16,290,000,000
BITUMINOUS.[c]						
Eastern province.						
Atlantic coast region:						
Virginia	150	(d)	(d)	(d)	(d)	(d)
North Carolina	60	200,000,000	200	477,125	715,700	199,284,300
Appalachian region:						
Pennsylvania	14,200	112,574,000,000	161,865,488	2,558,163,842	3,837,200,000	108,736,800,000
Ohio	12,660	86,028,000,000	34,528,727	646,478,019	969,700,000	85,058,300,000
Maryland	455	8,044,000,000	4,964,038	170,873,840	256,300,000	7,787,700,000
Virginia	1,750	22,500,000,000	7,846,638	87,459,713	131,200,000	22,368,800,000
West Virginia	17,000	150,000,000,000	66,786,687	716,234,888	1,074,400,000	148,925,600,000
Eastern Kentucky	10,270	67,787,000,000	8,617,193	82,324,951	123,500,000	67,663,500,000
Tennessee	4,400	25,665,000,000	6,473,228	116,890,181	175,300,000	25,489,700,000
Georgia	167	933,000,000	227,503	9,169,672	13,800,000	919,200,000
Alabama	8,430	68,903,000,000	16,100,600	237,275,836	355,900,000	68,547,100,000
Total	69,332	542,434,000,000	307,410,102	4,624,870,942	6,937,300,000	535,496,700,000
Interior province.						
Northern region:						
Michigan	11,000	12,000,000,000	1,206,230	21,679,925	32,500,000	11,967,500,000
Eastern region:						
Indiana	6,500	44,169,000,000	15,285,718	234,466,427	351,700,000	43,817,300,000
Western Kentucky	6,400	36,241,000,000	7,873,328	106,187,103	159,300,000	36,081,700,000
Illinois	35,600	240,000,000,000	59,885,226	903,897,579	1,355,800,000	238,644,200,000
Total	48,500	320,410,000,000	83,044,272	1,244,551,109	1,866,800,000	318,543,200,000

Western and southwestern regions:[e]						
Iowa	12,500	29,160,000,000	7,289,529	179,077,161	268,600,000	28,891,400,000
Missouri	16,700	40,000,000,000	4,339,856	115,850,347	173,800,000	39,826,200,000
Kansas	3,100	7,022,000,000	6,986,182	122,494,551	183,700,000	6,838,300,000
Arkansas	1,684	1,887,000,000	2,100,819	34,325,481	51,500,000	1,835,500,000
Oklahoma	10,000	79,278,000,000	3,675,418	55,308,394	83,000,000	79,195,000,000
Texas	10,200	31,000,000,000	2,188,612	24,220,146	36,300,000	30,963,700,000
Total	54,244	188,347,000,000	26,580,416	531,276,080	796,900,000	187,550,100,000
Rocky Mountain and Northern Great Plains provinces.						
Arizona	30	60,000,000	....	....	....	60,000,000
North Dakota	31,240	500,000,000,000	499,480	4,928,196	7,400,000	499,992,600,000
Montana	34,067	303,060,000,000	3,048,495	38,159,086	57,200,000	303,002,800,000
South Dakota	2,000	10,000,000,000	....	....	....	10,000,000,000
Wyoming	20,568	424,085,000,000	7,368,124	111,347,852	167,000,000	423,918,000,000
Utah	13,130	196,458,000,000	3,016,149	30,998,006	46,500,000	196,411,500,000
Colorado	10,105	371,770,000,000	10,977,824	166,129,188	249,200,000	371,520,800,000
New Mexico	13,331	163,780,000,000	3,536,824	37,787,800	56,700,000	163,723,300,000
Idaho	200	600,000,000	[f] 2,964	46,480	69,700	599,930,300
Total	124,671	1,969,813,000,000	28,449,860	389,396,608	584,069,700	1,969,228,930,300
Pacific coast province and Alaska.						
Washington	1,100	20,000,000,000	3,360,932	60,581,549	90,900,000	19,909,100,000
Oregon	230	1,000,000,000	41,637	2,119,758	3,200,000	996,800,000
California	500	1,000,000,000	} 11,333	5,128,425	7,700,000	992,300,000
Alaska	....	....		45,669	....	....
Total	1,830	22,000,000,000	3,413,902	67,875,401	101,800,000	21,898,200,000
Total production, including colliery consumption	[g] 310,296	3,076,204,000,000	534,466,580	9,274,188,965	15,030,085,400	3,061,173,914,600

[a] Known to contain workable coal.
[b] Included in Rocky Mountain and Northern Great Plains provinces.
[c] Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.
[d] Included in Appalachian region.
[e] Including Texas lignite fields of Gulf province.
[f] Includes a little coal from Nevada.
[g] Not including 160,705 square miles of which little is known, but which may contain workable coal, and 31,805 square miles where coal lies under heavy cover and is not at present available.

The following statistics cover the annual production of coal in each of the various regions from 1887 to the close of 1912:

Total production of each region, 1887–1912, in short tons.

	Anthracite.	Bituminous.		
		Atlantic coast.	Appalachian.	Northern.
Area [a] ... square miles..	[b] 509	210	69,332	11,000
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
1907	85,666,404	....	266,501,527	2,035,858
1908	83,310,412	....	216,499,163	1,835,019
1909	81,070,359	....	251,630,500	1,784,692
1910	84,485,236	....	287,816,446	1,534,967
1911	90,464,067	120	275,212,234	1,476,074
1912	84,361,598	200	307,410,102	1,206,230

Total production of each region, 1887–1912, in short tons—Continued.

	Bituminous.			
	Eastern.	Western and Southwestern.	Rocky Mountain, etc.	Pacific coast and Alaska.
Area [a] square miles	48,500	54,244	124,671	1,830
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
1907	71,598,256	26,856,622	23,929,155	3,775,602
1908	65,774,700	23,645,983	21,644,307	3,133,064
1909	71,598,795	25,821,744	25,158,772	3,735,375
1910	72,634,356	22,276,364	28,857,413	3,991,596
1911	75,041,014	24,502,107	26,044,387	3,631,123
1912	83,044,272	26,580,416	28,449,860	3,413,902

[a] Known to contain workable coal. [b] Includes 29 square miles in Colorado and New Mexico.

The following table shows how the production in the six principal bituminous areas has developed since 1887 and how the percentages of the total produced in each during the last two years compare with one another. The production in the northern region of Michigan shows the largest percentage of increase in the period since 1887, and the percentage of the total contributed by the Pacific coast has decreased.

Production of the six principal bituminous coal regions in 1887, 1911, and 1912, compared, in short tons.

Region.	1887		1911		1912	
	Quantity.	Percentage of total.	Quantity.	Per centage of total.	Quantity.	Per centage of total.
Appalachian	55,888,088	63.11	275,212,234	67.80	307,410,102	68.30
Eastern	14,478,883	16.50	75,041,014	18.49	83,044,272	18.45
Western	10,172,634	11.49	24,502,107	6.04	26,580,416	5.90
Northern	71,461	.08	1,476,074	.36	1,206,230	.27
Rocky Mountain	3,646,280	4.15	26,044,387	6.42	28,449,860	6.32
Pacific coast	854,308	1.00	3,631,123	.89	3,413,902	.76

Region.	Increase in 1912 over 1887.		Increase in 1912 over 1911.	
	Quantity.	Percentage.	Quantity.	Percentage.
Appalachian	251,522,014	450.05	32,197,868	11.70
Eastern	68,565,389	473.55	8,003,258	10.67
Western	16,407,782	161.29	2,078,309	8.48
Northern	1,134,769	1,587.96	a 269,844	a 18.28
Rocky Mountain	24,803,580	680.24	2,405,473	9.24
Pacific coast	2,559,594	299.61	a 217,221	a 5.98

a Decrease.

RANK OF COAL-PRODUCING STATES.

In the following table the States are arranged according to their rank as coal producers—first, in the quantity of coal mined, and, second, in the value of the product.

The first four States maintained the same relative position in 1912 as in 1911. Kentucky, which was the seventh in rank in 1911, has advanced to fifth place, displacing Alabama and Indiana, which have dropped to sixth and seventh places, respectively. Colorado remains eighth in rank, but Virginia and Wyoming have gone ahead of Iowa, which was ninth in 1911, but has dropped to eleventh place in 1912. Kansas has superseded Tennessee as twelfth in rank, and Washington, because of its decreased production in 1912 (owing to competition with fuel oil), has dropped from sixteenth to eighteenth place.

West Virginia's production of coal, which in 1912 amounted to 66,786,687 short tons, exceeded that of Illinois by 6,900,000 tons, whereas the value of Illinois output was $70,294,338, or about $7,500,000 more than that of West Virginia. Illinois accordingly holds second place in the value of the output. The price per ton of West Virginia's product in 1912 was 94 cents, while that of Illinois was $1.17. Virginia, which ranks ninth in the quantity of coal produced, drops to fifteenth place in relation to the value of the output. West Virginia and Virginia were the only two States where the average price per ton in 1912 was less than $1, the average in Virginia having been in that year 96 cents. In the combined production of anthracite and bituminous coal Pennsylvania is credited in 1912 with 46.1 per cent of the total for the United States in quantity and with 50 per cent in value; in 1911 Pennsylvania was credited with

47.3 per cent in production and with 51.3 per cent in value. West Virginia's percentage in quantity increased from 12.1 in 1911 to 12.5 in 1912, and the value from 8.6 to 9. The percentage of Illinois increased from 10.8 to 11.2 in quantity and from 9.5 to 10.1 in value. Ohio increased from 6.2 to 6.4 per cent in quantity and from 5.1 to 5.3 per cent in value. Alabama contributed the same percentage in both years in quantity and also in value. Kentucky's percentage increased from 2.8 to 3.1 in quantity and from 2.3 to 2.4 in value. Indiana showed a slight decrease in the percentage of quantity and a small increase in the percentage of value.

Rank of coal-producing States in 1911 and 1912, with quantity and value of product and percentage of each.

1911.

Production.				Value.			
Rank.	State or Territory.	Quantity (short tons).	Percentage of total production.	Rank.	State or Territory.	Value.	Percentage of total value.
1	Pennsylvania:			1	Pennsylvania:		
	Anthracite	90,464,067	18.2		Anthracite	$175,189,392	28.0
	Bituminous	144,561,257	29.1		Bituminous	146,154,952	23.3
2	West Virginia	59,831,580	12.1	2	Illinois	59,519,478	9.5
3	Illinois	53,679,118	10.8	3	West Virginia	53,670,515	8.6
4	Ohio	30,759,986	6.2	4	Ohio	31,810,123	5.1
5	Alabama	15,021,421	3.0	5	Alabama	19,079,949	3.0
6	Indiana	14,201,355	2.9	6	Indiana	15,326,808	2.4
7	Kentucky	14,049,703	2.8	7	Colorado	14,747,764	2.4
8	Colorado	10,157,383	2.1	8	Kentucky	14,008,458	2.3
9	Iowa	7,331,648	1.5	9	Iowa	12,663,507	2.0
10	Virginia	6,864,667	1.4	10	Wyoming	10,508,863	1.7
11	Wyoming	6,744,864	1.4	11	Kansas	9,473,572	1.5
12	Tennessee	6,433,156	1.3	12	Washington	8,174,170	1.3
13	Kansas	6,178,728	1.2	13	Tennessee	7,209,734	1.1
14	Maryland	4,685,795	.9	14	Missouri	6,603,066	1.1
15	Missouri	3,836,107	.8	15	Oklahoma	6,291,494	1.0
16	Washington	3,572,815	.7	16	Virginia	6,254,804	1.0
17	New Mexico	3,148,158	.6	17	Montana	5,342,168	.9
18	Oklahoma	3,074,242	.6	18	Maryland	5,197,066	.8
19	Montana	2,976,358	.6	19	New Mexico	4,525,925	.7
20	Utah	2,513,175	.5	20	Utah	4,248,666	.7
21	Arkansas	2,106,789	.4	21	Arkansas	3,396,849	.5
22	Texas	1,974,593	.4	22	Texas	3,273,288	.5
23	Michigan	1,476,074	.3	23	Michigan	2,791,461	.4
24	North Dakota	502,628	.1	24	North Dakota	720,489	.1
25	Georgia and North Carolina	165,330		25	Georgia and North Carolina	246,448	
26	Oregon	46,661		26	Oregon	108,033	
27	California and Alaska	11,647	.1	27	California and Alaska	23,297	.1
28	Idaho and Nevada	1,821		28	Idaho and Nevada	4,872	
	Total	496,371,126	100.0		Total	626,565,211	100.0

Rank of coal-producing States in 1911 and 1912, with quantity and value of product and percentage of each—Continued.

1912.

Production.				Value.			
Rank.	State or Territory.	Quantity (short tons).	Percentage of total production.	Rank.	State or Territory.	Value.	Percentage of total value.
1	Pennsylvania:			1	Pennsylvania:		
	Anthracite	84,361,598	15.8		Anthracite	$177,622,626	25.6
	Bituminous	161,865,488	30.3		Bituminous	169,370,497	24.4
2	West Virginia	66,786,687	12.5	2	Illinois	70,294,338	10.1
3	Illinois	59,885,226	11.2	3	West Virginia	62,792,234	9.0
4	Ohio	34,528,727	6.4	4	Ohio	37,083,363	5.3
5	Kentucky	16,490,521	3.1	5	Alabama	20,829,252	3.0
6	Alabama	16,100,600	3.0	6	Indiana	17,480,546	2.5
7	Indiana	15,285,718	2.8	7	Kentucky	16,854,207	2.4
8	Colorado	10,977,824	2.0	8	Colorado	16,345,336	2.4
9	Virginia	7,846,638	1.5	9	Iowa	13,152,088	1.9
10	Wyoming	7,368,124	1.4	10	Wyoming	11,648,088	1.7
11	Iowa	7,289,529	1.4	11	Kansas	11,324,130	1.6
12	Kansas	6,986,182	1.3	12	Washington	8,042,871	1.2
13	Tennessee	6,473,228	1.2	13	Oklahoma	7,867,331	1.1
14	Maryland	4,964,038	.9	14	Missouri	7,633,864	1.1
15	Missouri	4,339,856	.8	15	Virginia	7,518,576	1.1
16	Oklahoma	3,675,418	.7	16	Tennessee	7,379,903	1.1
17	New Mexico	3,536,824	.7	17	Maryland	5,839,079	.8
18	Washington	3,360,932	.6	18	Montana	5,558,195	.8
19	Montana	3,048,495	.6	19	Utah	5,046,451	.7
20	Utah	3,016,149	.6	20	New Mexico	5,037,051	.7
21	Texas	2,188,612	.4	21	Texas	3,655,744	.5
22	Arkansas	2,100,819	.4	22	Arkansas	3,582,789	.5
23	Michigan	1,206,230	.2	23	Michigan	2,399,451	.3
24	North Dakota	499,480	.1	24	North Dakota	765,105	.1
25	Georgia and North Carolina	227,703	.1	25	Georgia and North Carolina	338,926	.1
26	Oregon	41,637		26	Oregon	108,276	
27	California and Alaska	11,333		27	California and Alaska	26,441	
28	Idaho and Nevada	2,964		28	Idaho and Nevada	9,313	
	Total	534,466,580	100.0		Total	695,606,071	100.0

PRODUCTION BY CLASSES OF MINES.

In the following tables the production of coal in the United States in 1911 and 1912 has been distributed according to the importance of the producing mines. The mines have been divided into five classes; First: mines producing 200,000 short tons or more during the year; second, mines producing from 100,000 to 200,000 short tons; third, mines producing between 50,000 and 100,000 short tons; fourth, mines producing between 10,000 and 50,000 tons; and, fifth, mines producing less than 10,000 tons. In this compilation no account is taken of the small mines operated for purely local trade nor of the anthracite recovered from old culm banks or river beds. Some producers in making their reports to the Survey combine the production of two or more mines on one schedule; in such cases the production of each mine has been assumed to be the average of all the mines covered by the schedule.

Prominent among the interesting comparisons presented in these tables is the concentration of the anthracite industry into strong and relatively few units, as shown by the fact that 78.5 per cent of the anthracite mines in 1912 were producers of more than 100,000 tons each. Nearly 62 per cent of the anthracite mines produced over 200,000 tons each and the total production of the mines of the first and second class—that is, of those producing over 100,000 tons—was 97.3 per cent of the entire anthracite output. Only one-tenth of 1 per cent of the anthracite production was from mines producing less than 10,000 tons. In 1911 the anthracite mines of the first and second classes produced 74.6 per cent of the total output. The average production per mine in the anthracite region shows a decrease in 1912 as compared with 1911, due to the general decrease in production which was caused by the suspension of six weeks, beginning on April 1. There was an increase of 2 in the number of mines of the first class, from 168 in 1911 to 170 in 1912; a decrease of 4 in the mines of the second class, from 50 in 1911 to 46 in 1912. The average production from the mines of the first class was 411,768 short tons in 1912, against 444,697 short tons in 1911, and the total production from this class of mines showed a decrease of approximately 4,700,000 short tons. The average production from mines of the second class (those from 100,000 to 200,000 short tons each) decreased from 170,293 in 1911 to 164,262 in 1912. The anthracite mines of the third class (producing from 50,000 to 100,000 short tons) represented 5.6 per cent of the total number of mines and yielded 1.6 per cent of the total production, and those of the fourth class (from 10,000 to 50,000 short tons) represented 8.7 per cent in number and yielded 1 per cent of the total output.

The production of bituminous coal in 1911 was less than that of 1910 by something over 11,350,000 short tons, and the effect of this falling off in the production was exhibited largely in the decrease in the number of mines of the first class and in the output therefrom. The number of bituminous mines producing over 200,000 short tons in 1910 was 618, decreasing to 568 in 1911, and the production from this class of mines decreased from 191,500,000 short tons to 178,-950,000 tons, the difference being 12,550,000 tons, while the decrease in the total production of bituminous coal was, as stated, 11,350,000 tons. The average production of this class of mines increased, however, from 309,901 short tons in 1910 to 315,064 tons in 1911. With the notable increase in the total production of bituminous coal in 1912, the number of mines of the first class increased to 677, a gain of 109 over 1911. In 1911 the percentage of the total number represented by the mines of the first class was 9.6; in 1912 it was 11.8. The total production from this class of mines increased in 1912 to 221,017,125 short tons, or 49.2 per cent of the total bituminous production, and the average for each mine to 326,465 tons, or over 11,000 tons per mine more than in 1911. The number of mines of the second class (those producing from 100,000 to 200,000 short tons) increased from 763 in 1910 to 794 in 1911, but decreased to 790 mines in 1912. The total production from this class of mines increased from 107,052,053 short tons in 1910 to 115,072,711 tons in 1911, and decreased to 112,471,613 tons in 1912. The average production per mine, which had increased from 140,304 tons to 144,382 tons, decreased in 1912 to 142,369 tons. The percentage of production from mines of the second class decreased from 28.4 in 1911 to 25 in 1912. The mines of the third class (those producing from 50,000 to 100,000 short tons) contributed about the same percentage in 1911 and 1912, 14.8 in the latter year against 15 in the former. The percentage of production from the mines of the fourth class decreased from 10.7 in 1911 to 9.5 in 1912, and those of the fifth class from 1.7 to 1.5, all of these figures indicating the general trend toward concentration of coal-mining operations into larger units. The principal increase in the number and production by mines of the first class was in the four leading coal-producing States, Pennsylvania showing an increase from 269 mines in 1911 to 309 in 1912, with an increase in production from 86,556,892 short tons (321,773 tons per mine) to 105,837,953 tons (342,518 tons per mine); West Virginia, relatively speaking, showed the greatest increase in the number and production of this class of mines, from 59 in number in 1911 to 84 in 1912, with an increase in total production from 16,465,754 tons (279,081 tons per mine) to 24,540,193 tons (292,145 tons per mine); the number of mines of the first class in Illinois increased from 93 to 115, and the total production from 31,650,391 tons to 39,027,660 tons; Ohio's number of mines increased from 38 to 58, and the total production from 10,871,319 to 16,357,508 tons. The total production of classes 1 and 2 increased from 294,039,249 short tons in 1911 to 333,488,738 tons in 1912, a gain of about 39,450,000 tons, or 13.5 per cent, and the increase in the production from the smaller mines was almost exactly 5,000,000 tons, or 4.5 per cent.

Comparison of the production from the anthracite and the bituminous mines shows that whereas in 1912, 62 per cent of the anthracite mines were of the first class, these producing 88 per cent of the total production, only a scant 12 per cent of the number of bituminous mines were in this class, but this 12 per cent produced approximately one-half of the total output of bituminous coal. As for the first three classes of mines—that is, all those producing more than 50,000 tons in 1912—it is found that 99 per cent of the anthracite output and 89 per cent of the bituminous output was from these mines. The total number of mines in the anthracite region of Pennsylvania in 1912 was 275, which had an average output of 289,456 short tons. The total number of bituminous mines was 5,747 and the average production for all the bituminous mines was 78,184 tons, from which it appears that the average production from each anthracite mine is nearly four times that from the bituminous.

The changes which have taken place in the percentage of production of anthracite and bituminous coal from mines of the different classes during the last four years have been as follows:

Changes of percentage of production of anthracite and bituminous coal from mines of different classes, 1909–1912.

	Anthracite.	Bituminous.		Anthracite.	Bituminous.
1909:			1911:		
First class	85.6	42.5	First class	87.2	44.2
Second clas	10.7	27.6	Second class	9.9	28.4
Third class	2.5	17.3	Third class	1.9	15.0
Fourth class	1.0	10.7	Fourth class	.9	10.7
Fifth class	.2	1.9	Fifth class	.1	1.7
1910:			1912:		
First class	82.5	46.0	First class	87.9	49.2
Second class	13.4	25.7	Second clas.s	9.4	25.0
Third class	2.9	16.5	Third class	1.6	14.8
Fourth class	1.0	10.2	Fourth class	1.0	9.5
Fifth class	.2	1.6	Fifth class	.1	1.5

The statistics of production, by classes of mines, in 1911 and 1912, by States, are shown in the following tables:

Production of coal in the United States in 1911 and 1912 according to classes of mines, in short tons.

1911.

State.	First class. Mines producing over 200,000 tons.					Second class. Mines producing from 100,000 to 200,000 tons.					Third class. Mines producing from 50,000 to 100,000 tons.				
	Mines.		Production.			Mines.		Production.			Mines.		Production.		
	Number.	Per centage.	Total.	Average per mine.	Per centage.	Number.	Per centage.	Total.	Average per mine.	Per centage.	Number.	Per centage.	Total.	Average per mine.	Per centage.
Alabama	11	5.2	3,178,290	288,935	21.2	45	21.3	6,945,637	154,347	46.3	40	19.0	2,887,974	72,199	19.1
Arkansas	1	1.7	255,938	255,938	12.2	6	10.2	805,994	134,332	38.2	9	15.2	606,533	67,393	28.8
California	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado	11	6.5	3,208,848	291,713	31.6	25	14.8	3,318,349	132,734	32.7	31	18.3	2,039,403	65,787	20.1
Georgia	.....	.....	.....	.....	.....	1	50.0	148,936	148,936	90.1	.....	.....	.....	.....	.....
Idaho	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Illinois	93	16.1	31,650,391	340,327	59.0	95	16.4	13,831,541	145,595	25.8	61	10.5	4,386,730	71,914	8.2
Indiana	15	5.8	3,961,824	264,122	28.0	39	15.2	5,832,325	149,547	41.2	35	13.6	2,445,817	69,880	17.3
Iowa	4	1.7	1,042,971	260,743	14.3	21	8.9	2,989,310	142,348	40.9	22	9.3	1,530,006	69,546	21.0
Kansas	1	.6	226,674	226,674	3.7	23	14.5	2,974,190	129,313	48.3	24	15.1	1,651,097	68,796	26.8
Kentucky	7	2.3	1,852,904	264,701	3.3	39	12.7	5,346,521	138,931	38.5	49	16.0	3,358,531	68,541	24.2
Maryland	3	3.8	1,889,996	629,999	40.5	6	7.6	851,723	141,954	18.2	9	11.4	721,921	80,213	15.5
Michigan	1	3.9	202,329	202,329	13.7	4	15.4	499,247	124,812	33.8	9	34.6	664,344	73,816	45.0
Missouri	2	.9	442,975	221,488	11.9	6	2.6	829,749	138,292	22.3	13	5.6	932,976	71,767	25.0
Montana	5	10.2	1,943,326	388,665	65.4	3	6.1	435,951	145,317	14.7	3	6.1	220,468	73,489	7.4
New Mexico	8	21.0	2,567,197	320,900	81.6	2	5.3	315,167	157,584	10.0	.....	.....	.....	.....	.....
North Dakota	.....	.....	.....	.....	.....	1	1.7	167,714	167,714	35.1	1	1.7	57,600	57,600	12.0
Ohio	38	5.6	10,871,319	286,087	35.6	67	9.9	9,854,243	147,078	32.3	66	9.7	4,842,037	73,364	15.8
Oklahoma	1	.9	201,127	201,127	6.6	4	3.6	455,647	113,912	14.8	16	14.3	1,120,606	70,038	36.5
Oregon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pennsylvania bituminous	269	18.1	86,556,892	321,773	59.9	214	14.4	31,031,009	145,005	21.5	211	14.2	15,148,823	71,795	10.5
Tennessee	6	4.6	1,605,900	267,650	25.0	11	8.4	1,509,505	137,228	23.5	24	18.5	1,661,340	69,223	25.8
Texas	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17	37.8	1,293,044	76,061	65.5
Utah	5	20.0	1,919,585	383,917	76.5	4	16.0	424,050	106,013	16.9	.....	.....	.....	.....	.....
Virginia	10	16.4	4,434,445	443,445	64.6	6	9.8	965,819	160,970	14.1	11	18.0	776,325	70,595	11.3
Washington	5	10.0	1,281,115	256,223	35.9	8	16.0	1,222,558	152,820	34.2	7	14.0	645,015	92,145	18.0
West Virginia	59	7.8	16,465,754	279,081	27.6	153	20.2	22,106,516	144,487	37.0	184	24.4	12,982,737	70,558	21.7
Wyoming	13	18.8	3,196,738	245,903	47.4	14	20.3	2,211,007	157,929	32.8	11	16.0	774,181	70,380	11.5
Total bituminous	568	9.6	178,956,538	315,064	44.2	797	13.5	115,072,711	144,382	28.4	853	14.5	60,747,508	71,216	15.0
Pennsylvania anthracite	168	57.5	74,709,145	444,697	87.2	50	17.1	8,514,667	170,293	9.9	21	7.2	1,607,527	76,549	1.9
Grand total	736	11.9	253,665,683	344,654	51.7	847	13.7	123,587,378	145,912	25.2	874	14.2	62,355,035	71,344	12.8

Production of coal in the United States in 1911 and 1912 according to classes of mines, in short tons—Continued.

1911—Continued.

State.	Fourth class. Mines producing from 10,000 to 50,000 tons.					Fifth class. Mines producing less than 10,000 tons.					Total.		
	Mines.		Production.			Mines.		Production.					
	Number.	Percentage.	Total.	Average per mine.	Percentage.	Number.	Percentage.	Total.	Average per mine.	Percentage.	Mines.	Quantity.	Average per mine.
Alabama	74	35.1	1,841,776	24,889	12.3	41	19.4	167,545	4,086	1.1	211	15,021,222	71,191
Arkansas	19	32.2	343,022	18,054	16.3	24	40.7	94,750	3,948	4.5	59	2,106,237	35,699
California						2	100.0	10,747	5,374	100.0	2	10,747	5,374
Colorado	50	29.6	1,406,744	28,135	13.9	52	30.8	172,644	3,320	1.7	169	10,145,988	60,035
Georgia	1	50.0	16,274	16,274	9.9						2	165,210	82,605
Idaho						2	100.0	1,805	903	100.0	2	1,805	903
Illinois	120	20.7	3,079,412	25,662	5.8	210	36.3	657,942	3,133	1.2	579	53,606,019	92,584
Indiana	60	23.4	1,564,782	26,080	11.1	108	42.0	344,769	3,192	2.4	257	14,149,517	55,056
Iowa	60	25.3	1,396,644	23,277	19.1	130	54.8	345,896	2,661	4.7	237	7,304,827	30,822
Kansas	42	26.4	1,060,931	25,260	17.2	69	43.4	243,916	3,535	4.0	159	6,156,808	38,722
Kentucky	107	35.0	2,924,058	27,328	21.1	104	34.0	396,783	3,815	2.9	306	13,878,797	45,356
Maryland	35	44.3	1,117,148	31,919	23.9	26	32.9	88,993	3,423	1.9	79	4,669,781	59,111
Michigan	5	19.2	86,083	17,217	5.9	7	26.9	23,732	3,390	1.6	26	1,475,735	56,759
Missouri	48	20.7	1,018,666	21,222	27.3	163	70.2	502,625	3,084	13.5	232	3,726,991	16,065
Montana	11	22.5	289,578	26,325	9.7	27	55.1	82,016	3,038	2.8	49	2,971,339	60,640
New Mexico	9	23.7	224,026	24,892	7.1	19	50.0	40,994	2,158	1.3	38	3,147,384	82,826
North Dakota	7	11.6	131,717	18,817	27.6	51	85.0	121,035	2,373	25.3	60	478,066	7,968
Ohio	154	22.7	3,877,190	25,177	12.8	353	52.1	1,064,478	3,016	3.5	678	30,509,267	44,999
Oklahoma	43	38.4	1,049,672	24,411	34.2	48	42.8	243,318	5,069	7.9	112	3,070,370	27,414
Oregon	1	11.1	30,365	30,365	65.1	8	88.9	16,296	2,037	34.9	9	46,661	5,185
Pennsylvania bituminous	356	24.0	10,054,433	28,243	7.0	436	29.3	1,594,265	3,657	1.1	1,486	144,385,422	97,164
Tennessee	52	40.0	1,476,126	28,387	23.0	37	28.5	177,197	4,789	2.7	130	6,430,068	49,462
Texas	23	51.1	650,257	28,272	32.9	5	11.1	31,292	6,258	1.6	45	1,974,593	43,880
Utah	5	20.0	156,982	31,396	6.2	11	44.0	9,905	900	.4	25	2,510,522	100,421
Virginia	26	42.6	659,769	25,376	9.6	8	13.2	26,977	3,372	.4	61	6,863,335	112,514
Washington	11	22.0	353,035	32,094	9.9	19	38.0	71,092	3,742	2.0	50	3,572,815	71,456
West Virginia	258	34.2	7,808,005	30,264	13.1	101	13.4	390,689	3,868	.6	755	59,753,701	79,144
Wyoming	15	21.7	511,737	34,116	7.6	16	23.2	48,734	3,046	.7	69	6,742,397	97,716
Total bituminous	1,592	27.1	43,128,432	27,091	10.7	2,077	35.3	6,970,435	3,356	1.7	5,887	404,875,624	68,775
Pennsylvania anthracite	27	9.3	782,856	28,995	.9	26	8.9	111,498	4,288	.1	292	85,725,693	293,581
Grand total	1,619	26.2	43,911,288	27,122	9.0	2,103	34.0	7,081,933	3,368	1.4	6,179	490,601,317	79,398

Production of coal in the United States in 1911 and 1912 according to classes of mines, in short tons—Continued.

1912.

State.	First class. Mines producing over 200,000 tons.					Second class. Mines producing from 100,000 to 200,000 tons.					Third class. Mines producing from 50,000 to 100,000 tons.				
	Mines.		Production.			Mines.		Production.			Mines.		Production.		
	Number.	Percentage.	Total.	Average per mine.	Percentage.	Number.	Percentage.	Total.	Average per mine.	Percentage.	Number.	Percentage.	Total.	Average per mine.	Percentage.
Alabama	13	6.0	3,734,754	287,289	23.2	50	23.0	7,364,764	147,295	45.7	41	18.9	2,967,102	72,368	18.4
Alaska															
Arkansas	1	1.8	279,707	279,707	13.3	6	10.9	784,865	130,811	37.4	7	12.7	506,977	72,425	24.1
California															
Colorado	13	8.2	3,847,332	295,949	35.0	19	12.0	2,610,818	137,411	23.8	39	24.5	2,817,912	72,254	25.7
Georgia						1	50.0	199,219	199,219	87.6					
Idaho															
Illinois	115	20.8	39,027,660	339,371	65.2	88	15.9	12,675,772	144,043	21.2	66	12.0	4,757,036	72,076	7.9
Indiana	18	7.6	4,687,606	260,423	30.6	42	17.6	6,072,590	144,585	39.7	37	15.5	2,839,683	76,748	18.6
Iowa	2	1.0	409,297	204,649	5.6	20	9.1	2,979,099	148,955	40.9	25	11.4	1,823,970	72,959	25.0
Kansas						27	17.6	3,509,287	129,974	50.2	29	19.0	2,168,807	74,786	31.0
Kentucky	8	2.3	2,088,287	261,036	12.8	45	12.8	6,356,977	141,288	38.8	63	17.9	4,207,400	66,784	25.7
Maryland	3	4.0	1,797,599	599,200	36.3	10	13.5	1,393,874	139,387	28.2	10	13.5	810,817	81,082	16.4
Michigan						1	4.5	106,631	106,631	8.8	13	59.1	919,364	70,720	76.2
Missouri	1	.5	228,097	228,097	5.4	11	5.0	1,405,683	127,789	33.1	14	6.5	1,041,607	74,401	24.6
Montana	3	6.1	1,667,159	555,720	54.7	5	10.2	693,870	138,774	22.8	3	6.1	245,918	81,973	8.1
New Mexico	7	20.0	2,546,861	363,837	72.0	4	11.4	631,250	157,813	17.9	2	5.7	149,750	74,875	4.2
North Dakota						1	2.0	181,918	181,918	38.8					
Ohio	58	9.0	16,357,508	282,026	47.8	56	8.7	8,197,305	146,380	23.9	61	9.4	4,584,730	75,160	13.4
Oklahoma						9	8.9	1,130,545	125,616	30.8	17	16.8	1,151,824	67,754	31.4
Oeegon															
Prnnsylvania bituminous	309	20.9	105,837,953	342,518	65.5	194	13.1	27,871,850	143,669	17.3	221	15.0	16,243,055	73,498	10.0
Tennessee	4	3.4	1,407,606	351,902	21.8	16	13.4	2,159,948	134,997	33.4	21	17.7	1,385,498	65,976	21.4
Texas	1	2.2	230,578	230,578	10.5	7	15.6	737,988	105,427	33.7	10	22.2	664,225	66,423	30.4
Utah	6	26.0	2,385,187	397,531	79.2	3	13.0	420,243	140,081	14.0	2	8.8	133,603	66,802	4.4
Virginia	13	21.3	5,507,875	423,683	70.2	4	6.6	619,211	154,803	7.9	15	24.6	1,103,248	73,950	14.0
Washington	4	8.3	961,210	240,303	28.6	11	22.9	1,516,430	137,857	45.1	6	12.5	417,288	69,548	12.4
West Virginia	84	11.3	24,540,193	292,145	36.8	143	19.3	20,226,111	141,441	30.3	205	27.6	14,603,428	71,236	21.9
Wyoming	14	19.5	3,474,656	248,190	47.2	17	23.6	2,625,365	154,433	35.7	14	19.5	1,129,711	80,694	15.3
Total bituminous	677	11.8	221,017,125	326,465	49.2	790	13.7	112,471,613	142,369	25.0	921	16.0	66,672,953	72,392	14.8
Pennsylvania anthracite	170	61.8	70,000,585	411,768	87.9	46	16.7	7,556,053	164,262	9.4	15	5.6	1,284,301	85,620	1.6
Grand total	847	14.0	291,017,710	343,586	55.0	836	13.9	120,027,666	143,574	22.6	936	15.5	67,957,254	72,604	12.9

Production of coal in the United States in 1911 and 1912 according to classes of mines, in short tons—Continued.

1912—Continued.

State.	Fourth class. Mines producing from 10.000 to 50,000 tons.					Fifth class. Mines producing less than 10,000 tons.					Total.		
	Mines.		Production.			Mines.		Production.					
	Number.	Percentage.	Total.	Average per mine.	Percentage.	Number.	Percentage.	Total.	Average per mine.	Percentage.	Mines.	Quantity.	Average per mine.
Alabama	75	34.6	1,843,623	24,582	11.5	38	17.5	190,357	5,009	1.2	217	16,100,600	74,196
Alaska						1	100.0	355	355	106.0	1	355	355
Arkansas	20	36.4	453,242	22,662	21.6	21	38.2	76,028	3,620	3.6	55	2,100,819	38,197
California						4	100.0	10,978	2,744	100.0	4	10,978	2,744
Colorado	53	33.3	1,562,581	29,483	14.2	35	22.0	139,181	3,977	1.3	159	10,977,824	69,043
Georgia	1	50.0	28,284	28,284	12.4						2	227,503	113,752
Idaho						3	100.0	2,319	773	100.0	3	2,319	773
Illinois	112	20.3	2,755,551	24,603	4.6	171	31.0	669,207	3,913	1.1	552	59,885,226	108,488
Indiana	48	20.2	1,311,307	27,319	8.6	93	39.1	374,532	4,027	2.5	238	15,285,718	64,226
Iowa	62	28.3	1,641,956	26,483	22.5	110	50.2	435,207	3,956	6.0	219	7,289,529	33,286
Kansas	42	27.5	1,049,202	24,981	15.0	55	35.9	258,886	4,707	3.8	153	6,986,182	45,661
Kentucky	124	35.2	3,341,547	26,948	20.4	112	31.8	377,444	3,370	2.3	352	16,371,655	46,510
Maryland	26	35.2	858,433	23,017	17.4	25	33.8	86,406	3,456	1.7	74	4,947,129	66,853
Michigan	4	18.2	167,169	41,792	13.9	4	18.2	12,855	3,214	1.1	22	1,206,019	54,819
Missouri	46	21.1	1,115,883	24,258	26.3	145	66.9	449,771	3,102	10.6	217	4,241,041	19,544
Montana	11	22.5	361,966	32,906	11.9	27	55.1	76,775	2,844	2.5	49	3,045,688	62,157
New Mexico	7	20.0	169,994	24,285	4.8	15	42.9	38,032	2,535	1.1	35	3,535,887	101,025
North Dakota	10	19.6	176,526	17,653	37.6	40	78.4	110,610	2,765	23.6	51	469,054	9,197
Ohio	160	24.7	4,108,676	25,679	12.0	312	48.2	1,003,909	3,218	2.9	647	34,252,128	52,940
Oklahoma	50	49.5	1,293,069	25,861	35.3	25	24.8	93,069	3,723	2.5	101	3,668,507	36,322
Oregon	2	22.2	25,554	12,777	61.5	7	77.8	16,001	2,286	38.5	9	41,555	4,617
Pennsylvania bituminous	380	25.7	10,415,567	27,409	6.4	373	25.3	1,347,979	3,614	.8	1,477	161,716,404	109,490
Tennessee	55	46.2	1,422,580	25,865	21.9	23	19.3	95,893	4,169	1.5	119	6,471,525	54,383
Texas	25	55.6	550,661	22,026	25.2	2	4.4	5,160	2,580	2.3	45	2,188,612	48,636
Utah	2	8.8	48,387	24,194	1.6	10	43.4	24,786	2,479	.8	23	3,012,206	130,965
Virginia	23	37.7	603,616	26,244	7.7	6	9.8	11,908	1,984	.2	61	7,845,858	128,621
Washington	12	25.0	389,947	32,496	11.6	15	31.3	76,057	5,070	2.3	48	3,360,932	70,019
West Virginia	235	31.7	7,077,673	30,118	10.6	75	10.1	274,654	3,662	.4	742	66,722,059	89,922
Wyoming	4	5.5	66,788	16,697	.9	23	31.9	65,291	2,839	.9	72	7,361,811	102,247
Total bituminous	1,589	27.7	42,839,782	26,960	9.5	1,770	30.8	6,323,650	3,573	1.5	5,747	449,325,123	78,184
Pennsylvania anthracite	24	8.7	668,853	27,869	1.0	20	7.2	90,674	4,534	.1	275	79,600,466	289,456
Grand total	1,613	26.8	43,508,635	26,974	8.2	1,790	29.8	6,414,324	3,583	1.2	6,022	528,925,589	87,832

KINDS OF COAL PRODUCED IN THE UNITED STATES.

Under the general head of bituminous coal in this series of reports all coal except the anthracite product of Pennsylvania is considered. Strictly speaking, the anthracite production should include small quantities of that grade mined in Colorado and New Mexico. This factor is so relatively insignificant, however, never having amounted to as much as 100,000 tons in one year, that it has seemed best and has been the invariable custom to give Pennsylvania anthracite separate treatment, and the small Rocky Mountain product has been included in the bituminous production. The latter includes also those grades of coal classed as semianthracite, semibituminous, cannel, block, splint, and lignite. In the following tables the production of these varieties of coal in 1911 and 1912 have been compiled according to the replies made by the operators to the inquiries as to the character of the coal produced. Technical exactness is, therefore, not claimed, but it is believed that the quantities stated approximate quite closely the actual production of each variety in each State, and that they are sufficiently correct for practical purposes.

The statement for 1912 shows that in addition to the 84,361,598 short tons (75,322,855 long tons) of anthracite produced in Pennsylvania, there were 52,165 tons mined in Colorado and 32,411 tons in New Mexico. The principal production of semianthracite is in Arkansas, with smaller quantities in Oklahoma and Virginia. The designation of a few thousand tons of this grade of coal in Kansas and Kentucky is open to question. The production of Sullivan County, Pa., is included with the anthracite production of that State, though its classification as anthracite is a matter of some contention. West Virginia leads in the production of semibituminous coal, with Pennsylvania second and Maryland third. West Virginia and Kentucky are credited with practically the entire output of splint coal, though a small output of this grade was reported from Tennessee in 1912. The small production of cannel coal was in six States in 1911 and in eight in 1912, Kentucky contributing over 50 per cent of the total. Wyoming is the principal producer of subbituminous coal, or "black lignite," with Colorado second and Montana third. All of the output of North Dakota, and nearly half of that of Texas, is lignite, or brown coal. The output of block coal is chiefly from Indiana. Bituminous coal is produced in every State having a production of 100,000 tons or more, with the exception of North Dakota.

Classification of the coal product of the United States in 1911, by States, in short tons.

State.	Bituminous.	Anthracite.	Semibituminous.	Lignite and subbituminous.	Semianthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	139,535,324	90,464,067	4,986,054					39,879	235,025,324
West Virginia	49,613,340		5,574,281			42,652	4,587,057	14,250	59,831,580
Illinois	53,679,118								53,679,118
Ohio	30,754,303							5,683	30,759,986
Alabama	15,021,421								15,021,421
Indiana	13,761,620					a 427,860		11,875	14,201,355
Kentucky	12,621,223		112,526			24,600	1,201,079	90,275	14,049,703
Colorado	6,680,257	64,389	1,950,476	1,462,261					10,157,383
Iowa	7,315,058					16,590			7,331,648
Virginia	6,856,205				8,462				6,864,667
Wyoming	455,564		2,933,068	3,356,232					6,744,864
Tennessee	6,425,108							8,048	6,433,156
Kansas	6,178,728								6,178,728
Maryland	1,422,900		3,262,895						4,685,795
Missouri	3,774,107					62,000			3,836,107
Washington	2,890,267		246,371	436,177					3,572,815
New Mexico	2,382,621	34,172		731,365					3,148,158
Oklahoma	2,983,232		65,554		25,456				3,074,242
Montana	664,668		1,418,775	892,915					2,976,358
Utah	2,356,193			156,982					2,513,175
Arkansas	1,809,004				297,785				2,106,789
Texas	1,051,858		32,094	890,641					1,974,593
Michigan	1,476,074								1,476,074
North Dakota				502,628					502,628
Georgia Oregon California Idaho Alaska North Carolina Nevada	172,930		30,365	22,164					225,459
Total	369,881,123	90,562,628	20,612,459	8,451,365	331,703	573,702	5,788,136	170,010	496,371,126

a Includes 25,692 tons of semiblock coal.

Classification of the coal product of the United States in 1912, by States, in short tons.

State.	Bituminous.	Anthracite.	Semibituminous.	Lignite and subbituminous.	Semianthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	158,364,023	84,361,598	3,433,374					68,091	246,227,086
West Virginia	56,627,727		5,050,993			37,750	a 4,834,784	b 235,433	66,786,687
Illinois	59,861,735					23,491			59,885,226
Ohio	34,456,137		2,497			66,054		4,039	34,528,727
Kentucky	14,889,478		160,293		3,736	41,050	1,221,295	c 174,669	16,490,521
Alabama	16,100,600								16,100,600
Indiana	14,817,006					d 461,339		7,373	15,285,718
Colorado	6,601,744	52,165	2,128,847	2,195,068					10,977,824
Virginia	7,800,804				45,834				7,846,638
Wyoming	1,024,395		2,821,069	3,522,660					7,368,124
Iowa	7,220,235					60,950		8,344	7,289,529
Kansas	6,975,862				10,320				6,986,182
Tennessee	6,458,028						2,700	12,500	6,473,228
Maryland	1,363,216		3,600,822						4,964,038
Missouri	4,322,116					14,157		3,583	4,339,856
Oklahoma	3,327,632		73,564		274,222				3,675,418
New Mexico	2,768,869	32,411	100,673	634,871					3,536,824
Washington	2,538,694		215,411	606,827					3,360,932
Montana	656,565		1,405,735	986,195					3,048,495
Utah	2,967,762			48,387					3,016,149
Texas	1,141,667		56,240	990,705					2,188,612
Arkansas	1,049,898		8,319		1,042,602				2,100,819
Michigan	1,206,230								1,206,230
North Dakota				499,480					499,480
Georgia									
Oregon									
California									
Idaho	240,577		15,153	27,907					283,637
Nevada									
Alaska									
North Carolina									
Total	412,781,000	84,446,174	19,072,990	9,512,100	1,376,714	704,791	6,058,779	514,032	534,466,580

a Includes 157,537 tons of semisplint coal.
b Includes 206,585 tons of semicannel coal.
c Includes 86,377 tons of semicannel coal.
d Includes 32,842 tons of semiblock coal.

LABOR STATISTICS.

The statistics of the labor employed in the anthracite and bituminous mines of the United States in 1912 indicate a somewhat anomalous condition. Notwithstanding the increase of practically 11 per cent in the total output of bituminous coal, there were fewer men employed in the bituminous mines in that year than in 1911. In the anthracite region, on the contrary, with a decreased production of 6¾ per cent, there was an increase in the number of employees reported to the Survey. The total production of bituminous coal increased from 405,907,059 short tons to 450,104,982 tons, and the number of men employed decreased from 549,775 to 548,632, in the two years. The principal reason for this decrease in the number of men employed has been assigned to the migration of some of the mine workers to the scene of war in the Balkan States of Europe. The only explanation of the increase of employees in the anthracite region appears to be that, in anticipation of the suspension on the 1st of April, mining operations were unusually active and the number of men employed larger than customary. Similarly, after operations were resumed, more men were employed in the effort to make up for the loss of time during the suspension. Although the suspension in the anthracite region continued about six weeks, the net loss in working time, as compared with 1911, was only 15 days, or from 246 to 231. The number of working days in the bituminous regions increased from 211 in 1911 to 223 in 1912. The effect of the time lost in the anthracite region in getting the mines into active operation after mining was resumed is exhibited in a decrease in the average tonnage per man per day from 2.13 in 1911 to 2.1 in 1912. The effect of the idleness is exhibited in a decrease in the average production by each man during the year from 524 tons in 1911 to 485 tons in 1912. In the bituminous mines, on the other hand, in the average tonnage per man, both annual and daily, in 1912, new records were established, the figures for 1912 being 3.68 tons per man per day and 820 tons per man per year. The corresponding figures in 1911 were 3.5 and 738 tons, respectively.

The following table shows the number of men employed in the coal mines of the United States in 1907, 1908, 1910, 1911, and 1912, with the average number of days worked, by States. The statistics of labor in 1909 were collected by the Bureau of the Census, and the inquiries were in such form that the compilations did not give results comparable with the statistics presented in these reports:

Statistics of labor employed in coal mines of the United States, 1907–1912, by States.

State.	1907		1908		1910		1911		1912	
	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	242	21,388	222	19,197	249	22,210	227	22,707	245	22,613
Arkansas	190	5,085	145	5,337	128	5,568	133	5,657	157	4,536
California	a 187	a 76	a 220	a 49	189	19	a 265	a 60	a 184	a 52
Colorado	258	14,223	212	14,523	236	15,864	207	14,316	227	13,000
Georgia	262	808	261	670	265	386	b 277	b 514	b 254	b 450
Idaho	d 121	d 22	160	24	200	14	c 228	c 13	c 253	c 20
Illinois	218	65,581	185	68,035	160	72,645	188	76,600	194	78,098
Indiana	197	21,022	174	18,380	229	21,878	182	21,182	182	21,651
Iowa	230	15,585	214	16,021	218	16,666	203	16,599	188	16,370
Kansas	225	12,439	181	13,916	148	12,870	190	11,357	202	11,646
Kentucky	210	16,971	186	16,996	221	20,316	201	21,921	201	24,304
Maryland	263	5,880	220	6,079	270	5,809	243	5,881	259	6,162
Michigan	234	3,982	207	4,247	211	3,575	218	3,323	183	3,113
Missouri	214	8,448	169	8,988	154	9,691	182	10,259	206	9,704
Montana	268	2,735	224	3,146	239	3,837	220	3,866	220	3,440
New Mexico	269	2,970	197	3,448	283	3,585	230	4,007	274	3,928
North Dakota	223	562	181	631	207	534	229	640	232	622
Ohio	199	46,833	161	47,407	203	46,641	179	46,035	201	45,527
Oklahoma (Indian Territory)	216	8,398	172	8,651	144	8,657	156	8,790	174	8,785
Oregon	231	184	249	214	257	153	179	189	239	222
Pennsylvania bituminous	255	163,295	201	165,961	238	175,403	233	168,199	252	165,144
Tennessee	232	12,052	209	11,812	225	11,930	232	10,703	234	10,309
Texas	242	4,227	254	4,400	234	4,197	226	5,353	230	5,127
Utah	258	2,203	227	2,664	260	3,053	236	3,060	285	3,328
Virginia	241	6,670	200	6,208	241	7,264	261	7,392	251	8,678
Washington	273	5,945	202	5,484	256	6,314	225	6,498	226	5,519
West Virginia	230	59,029	185	56,861	228	68,663	221	66,730	266	68,248
Wyoming	275	6,645	217	6,915	248	7,771	230	7,924	238	8,036
Total bituminous	234	513,258	193	516,264	217	555,533	211	549,775	223	548,632
Pennsylvania anthracite	220	167,234	200	174,174	229	169,497	246	172,585	231	174,030
Grand total	231	680,492	195	690,438	220	725,030	220	722,360	225	722,662

a Includes Alaska. b Includes North Carolina. c Includes Nevada. d Includes Nebraska and Nevada.

In the following table a statement is presented covering the number of men employed in the anthracite and bituminous mines since 1890, with the average number of days worked, the average production per man each day and each year, except, for the reason stated, in 1909. The most pronounced feature of this statement is the marked increase in the average tonnage, both daily and annual, by the workers in the bituminous mines, and the decreasing efficiency evinced by the daily tonnage per man in the anthracite region. It is to be noted that in the bituminous mines in 1890 the average daily production per man was 2.56 tons; in 1912 it was 3.68 tons, an increase of 1.12 tons, or 44 per cent. The increase in the average annual tonnage per man was from 579 to 820 tons, or 42 per cent. There has also been an increasing tendency in the average yearly tonnage per man in the anthracite region (the lower rate in 1912, as compared with 1911, being due to the six weeks' suspension), and in spite of the decreasing tendency in the daily output of each man employed. The increased annual tonnage per man in the anthracite mines has been due to the policy of the operators, adopted in 1901, of allowing discounts from the circular prices during the spring and winter months, for the purpose of encouraging consumers to purchase their supplies at that time and make their cellars storage places for the winter fuel. It is to be observed that in the five years from 1897 to 1901, which include the period immediately preceding the time when the discounts become effective, the average working time in the anthracite region ranged from 150 to 196 days, with a mean average of 167 days. There was no year during this period when the mines worked an average of 200 days. The year 1902 is passed over because of the prolonged strike in that year, when the men averaged only 116 days. In 1906 there was a prolonged suspension, and the average number of working days was only 195. This was the only year from 1903 to 1912, inclusive, that the anthracite miners did not average more than 200 days. Exclusive of 1906 the average working time since 1903 has ranged from 200 to 246 days, and including 1906 but excluding 1909, for the reason stated, the mean average from 1903 to 1912, inclusive, has been 216 days. The mean average for the later period has exceeded that of the earlier by 49 days, or 29 per cent. The shortest year (1906) in the latter period was only one day less than the longest year of the earlier period. The average working time in the bituminous regions has not shown the same increasing tendency, but, on the contrary, the mines have been worked an average of fewer days since 1902 than in the half decade ended in that year. From 1897 to 1901 the average working time in the bituminous mines ranged from 196 to 234 days, with an average of 220 days. From 1902 to 1912 it has ranged from 193 to 230 days, with a mean average of 216 days. The increased production per man in the bituminous mines, coincident with the fewer number of days worked, has been due to the increase in the use of mining machinery. In 1891, the first year for which the statistics of machine-mined coal were collected, this factor represented an output of 6,211,752 short tons, or a little more than 5 per cent of the total output. The average number of days worked in that year was 223 and the average output per man per day 2.57 tons, the average annual output being 573 tons. In 1912 the machine-mined production of bituminous coal was

210,538,822 tons, or 46.8 per cent. The average number of days worked was 223, the average daily production per man was 3.68 tons, and the average annual production by each man was 820 tons.

Production of coal according to number of persons employed, 1890–1912.

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
1907	167,234	220	2.33	512	513,258	234	3.29	769
1908	174,174	200	2.39	478	516,264	193	3.34	644
1910	169,497	229	2.17	498	555,533	217	3.46	751
1911	172,585	246	2.13	524	549,775	211	3.50	738
1912	174,030	231	2.10	485	548,632	223	3.68	820

In most of the bituminous mines of the United States the 8-hour working day prevails. In 1912, out of a total of 548,632 employees in the bituminous coal mines, 321,982 worked in mines that were operated 8 hours a day; 60,015 worked in mines that were operated 9 hours a day, and 141,107 worked in mines operated 10 hours a day. The mines which did not report the number of hours to the working day in 1912 employed a total of 25,006 men. It must be remembered, however, that when the length of the working day is stated reference is made to the time the mines are supposed to be in operation, not to the number of hours worked by the miners. In both the anthracite and the bituminous fields practically all the coal is mined by contract at so much per ton, per mine car, by yardage, or on other basis of payment, and the miner being an independent contractor is not obliged to put in a certain number of hours at his working place. Since the settlement of the great strike of 1902 the anthracite mines of Pennsylvania have been operated on a 9-hour basis, with the exception of engineers and pumpmen, who work 8 hours, and, of course, the miners who work by contract. In the bituminous fields the 8-hour day prevails in the States where the men are well organized, and in the districts where the mines are "open shop" or nonunion the 9 or 10 hour day is usual.

The important bituminous coal producing States in which the 8-hour day is generally observed are Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, Montana, Ohio, Oklahoma, Pennsylvania, Texas, Utah, Washington, and Wyoming. It will be noted in the following table that this list includes all of the States of the Mississippi Valley region, two—Ohio and Pennsylvania—in the Appalachian region, and three—Montana, Utah, and Wyoming—in the Rocky Mountain region. In two of the Rocky Mountain States—Colorado and New Mexico—the 10-hour day prevails, and this is also the case in the Southern States of Alabama, Kentucky, Maryland, Virginia, and West Virginia. In Tennessee the majority of the mines are worked 9 hours a day.

Number of hours to the working day, by States.

1911.

State.	8 hours.		9 hours.		10 hours.		All others.
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Men.
Alabama	15	550	50	5,345	102	12,628	4,184
Arkansas	53	5,196	......	......	......	......	461
Colorado	57	2,701	10	299	46	4,559	6,757
Illinois	513	75,088	9	68	2	10	1,434
Indiana	213	20,946	2	7	3	16	213
Iowa	196	16,095	3	16	......	......	488
Kansas	121	10,989	7	177	......	......	191
Kentucky	79	6,103	46	4,789	144	10,289	740
Maryland	2	8	9	148	59	5,670	55
Michigan	21	3,274	......	......	......	......	49
Missouri	193	9,970	8	84	......	......	205
Montana	44	3,862	......	......	......	......	4
New Mexico	2	5	6	167	22	3,823	12
North Dakota	12	115	4	46	24	423	56
Ohio	566	44,351	7	378	3	8	1,298
Oklahoma	90	8,247	......	......	3	35	508
Oregon	6	87	......	......	1	2	100
Pennsylvania	842	99,522	273	28,204	213	37,586	2,887
Tennessee	6	375	56	5,929	30	3,978	421
Texas	16	3,007	3	179	18	1,649	518
Utah	21	3,056	......	......	......	......	4
Virginia	2	43	4	33	52	6,929	387
Washington	45	5,642	......	......	......	......	856
West Virginia	49	4,242	126	11,477	527	49,996	1,015
Wyoming	60	6,571	2	5	......	......	1,348
Total	3,224	330,045	625	57,351	1,249	137,601	24,191

1912.

State.	8 hours.		9 hours.		10 hours.		All others.
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Men.
Alabama	11	338	46	4,145	107	13,938	4,192
Arkansas	46	4,196	......	......	......	......	340
Colorado	61	2,923	5	173	50	4,631	5,273
Illinois	480	75,411	10	67	......	......	2,620
Indiana	211	21,220	1	6	5	109	316
Iowa	194	15,806	1	9	1	4	551
Kansas	132	11,186	7	380	......	......	80
Kentucky	69	6,037	58	4,901	149	11,815	1,551
Maryland	2	53	4	41	57	6,000	68
Michigan	20	3,107	......	......	......	......	6
Missouri	172	9,139	5	72	3	17	476
Montana	39	3,435	......	......	1	5	......
New Mexico	2	4	6	140	23	3,777	7
North Dakota	12	59	4	51	23	415	97
Ohio	581	44,180	11	474	1	10	863
Oklahoma	82	8,105	......	......	3	120	560
Oregon	5	170	......	......	......	......	52
Pennsylvania	774	91,928	316	32,935	214	35,322	4,959
Tennessee	5	317	77	5,720	29	3,980	292
Texas	20	2,908	1	40	19	1,789	390
Utah	22	3,326	1	2	......	......	......
Virginia	2	24	3	41	49	8,181	432
Washington	42	5,344	......	......	2	50	125
West Virginia	47	4,959	119	10,815	535	50,944	1,530
Wyoming	60	7,807	1	3	......	......	226
Total	3,091	321,982	676	60,015	1,271	141,107	25,006

There are so many influences affecting the production of coal in the several States that it is not possible to draw any reliable conclusions in regard to the effect of the length of the working-day upon the productive efficiency of the labor. Principal among these is the independent character of the miner himself, for whom no time record is kept. The thickness of the coal beds and the character of the coal are potential influences upon the capacity of the miner, and these vary over such wide ranges even in one State that any deductions drawn from the statistics herewith presented would be misleading and valueless. The following table shows the prevailing number of hours to the day in the more important coal-producing States, the number of days worked in each, and the average tonnage made by each employee per day for the year, in 1911 and 1912. The largest average yearly tonnage—980 tons—per man in 1912 was made in Pennsylvania bituminous mines most of which are worked 8 hours a day. The second largest tonnage—979 tons—was made in West Virginia, where most of the mines are worked 10 hours per day. The third largest production—917 tons—was made in Wyoming, where nearly all of the mines are worked 8 hours per day. Altogether there were six States in which the average tonnage per man was 900 tons or more, of which three, Pennsylvania (bituminous mines only), Utah, and Wyoming, are 8-hour States, two, New Mexico and Virginia, are 10-hour States, and one, West Virginia, is a State in which most of the mines are worked 9 or 10 hours daily. The smallest average—388 tons—was made in Michigan, an 8-hour per day State, and next to the lowest was made in Oklahoma—417 tons—also an 8-hour per day State; but it is well known that mining conditions in Oklahoma and Arkansas are not nearly so favorable as in most of the other coal-producing States. The mean average production per man in 1912 in the States in which the 8-hour day previals was 663 tons, and in the States in which the 9-hour and 10-hour day prevails it was 808 tons. The best average daily production per man in 1912 was in Montana, where the 8-hour day prevails. In 1911 the best daily record was made in West Virginia, where the 10-hour day prevails. The lowest daily tonnages in 1911 and in 1912 were made in Michigan and Missouri, both 8-hour-day States, but in both States the beds are thin and mining is difficult as compared with other States. Montana was the only State in 1912 and West Virginia was the only State in 1911 in which the average daily production per man exceeded 4 tons.

In 1912 the mean average number of days worked in the mines operating 8 hours a day was 208, and in the States where the 9-hour and 10-hour day prevails the average number of days worked was 245, indicating that in the States in which the longer days prevailed the men were able also to work more days in the year. The 8-hour States are those in which the men are most thoroughly organized and most of them were affected by the wage suspensions on April 1, 1912.

Average production per man compared with hours worked per day, and average number of days per year in 1911 and 1912.

State.	1911				1912			
	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.
Alabama	9 and 10	227	662	2.92	9 and 10	245	712	2.91
Arkansas	8	133	372	2.80	8	157	463	2.95
Colorado	8 and 10	207	710	3.42	8 and 10	227	844	3.72
Illinois	8	188	701	3.73	8	194	767	3.95
Indiana	8	182	670	3.68	8	182	706	3.88
Iowa	8	203	442	2.18	8	188	445	2.37
Kansas	8	189	544	2.86	8	202	600	2.97
Kentucky	8, 9, and 10	191	640	3.18	8, 9, and 10	201	679	3.38
Maryland	10	248	797	3.21	10	259	806	3.11
Michigan	8	218	444	2.04	8	183	387	2.11
Missouri	8	182	374	2.05	8	206	447	2.17
Montana	8	220	770	3.50	8	220	886	4.03
New Mexico	10	230	788	3.41	10	274	900	3.28
Ohio	8	179	668	3.73	8	201	758	3.77
Oklahoma	8	156	350	2.24	8	174	418	2.4
Pennsylvania:								
Anthracite	9	246	524	2.13	9	231	485	2.1
Bituminous	*a* 8	233	859	3.69	*a* 8	252	980	3.89
Tennessee	9 and 10	232	601	2.59	9 and 10	234	628	2.68
Utah	8	236	821	3.48	8	285	906	3.18
Virginia	10	261	929	3.56	10	251	904	3.6
Washington	8	225	550	2.44	8	226	609	2.69
West Virginia	9 and 10	221	896	4.05	8, 9, and 10	266	979	3.68
Wyoming	8	230	851	3.70	8	238	917	3.85

a Represents 60 per cent of employees; the other 40 per cent about evenly divided between 9 and 10 hours.

STRIKES AND SUSPENSIONS.

For the last decade or more, in the coal-mining industry, the "even" years on the calendar have been made conspicuous by the biennial recurrence of "suspensions" on April 1, while miners and operators contended over the wage scale in the States where the miners are organized. The year 1912 was no exception to the rule, but was made somewhat unusual by the fact that the biennial agreement in the anthracite region also terminated on March 31, and by the additional fact that the struggles in the bituminous fields were not as a general thing prolonged, the operators granting advances equivalent to about 5 per cent. The suspension in the anthracite region lasted from April 1 to May 20, and was finally terminated by an increase of 10 per cent in wages, the abolition of the sliding scale which had been in effect for nine years, and certain modifications in the awards of the Anthracite Coal Strike Commission under which mining operations had been carried on since 1903. These are discussed in detail in the section devoted to anthracite production.

The number of men affected in the anthracite region was nearly as many as in all the bituminous fields combined, and the total time lost by the anthracite workers exceeded that lost by the employees in the bituminous mines. The suspension in the anthracite region caused the idleness of 151,958 men (87 per cent of the total number employed) and the total number of days lost was 6,913,475, or an average of 45 days for each man. In the bituminous mines there were 159,098 men idle for an average of 35 days, the total time lost amounting to 5,613,830 days. The largest number of men affected by the suspension in the bituminous fields was in Illinois where 60,505 men (77 per cent of the total number employed) were idle for an average of 33 days. Ohio was next with 27,200 men idle for an average of 32 days, and in the bituminous mines of Pennsylvania 22,538 men were idle for an average of 24 days. Indiana had 15,400 men idle for an average of 52 days, and Iowa had 8,455 men idle for an average of 44 days. The largest number of days lost by the men affected was in Arkansas where the average idle time was 94 days, but there were only 403 men idle out of a total of 4,536 employees. The most serious trouble occurred in the Paint Creek and Cabin Creek mining districts of the Kanawha region of West Virginia, and was not a suspension for an adjustment of the wage scale but a struggle for a recognition of the mineworkers' union. The struggle lasted during the greater part of the year, was attended by riot and bloodshed, and finally resulted in the declaration of martial law by the governor of the State. The trouble began in the first part of August, the various mines shutting down as the men were induced to quit work. Most of the mines resumed work in November, but in others the strikes were still on at the close of the year. Although relatively local, the fight was one of the most bitter in recent years and has been given more prominence in the press, daily, weekly, and monthly, than any contest of the kind since the anthracite strike of 1902. It has been made the subject of investigation by a special committee of the United States Senate, and at the time of writing this report (July, 1913) is still not entirely settled. Other minor difficulties occurred in various parts of the State, and the average time lost by the 12,165 men affected was 50 days. In Kanawha County, where the chief trouble occurred, there were 6,133 men idle for an average of 65 days.

The statistics of labor troubles in the coal fields of the United States are presented in the following table. In computing the number of days lost, Sundays have not been included, possible working days only having been considered.

Statistics of labor strikes in the coal mines of the United States in 1911 and 1912.

State.	1911			1912		
	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	210	1,260	6	384	12,323	32
Arkansas	665	4,615	7	403	37,685	94
Colorado	150	32,375	216			
Georgia						
Illinois	5,543	100,588	18	60,505	2,026,526	33
Indiana	4,577	146,636	32	15,400	795,887	52
Iowa	1,622	31,870	20	8,455	370,449	44
Kansas	984	8,507	9	2,088	13,487	65
Kentucky	1,080	34,008	32	2,759	79,685	29
Maryland				347	3,228	9
Michigan				2,028	101,424	50
Missouri	504	24,216	48	952	55,022	58
Montana	529	8,114	15	869	8,445	10
North Dakota	34	69	2	10	20	2
Ohio	9,530	350,039	37	27,200	895,777	32
Oklahoma	444	15,106	34	860	12,109	14
Oregon				60	420	7
Pennsylvania	5,601	148,124	26	22,538	538,248	24
Tennessee	163	1,630	10	670	20,011	30
Texas	60	300	5	238	1,724	7
Utah	208	624	3			
Washington	2,099	22,215	10	807	31,347	39
West Virginia	1,510	16,483	11	12,165	606,588	50
Wyoming				360	3,425	10
Total bituminous	35,513	946,779	27	159,098	5,613,830	35
Pennsylvania anthracite	5,900	36,958	6	151,958	6,913,475	45

A summary of the statistics of strikes in the coal mines of the United States since 1899 is given in the following table:

Summary of labor strikes in the coal mines of the United States, 1899–1912.

Years.	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
1907 [a]	32,540	462,392	14
1908 [a]	145,145	5,449,938	38
1909 [a]	24,763	723,634	29
1910	218,493	19,250,524	88
1911	41,413	983,737	24
1912	311,056	12,527,305	40

[a] Bituminous mines only.

COAL MINED BY MACHINES.

One of the interesting features connected with the mining of bituminous coal in the United States in 1912 was the continued increase in the production by the use of machines, both in actual tonnage and in the proportion that the machine-mined output bore to the total. The total production of bituminous coal in the United States increased from 405,907,059 short tons in 1911 to 450,104,982 tons in 1912. The quantity of coal undercut or otherwise mined by the use of machines increased from 178,158,236 tons in 1911 to 210,538,822 tons in 1912. The increase in the total production was 44,197,923 tons, or 10.9 per cent, and the increase in the output by the use of machines was 32,380,586 tons, or 18 per cent, the increase in the production of machine-mined coal being equal to 75 per cent of the total increase in the production of bituminous coal in 1912 over 1911. The percentage of machine-mined coal to the total output has increased each year since the first successful undercutting machines were installed. In 1902, 10 years previous to the period covered by the present report, the quantity of coal mined by machinery in the United States represented only 27 per cent of the total output of bituminous coal. In 1912, 46.8 per cent of the total production was machine mined. In 1911, 43.9 per cent of the production was mined by machinery, and in 1910, 41.7 per cent.

It is much to be doubted if the present enormous production of bituminous coal (in 1912 within 10 per cent of half a billion tons) could, under present labor and market conditions, have been attained except through the substitution of mechanical methods in the mining of a large proportion of the output. Although the increase in the use of mining machinery is an evidence of progress in reducing the exacting character of the miner's employment, the reasons for the installation of mining machinery have been economic rather than humanitarian. In many cases the installation of machinery has been forced upon the operators by the constantly advancing cost of labor and the necessity for keeping mining costs within narrow limits because of the keen competition which has for many years existed in the bituminous coal trade. The bituminous coal mines of the United States were worked an average of 223 days in 1912, and they produced a total of a little over 450,000,000 tons, from which it is easy to deduce that had the mines been operated a full working year of 300 days, the tonnage would have reached 600,000,000, with the present capacity and equipment. During 1912 the scarcity of labor was in evidence in a large number of bituminous coal mining districts. Many of the miners are foreign born, and quite a large number are from the southern part of Europe, which was the scene of war during a large part of 1912, and the exodus of miners to the Balkan States was quite marked. Moreover, in 1912 there was an increased demand for labor in more attractive lines of employment, which drew upon the forces employed in the coal mines. There were fewer men engaged in bituminous coal mining in 1912 than in 1911, notwithstanding the increased activity and much larger production, and without making allowance for the natural increase in the number of employees in all lines of industry. It is to be expected, therefore, that the production of coal by mechanical methods will continue to show proportionate increase until a relatively small quantity will be mined by hand. In addition to the economic and humanitarian results accomplished by the use of machines, another important end is attained. The larger the proportion of coal mined by machines, the smaller will be the proportion of coal shot off the solid without having been previously mined or sheared. Any step which mitigates that evil in the mining of bituminous coal is a step in advance, and as shown in the section on mining methods in this report, there was a slight reduction in the percentage of coal mined by powder, although the quantity so mined in 1912 was larger than in 1911. Recent developments in the construction of mining machinery have provided machines which are adapted to beds of any inclination, so that there are now practically no insurmountable physical obstacles to the substitution of machines for hand labor.

The methods of attacking the coal by machinery are of two distinct types. One is that of sawing; the other, of chopping. Three types of machines represent the former method—the chain-breast, the long-wall, and the short-wall. In these machines the coal is attacked by bits attached to an endless chain or to the periphery of a disk, and, as can be readily seen, the action is very similar to that of sawing wood. In the second type of machine the coal is attacked by bits attached to arms actuated reciprocally, as in the action of drilling, except that the work of the drill is not confined to one hole, but is freely changed at the will of the operator. These machines are designated as the pick or puncher, in which the drill is mounted on two wheels and operated on a platform in front of the face of the coal, and as the radialaxe or post-puncher, in which the piston is attached to a post and the drill is radiated in one plane. This latter machine has been developed for use in the steep-pitching beds. A new machine, brought out in 1912, combines the sawing and the chopping actions of the other two types. In this machine bits are inserted in the manner of a screw around an arm projecting from the machine. This arm is given both a reciprocating and a revolving motion, so that the coal is attacked by both a chopping and a sawing action. This machine was not actually placed on the market until after the close of the year.

The total number of machines reported in use in the coal mines of the United States in 1912 was 15,298, an increase of 1,469 over 1911, when the number of machines reported was 13,829. The average number of tons mined by each machine in 1912 was 13,763, the largest tonnage per machine ever reported. The best previous record was in 1900, when the average production per machine was 13,510 tons. The most popular types of machines now in use are the pick or puncher and the chain-breast, nearly the same number of each having been in use in 1912, with the odds in favor of the pick machine. Out of a total of 15,298 machines employed in 1912, 6,833 were punchers, 6,425 were chain-breast, 545 were long-wall, 1,371 were short-wall, and 124 were of the radialaxe or post-puncher type. That the short-wall machine is rapidly gaining in popularity is evidenced by the fact that in 1911 there were 777 of that type employed and in 1912 there were 1,371. Pennsylvania, the largest producer of bituminous coal, is also the first in the total tonnage mined by machines and in the total number of machines in use, but the State falls behind Ohio, Kentucky, Indiana, Michigan, and West Virginia in the proportion of machine-mined coal to the total production. In 1912 Pennsylvania's production of machine-mined coal was 82,192,042 short tons, or 50.8 per cent of the total output of the State. Ohio, which ranks first in the percentage of coal mined by machines, although third in the quantity of coal so mined, produced by machinery 30,048,831 tons, or 87 per cent of the total in 1912. Kentucky ranks next to Ohio in the proportion of machine-mined coal, with 66.4 per cent (10,954,648 tons) in 1912. West Virginia, the second State in the production of coal, is also second in the quantity of coal mined by machines, but falls behind Ohio, Kentucky, Indiana, and Michigan in the percentage of the machine-mined production.

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, 1911 and 1912, by States.

State.	Number of machines in use.		Number of tons mined by machines.	
	1911	1912	1911	1912
Alabama	272	353	2,936,512	3,742,549
Arkansas	14	9	27,029	76,611
California	.....	1	.....	200
Colorado	242	304	1,975,411	2,552,168
Illinois	1,402	1,654	23,093,807	26,878,049
Indiana	667	687	7,049,758	8,363,759
Iowa	20	24	42,963	95,342
Kansas	15	11	100,444	75,816
Kentucky	987	1,168	9,188,548	10,954,648
Maryland	37	53	154,301	125,625
Michigan	113	126	734,246	635,560
Missouri	92	86	753,614	898,852
Montana	87	69	1,172,582	984,905
New Mexico	10	25	93,722	285,362
North Dakota	11	11	192,943	168,904
Ohio	1,536	1,547	26,556,630	30,048,831
Oklahoma	26	60	87,048	259,719
Pennsylvania	5,719	6,176	69,131,923	82,192,042
Tennessee	179	227	914,614	1,201,895
Texas	15	21	71,085	105,400
Utah	7	13	70,653	114,716
Virginia	156	185	2,551,627	3,205,504
Washington	23	56	188,707	258,089
West Virginia	2,044	2,253	29,121,480	34,946,394
Wyoming	155	179	1,948,589	2,367,882
Total	13,829	15,298	178,158,236	210,538,822

State.	Total tonnage of States using mining machinery.		Percentage of total product mined by machines.	
	1911	1912	1911	1912
Alabama	15,021,421	16,100,600	19.6	23.2
Arkansas	2,106,789	2,100,819	1.3	3.7
California	.....	10,978	.....	1.8
Colorado	10,157,383	10,977,824	19.5	23.2
Illinois	53,679,118	59,885,226	43	44.9
Indiana	14,201,355	15,285,718	49.6	54.7
Iowa	7,331,648	7,289,529	6.6	1.3
Kansas	6,178,728	6,986,182	1.7	1.1
Kentucky	14,049,703	16,490,521	65.4	66.4
Maryland	4,685,795	4,964,038	3.3	2.5
Michigan	1,476,074	1,206,230	49.7	52.7
Missouri	3,836,107	4,339,856	19.6	20.7
Montana	2,976,358	3,048,495	39.4	32.3
New Mexico	3,148,158	3,536,824	3	8.1
North Dakota	502,628	499,480	38.4	33.8
Ohio	30,759,986	34,528,727	86.3	87
Oklahoma	3,074,242	3,675,418	2.8	7.1
Pennsylvania	144,561,257	161,865,488	47.7	50.8
Tennessee	6,433,156	6,473,228	14.2	18.6
Texas	1,974,593	2,188,612	3.6	4.8
Utah	2,513,175	3,016,149	2.8	3.8
Virginia	6,864,667	7,846,638	37.2	40.8
Washington	3,572,815	3,360,932	5.3	7.7
West Virginia	59,831,580	66,786,687	48.7	52.3
Wyoming	6,744,864	7,368,124	28.9	32.1
Total	405,681,600	449,832,323	[a] 43.89	[a] 46.8

[a] Average.

One of the determining factors in the choice of machines for undercutting the coal is the character of the roof, it being impracticable to operate chain-breast machines when the roof is tender and the timbering has to be kept up close to the face. This limitation does not apply to the short-wall or continuous-cutter machines, which can be operated in mines where the timbering is within 3 feet, or even less, of the face. Neither of these machines is so well adapted as the punchers for use in mines where "sulphur balls" (nodules of iron pyrites) are prevalent, as the sulphur balls will break or quickly dull the cutting bits, whereas the operator of the puncher can cut around them. The limitations of the chain type of machine (including the continuous cutters) are compensated for, however, by the higher efficiency in the mines where they can be used and by the greater ease with which the wires can be carried through the mines as compared with the air pipes for the punchers. Most of the chain machines are operated by electricity, and compressed air is used to actuate the punchers. It will be observed from the following table that in Ohio where the machine production represents all but 15 per cent of the total, chain-breast machines are largely in the ascendant, while in Pennsylvania, where the largest tonnage is produced, the pick or puncher machines nearly double the number of chain machines. Among the other more important States pick machines are more numerous than the chain machines in Alabama, Colorado, Illinois, Kentucky, and Tennessee, and the chain machines appear to be the more popular in Indiana, Virginia, and West Virginia. Missouri is the only State in which long-wall machines are the more numerous. The radialaxe or post-puncher machine was intended principally to furnish a machine capable of cutting the coal in beds too steeply inclined for the puncher, chain-breast, or long-wall machines. The largest number of these machines in use is in Washington, where the beds are much inclined and distorted. Colorado, Oklahoma, and Wyoming were also prominent in the installation of this type of machine, which appears to meet some of the conditions in these States.

In the following table are shown the number and kind of machines in use in each State, so far as they were reported to the Survey in 1911 and 1912:

Number and kinds of machines in use in 1911 and 1912, by States.

State.	1911						1912					
	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.	Pick.	Chain breast.	Long wall.	Short wall.	Radial axe or post.	Total.
Alabama	184	53	13	22	......	272	222	60	12	59	......	353
Arkansas	......	10	......	2	2	14	......	......	......	6	3	9
California	......	......	......	......	......	......	......	......	......	......	1	1
Colorado	157	26	34	17	8	242	187	33	16	57	11	304
Illinois	780	555	20	47	......	1,402	847	701	22	81	3	1,654
Indiana	166	426	30	45	......	667	198	348	99	42	......	687
Iowa	10	6	3	......	1	20	16	3	3	1	1	24
Kansas	15	......	......	......	......	15	9	......	2	......	......	11
Kentucky	544	314	72	57	......	987	611	361	54	136	6	1,168
Maryland	29	......	1	6	1	37	41	......	5	7	......	53
Michigan	60	46	......	7	......	113	48	37	......	41	......	126
Missouri	17	......	75	......	......	92	2	2	78	4	......	86
Montana	56	18	......	11	2	87	38	21	......	8	2	69
New Mexico	4	4	2	......	......	10	7	4	......	13	1	25
North Dakota	......	11	......	......	......	11	......	11	......	......	......	11
Ohio	92	1,343	54	47	......	1,536	77	1,362	2	106	......	1,547
Oklahoma	5	6	5	2	8	26	16	14	4	15	11	60
Pennsylvania	3,556	1,874	82	188	19	5,719	3,660	2,023	52	439	2	6,176
Tennessee	121	15	9	31	3	179	154	17	15	39	2	227
Texas	12	......	3	......	......	15	18	......	3	......	......	21
Utah	5	2	......	......	......	7	5	6	......	2	......	13
Virginia	......	121	......	35	......	156	5	128	1	51	......	185
Washington	......	......	......	......	23	23	......	......	......	......	56	56
West Virginia	667	1,041	77	253	6	2,044	604	1,217	175	245	12	2,253
Wyoming	55	[a] 77	1	12	10	155	68	77	2	19	13	179
Total	6,535	5,948	481	782	83	13,829	6,833	6,425	545	1,371	124	15,298

[a] Includes 2 cutter-bar machines.

The statistics relating to the use of mining machines were first collected by the Survey for the year 1896. The inquiries at that time covered the number of machines in use and the quantity of coal won by them in 1891, five years before. From the returns to the Survey since 1896, the results of which have been published in detail in the preceding volumes of Mineral Resources of the United States, 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
1907	11,144	137,973,701	12,381
1908	11,569	123,183,334	10,648
1909	13,049	142,496,878	10,920
1910	13,254	174,012,293	13,127
1911	13,829	178,158,236	12,854
1912	15,298	210,538,822	13,763

As stated in the section in which the labor statistics for 1912 are discussed, it is impossible, owing to the widely differing conditions in the several States, to draw from these statistics any definite conclusions regarding the average tonnage won by each employee. It generally appears, however, that in the States where the percentage of machine-mined coal has shown a marked increase there has also been a gain in the efficiency of the labor, as indicated by the average daily tonnage of each man employed. In nearly every State where the percentage of machine-mined coal increased in 1912 there was also an increase in the average daily tonnage per man. There were, however, some notable exceptions to this rule. In Alabama the percentage of the machine-mined coal increased from 19.6 in 1911 to 23.2 in 1912, but the average daily output per man decreased from 2.92 tons to 2.91 tons. There was, however, an increase from 662 to 712 tons in the average annual production per man in Alabama. In Montana the percentage of machine-mined production decreased from 39.4 to 32.3, while the average daily tonnage per man increased from 3.5 to 4.03 tons. In West Virginia where the percentage of machine-mined coal increased from 48.7 to 52.3, the average daily tonnage per man decreased from 4.05 to 3.68 tons.

In the following table the quantity and percentage of machine-mined production in 1911 and 1912, by States, are compared with the average daily and yearly production by each employee in the States where mining machines are used:

Average production per man compared with production by machines in 1911 and 1912, by States, in short tons.

State.	Average tonnage.				Production by machines.			
	Per year.		Per day.		Total tonnage by machines.		Per cent of machine coal to State total.	
	1911	1912	1911	1912	1911	1912	1911	1912
Alabama	662	712	2.92	2.91	2,936,512	3,742,549	19.6	23.2
Arkansas	372	463	2.80	2.95	27,029	76,611	1.3	3.7
California	....	211	....	1.14	....	200	....	1.8
Colorado	710	844	3.42	3.72	1,975,411	2,552,168	19.5	23.2
Illinois	701	767	3.73	3.95	23,093,807	26,878,049	43.0	44.9
Indiana	670	706	3.68	3.88	7,049,758	8,363,759	49.6	54.7
Iowa	442	445	2.18	2.37	42,963	95,342	.6	1.3
Kansas	544	600	2.86	2.97	100,444	75,816	1.7	1.1
Kentucky	640	679	3.18	3.38	9,188,548	10,954,648	65.4	66.4
Maryland	797	806	3.21	3.11	154,301	125,625	3.3	2.5
Michigan	444	387	2.04	2.11	734,246	635,560	49.7	52.7
Missouri	374	447	2.05	2.17	753,614	898,852	19.6	20.7
Montana	770	886	3.50	4.03	1,172,582	984,905	39.4	32.3
New Mexico	788	900	3.41	3.28	93,722	285,362	3.0	8.1
North Dakota	785	803	3.43	3.46	192,943	168,904	38.4	33.8
Ohio	668	758	3.73	3.77	26,556,630	30,048,831	86.3	87.0
Oklahoma	350	418	2.24	2.40	87,048	259,719	2.8	7.1
Pennsylvania, bituminous	859	980	3.69	3.89	69,131,923	82,192,042	47.7	50.8
Tennessee	601	628	2.59	2.68	914,614	1,201,895	14.2	18.6
Texas	369	424	1.63	1.84	71,085	105,400	3.6	4.8
Utah	821	906	3.48	3.18	70,653	114,716	2.8	3.8
Virginia	929	904	3.56	3.60	2,551,627	3,205,504	37.2	40.8
Washington	550	609	2.44	2.69	188,707	258,089	5.3	7.7
West Virginia	896	979	4.05	3.68	29,121,480	34,946,394	48.7	52.3
Wyoming	851	917	3.70	3.85	1,948,589	2,367,882	28.9	32.1

MINING METHODS.

In this report and in that covering 1911 the first attempts have been made to present some statistics in regard to the quantity of bituminous coal properly mined, either by hand or machine, and the quantity and percentage that was shot or blasted without having been undercut or sheared. The method practiced in the latter case is characterized as "shooting off the solid," the only preparation for which consists in drilling the holes necessary to charge with the explosives. So much has been said and written in condemnation of this dangerous and reprehensible practice that it hardly seems necessary to do more than utter a plea for its prohibition by law or by the constituted inspection authorities of the several States. It increases the liability to accident in a vocation already extra hazardous by accentuating the liability to gas and dust explosions and to mine fires; it is injurious to the mining property in that the inordinate charges of powder weaken the roofs and pillars; and it is wickedly wasteful in that it materially reduces the quality of the output. The heavy charges of powder required when "the powder does the work" result in the production of a much larger percentage of fine coal at the start and render the lump coal so friable that it disintegrates badly in handling and in transportation and creates dissatisfaction on the part of the consumer who buys lump coal and gets, to say the least, mine-run coal.

The principal offenders in this respect are in those States where for more reasons than one the contrary condition should prevail. These are the States of the Middle West, or in what is designated as the interior province. Arkansas leads in wrongdoing, the figures collected by the Survey showing that 90.4 per cent of the State's output in 1911 and 92.2 per cent of the production in 1912 was shot off the solid. Oklahoma falls only a little behind, with 78.8 per cent of coal "powder mined" in 1911 and 86.4 per cent in 1912. Illinois reported 38.1 per cent of its total product shot off the solid in 1911 and 40.3 per cent in 1912. Iowa's proportion increased from 68.4 per cent to 69.1 per cent and that of Kansas from 78.6 to 83.9 per cent. Indiana showed an improvement by reducing its percentage from 38 to 30.2, and slight reductions were made in Michigan and Missouri. Among the Rocky Mountain States Wyoming and Montana had the highest records; New Mexico showed a marked improvement in 1912, the percentage of powder-mined coal dropping from 31.2 to 16.9, nearly 50 per cent; Colorado is well down, and Utah had the best record (3.1 per cent in 1912) of the States west of the Appalachian coal fields. The worst record in the Eastern States is held by Virginia, with 47.7 per cent of its output shot off the solid in 1912; Alabama comes next, with 35.1 per cent, and Georgia third, with 35 per cent. Pennsylvania, Maryland, Ohio, and West Virginia all had percentages of less than 5, and the last named, West Virginia, stands well at the head of the honor roll, with less than 1 per cent of its product improperly mined. The department of mines of that State has been commendably active in its efforts to suppress the evil in the coal mines of the State.

The total quantity of coal reported as shot off the solid in 1912 was 76,241,575 short tons, of which 46,848,403 tons, or over 60 per cent, were produced in the Mississippi Valley States, whose output is less than 20 per cent of the total output of bituminous coal in the United States.

The quantity of machine-mined coal increased from 178,158,236 short tons, or 43.9 per cent of the total, in 1911, to 210,538,822 tons, or 46.8 per cent, in 1912; the hand-mined coal increased from 120,-449,746 tons, or 29.7 per cent, to 136,650,635 tons, or 30.04 per cent; and the powder-mined coal increased from 69,054,500 tons to 76,241,-575 tons, with a decrease of 0.1 in its percentage of the total.

The following table shows the quantity and percentage of bituminous coal in the several States mined by hand and by machines, shot off the solid, and mined by unreported methods in 1911 and 1912:

Quantity and percentage of bituminous coal mined by different methods in 1911, by States.

State.	Mined by hand.	Per-centage.	Shot off the solid.	Per-centage.	Mined by machines.	Per-centage.	Not reported.	Per-centage.	Total production.
Alabama	4,673,719	31.1	6,623,252	44.1	2,936,512	19.6	787,938	5.2	15,021,421
Alaska	900	100.0	....	....	....	....	....	....	900
Arkansas	131,596	6.2	1,903,728	90.4	27,029	1.3	44,436	2.1	2,106,789
California	10,747	100.0	....	....	....	....	....	....	10,747
Colorado	5,822,282	57.3	1,260,191	12.4	1,975,411	19.5	1,099,499	10.8	10,157,383
Georgia	16,274	9.8	....	....	....	....	148,936	90.2	165,210
Idaho	230	12.7	1,575	87.3	....	....	....	....	1,805
Illinois	7,125,008	13.3	20,433,262	38.1	23,093,807	43.0	3,027,041	5.6	53,679,118
Indiana	1,098,903	7.7	5,390,503	38.0	7,049,758	49.6	662,191	4.7	14,201,355
Iowa	1,111,924	15.2	5,017,108	68.4	42,963	.6	1,159,653	15.8	7,331,648
Kansas	347,074	5.6	4,857,714	78.6	100,444	1.7	873,496	14.1	6,178,728
Kentucky	1,811,392	12.9	2,336,007	16.7	9,188,548	65.4	713,756	5.0	14,049,703
Maryland	3,660,778	78.1	24,402	.5	154,301	3.3	846,314	18.1	4,685,795
Michigan	158,480	10.7	548,858	37.2	734,246	49.8	34,490	2.3	1,476,074
Missouri	761,432	19.9	1,893,429	49.4	753,614	19.6	427,632	11.1	3,836,107
Montana	764,938	25.7	1,008,465	33.9	1,172,582	39.4	30,373	1.0	2,976,358
Nevada	16	100.0	....	....	....	....	....	....	16
New Mexico	2,059,844	65.4	981,760	31.2	93,722	3.0	12,832	.4	3,148,158
North Carolina	120	100.0	....	....	....	....	....	....	120
North Dakota	66,659	13.3	133,682	26.6	192,943	38.4	109,344	21.7	502,628
Ohio	2,117,414	6.9	857,234	2.8	26,556,630	86.3	1,228,708	4.0	30,759,986
Oklahoma	168,202	5.5	2,423,307	78.8	87,048	2.8	395,685	12.9	3,074,242
Oregon	4,080	8.7	30,885	66.2	....	....	11,696	25.1	46,661
Pennsylvania	49,527,801	34.3	3,769,404	2.6	69,131,923	47.8	22,132,129	15.3	144,561,257
Tennessee	2,267,786	35.2	2,423,515	37.7	914,614	14.2	827,241	12.9	6,433,156
Texas	625,233	31.7	204,092	10.3	71,085	3.6	1,074,183	54.4	1,974,593
Utah	1,993,574	79.3	192,752	7.7	70,653	2.8	256,196	10.2	2,513,175
Virginia	1,865,320	27.2	2,442,562	35.6	2,551,627	37.1	5,158	.1	6,864,667
Washington	2,247,074	62.9	987,196	27.6	188,707	5.3	149,838	4.2	3,572,815
West Virginia	28,054,005	46.9	626,295	1.0	29,121,480	48.7	2,029,800	3.4	59,831,580
Wyoming	1,956,941	29.0	2,683,322	39.8	1,948,589	28.9	156,012	2.3	6,744,864
Total	120,449,746	29.7	69,054,500	17.0	178,158,236	43.9	38,244,577	9.4	405,907,059

Quantity and percentage of bituminous coal mined by different methods in 1912, by States.

State.	Mined by hand.	Per-centage.	Shot off the solid.	Per-centage.	Mined by machines.	Per-centage.	Not reported.	Per-centage.	Total production.
Alabama	6,658,732	41.4	5,658,457	35.1	3,742,549	23.2	40,862	0.3	16,100,600
Arkansas	73,556	3.5	1,937,817	92.2	76,611	3.7	12,835	.6	2,100,819
California	7,778	70.9	.2,500	22.8	200	1.8	500	4.5	10,978
Colorado	7,076,131	64.5	1,309,544	11.9	2,552,168	23.2	39,981	.4	10,977,824
Georgia	147,815	65.0	79,688	35.0	....	....	....	....	227,503
Illinois	7,675,805	12.8	24,136,940	40.3	26,878,049	44.9	1,194,432	2.0	59,885,226
Indiana	2,094,397	13.7	4,615,580	30.2	8,363,759	54.7	211,982	1.4	15,285,718
Iowa	1,451,673	19.9	5,034,729	69.1	95,342	1.3	707,785	9.7	7,289,529
Kansas	408,835	5.9	5,864,226	83.9	75,816	1.1	637,305	9.1	6,986,182
Kentucky	2,306,222	14.0	2,727,399	16.5	10,954,648	66.4	502,252	3.1	16,490,521
Maryland	4,668,104	94.0	121,130	2.5	125,625	2.5	49,179	1.0	4,964,038
Michigan	120,637	10.0	443,222	36.7	635,560	52.7	6,811	.6	1,206,230
Missouri	1,036,994	23.9	2,083,656	48.0	898,852	20.7	320,354	7.4	4,339,856
Montana	923,698	30.3	1,123,571	36.9	984,905	32.3	16,321	.5	3,048,495
New Mexico	2,642,137	74.7	599,463	16.9	285,362	8.1	9,862	.3	3,536,824
North Dakota	71,103	14.2	181,798	36.4	168,904	33.8	77,675	15.6	499,480
Ohio	2,332,767	6.8	1,341,823	3.9	30,048,831	87.0	805,306	2.3	34,528,727
Oklahoma	49,212	1.3	3,175,455	86.4	259,719	7.1	191,032	5.2	3,675,418
Pennsylvania	54,545,218	33.7	4,801,784	3.0	82,192,042	50.8	20,326,444	12.5	161,865,488
Tennessee	2,708,650	41.8	2,127,917	32.9	1,201,895	18.6	434,766	6.7	6,473,228
Texas	1,028,025	47.0	280,105	12.8	105,400	4.8	775,082	35.4	2,188,612
Utah	2,805,498	93.0	91,992	3.1	114,716	3.8	3,943	.1	3,016,149
Virginia	898,821	11.5	3,741,533	47.7	3,205,504	40.8	780	....	7,846,638
Washington	1,991,549	59.3	1,102,993	32.8	258,089	7.7	8,301	.2	3,360,932
West Virginia	31,101,454	46.6	453,215	.7	34,946,394	52.3	285,624	.4	66,786,687
Wyoming	1,810,559	24.6	3,180,067	43.2	2,367,882	32.1	9,616	.1	7,368,124
Other States	15,265	33.8	24,971	55.3	....	....	4,920	10.9	45,156
Total	136,650,635	30.4	76,241,575	16.9	210,538,822	46.8	26,673,950	5.9	450,104,982

COAL-WASHING OPERATIONS.

A considerable quantity of coal is washed at the mines in order to reduce the percentage of impurities (ash and sulphur) and thus improve the quality of the product. The larger portion of the product so treated is slack used for coke making, but in some cases, as in Illinois and other States, where the coal is noncoking, the washed product is principally nut coal used for domestic fuel. In 1912 the quantity of coal prepared at the mines for coking or for market by washing was 19,844,517 short tons, which yielded 17,538,572 tons of cleaned coal and 2,305,945 tons of refuse. In 1911, 12,543,114 short tons of coal washed yielded 10,999,481 tons of cleaned coal and 1,543,633 tons of refuse. Alabama leads in the quantity of coal washed, and Pennsylvania is second, with Illinois third. Most of the washed product of Illinois is nut coal for domestic use, the coal washed in Alabama and Pennsylvania being principally for coke making. These three States reported over 80 per cent of the total quantity of coal washed in 1912.

In the report on the production of Pennsylvania anthracite, which will be found in the subsequent pages of this chapter and which is also published as a separate pamphlet, it is shown that 4,165,288 long tons, equivalent to 4,665,123 short tons, were recovered by washing from the old culm banks in 1912, against 4,136,044 long tons, or 4,632,369 short tons, in 1911. The quantity of coal recovered by the anthracite washeries is not included in the following table, which shows the quantity of bituminous coal washed at the mines in 1911 and 1912.

Bituminous coal washed at the mines in 1911 and 1912, with quantity of washed coal and of refuse obtained from it, by States, in short tons.

1911.

State.	Quantity of coal washed.	Quantity of cleaned coal.	Quantity of refuse.
Alabama	6,251,828	5,538,401	713,427
Arkansas			
Colorado	329,824	228,105	101,719
Georgia	111,579	83,327	28,252
Illinois	2,553,381	2,154,697	398,684
Indiana			
Kentucky	14,500	12,000	2,500
Maryland			
Michigan	234,063	207,135	26,928
Missouri			
Montana	557,770	536,822	20,948
North Dakota	13,079	12,571	508
Ohio	40,251	38,011	2,240
Oklahoma	10,568	8,449	2,119
Oregon	40,487	30,365	10,122
Pennsylvania	1,159,584	1,057,668	101,916
Tennessee	356,784	328,117	28,667
Texas	37,000	30,375	6,625
Virginia	50,297	42,417	7,880
Washington	392,503	338,708	53,795
West Virginia	202,218	183,655	18,563
Total	12,355,716	10,830,823	1,524,893

1912.

State.	Quantity of coal washed.	Quantity of cleaned coal.	Quantity of refuse.
Alabama	7,187,211	6,325,946	861,265
Arkansas	72,753	50,563	22,190
Colorado	116,950	107,174	9,776
Georgia	111,923	87,300	24,623
Illinois	3,522,760	3,070,523	452,237
Indiana	18,784	17,077	1,707
Kentucky	164,496	150,626	13,870
Maryland	53,842	53,191	651
Michigan	128,738	113,623	15,115
Missouri	140,582	101,953	38,629
Montana	666,713	599,104	67,609
North Dakota			
Ohio	336,639	305,629	31,010
Oklahoma	143,537	117,018	26,519
Oregon	12,501	10,501	2,000
Pennsylvania	4,819,330	4,326,162	493,168
Tennessee	449,847	390,994	58,853
Texas	25,599	20,639	4,960
Virginia	60,640	56,925	3,715
Washington	863,643	731,521	132,122
West Virginia	948,029	902,103	45,926
Total	19,844,517	17,538,572	2,305,945

PRICES.

As indicated by the statements regarding production and value, in the earlier pages of this report, the year 1912 was exceptional in the general advance in value of both anthracite and bituminous coal throughout the United States. Of the important coal-producing States, there were only two, New Mexico and Utah, both public-land States, where the average value per ton in 1912 was less than in 1911. The average price of anthracite was the highest recorded in the 33 years, beginning with 1880 and ending with 1912. The average price of bituminous coal in 1912 was exceeded during this period in only two years, in 1880, when the statement of values was largely a matter of estimate, and in 1903, when practically a fuel famine existed, following the prolonged strike in the anthracite region of Pennsylvania in 1902 and long periods of idleness from the same cause in many of the organized bituminous States. The average price of anthracite in 1912 was $2.36 per long ton ($2.11 per short ton), as compared with $2.17 per long ton ($1.94 per short ton) in 1911. The advance in the price of anthracite was due to the advance in wages following the six weeks' suspension on April 1, 1912. As will be seen by reference to the section on anthracite production, the estimated cost of mining anthracite prior to the advance in May, 1912, was $1.93 per long ton. The new wage agreement granted an increase of 10 per cent in wages. This increase in the estimated cost, as indicated above, will amount to 19.3 cents per long ton. The average price of anthracite in 1912 was 19 cents per long ton over 1911. The advances in bituminous prices ranged from 1 cent per short ton in Texas to 46 cents in Idaho. The next largest advance was 33 cents in the combined average value of California and Alaska coal, and Oregon showed an advance of 28 cents. In all of these States where the advance was large, however, the production was negligibly small. Outside of these unimportant States the most striking advance in value was in Michigan, where the average value in 1912 was 21 cents more than in 1911. This increase seems attributable to the inability of operators to sell some of the lower-grade coals at any price, because of the competition with Pennsylvania and West Virginia coals. Only the better grades of the State's product could find a market, and those grades, of course, commanded a higher value. The mean average gain in value per ton of all bituminous and lignite coals produced in the United States in 1912 over 1911 was 4 cents per short ton, the same gain which was shown in the average value of Pennsylvania bituminous coal and in the production of West Virginia and Ohio.

The following tables show the average price, by States, for the last 5 years, with the advances and declines in 1912 as compared with 1911, and the general averages for anthracite and bituminous prices for 33 years:

Average price per short ton for coal at the mines since 1908, by States and Territories.

State or Territory.	1908	1909	1910	1911	1912	Advance (+) or decline (−) in 1912.
Alabama	$1.26	$1.19	$1.26	$1.27	$1.29	+$0.02
Arkansas	1.68	1.48	1.56	1.61	1.71	+ .10
California	a 3.19	2.21	a 2.74	a 2.00	a 2.33	+ .33
Colorado	1.41	1.33	1.42	1.45	1.49	+ .04
Georgia	1.38	1.41	1.46	b 1.49	b 1.49	....
Idaho	4.02	4.27	3.92	c 2.68	c 3.14	+ .46
Illinois	1.05	1.05	1.14	1.11	1.17	+ .06
Indiana	1.06	1.02	1.13	1.08	1.14	+ .06
Iowa	1.63	1.65	1.75	1.73	1.80	+ .07
Kansas	1.49	1.44	1.61	1.53	1.62	+ .09
Kentucky	1.01	.94	.99	.99	1.02	+ .03
Maryland	1.17	1.11	1.12	1.11	1.18	+ .07
Michigan	1.81	1.79	1.91	1.78	1.99	+ .21
Missouri	1.64	1.65	1.79	1.72	1.76	+ .04
Montana	1.96	1.97	1.82	1.79	1.82	+ .03
New Mexico	1.37	1.29	1.39	1.44	1.42	− .02
North Dakota	1.63	1.56	1.49	1.43	1.53	+ .10
Ohio	1.06	.99	1.05	1.03	1.07	+ .04
Oklahoma	2.03	2.00	2.22	2.05	2.14	+ .09
Oregon	2.74	2.69	3.48	2.32	2.60	+ .28
Pennsylvania, bituminous	1.01	.94	1.02	1.01	1.05	+ .04
Tennessee	1.15	1.09	1.11	1.12	1.14	+ .02
Texas	1.80	1.72	1.67	1.66	1.67	+ .01
Utah	1.69	1.66	1.68	1.69	1.67	− .02
Virginia	.91	.89	.90	.91	.96	+ .05
Washington	2.21	2.54	2.50	2.29	2.39	+ .10
West Virginia	.95	.86	.92	.90	.94	+ .04
Wyoming	1.62	1.55	1.55	1.56	1.58	+ .02
Total bituminous	1.12	1.07	1.12	1.11	1.15	+ .04
Pennsylvania anthracite	1.90	1.84	1.90	1.94	2.11	+ .17
General average	1.28	1.20	1.25	1.26	1.30	+ .04

a Includes Alaska.
b Includes North Carolina.
c Includes Nevada.

Average price per short ton of coal in the United States for 33 years.

Year.	Anthracite.	Bituminous.	Year.	Anthracite.	Bituminous.
1880	$1.47	$1.25	1897	$1.51	$0.81
1881	2.01	1.12	1898	1.41	.80
1882	2.01	1.12	1899	1.46	.87
1883	2.01	1.07	1900	1.49	1.04
1884	1.79	.94	1901	1.67	1.05
1885	2.00	1.13	1902	1.84	1.12
1886	1.95	1.05	1903	2.04	1.24
1887	2.01	1.11	1904	1.90	1.10
1888	1.91	1.00	1905	1.83	1.06
1889	1.44	.99	1906	1.85	1.11
1890	1.43	.99	1907	1.91	1.14
1891	1.46	.99	1908	1.90	1.12
1892	1.57	.99	1909	1.84	1.07
1893	1.59	.96	1910	1.90	1.12
1894	1.51	.91	1911	1.94	1.11
1895	1.41	.86	1912	2.11	1.15
1896	1.50	.83			

SHIPMENTS BY RAILROADS.

In the following tables is presented a statement showing the shipments of bituminous coal in 1911 and 1912 according to the initial railroads and waterways by which the product is shipped. The quantities as given in these tables do not represent the total quantity of coal carried by the various transportation interests. They indicate only the tonnage originating on each railroad system or waterway and do not consider any of the tonnage received by one railroad from another except when the originating road is simply a side line of a few miles in length operated for the purpose of delivering the coal to a regular carrier. The tables have been compiled from the reports of the coal producers as to the railroads or waterways over which their product was shipped, and not from the transportation companies. All of the shipments over any particular system are grouped; for instance, the Pennsylvania system includes the Pennsylvania lines west of Pittsburgh, such as the Pittsburgh, Fort Wayne & Chicago, the Pittsburgh, Cincinnati, Chicago & St. Louis, the Terre Haute & Indianapolis, the Vandalia, and other subsidiary lines; the New York Central system includes the Lake Shore & Michigan Southern, the Cleveland, Cincinnati, Chicago & St. Louis (Big Four), the Pittsburgh & Lake Erie, the Chicago, Indiana & Southern, the Cincinnati Northern, and other subsidiary lines; the Baltimore & Ohio system includes the Baltimore & Ohio Southwestern, the Cleveland, Lorain & Wheeling, and the Cincinnati, Hamilton & Dayton; the Chesapeake & Ohio system includes the Chesapeake & Ohio Railroad of Indiana and the Hocking Valley; the Frisco system includes, in addition to the St. Louis & San Francisco Railroad, the Chicago & Eastern Illinois and the Fort Worth & Rio Grande.

The total shipments as presented in these tables are slightly less than those shown in the tables of production, for the reason that a number of operators, usually small ones, did not reply to these inquiries on the schedules. The total quantity of bituminous coal loaded for shipment in 1912 was 377,000,066 short tons, of which 373,897,332 tons are distributed according to the originating railroad or waterway over which shipped. The corresponding figures for 1911 were 340,361,212 tons and 339,496,309 tons.

Nearly 50 per cent of the total railroad shipments is taken by five systems penetrating the Appalachian coal field, the Pennsylvania, the Baltimore & Ohio, the New York Central, the Norfolk & Western, and the Chesapeake & Ohio, though the first three also get considerable tonnage (about 14,000,000 tons in the aggregate) from the Central coal field. All of the shipments over the Norfolk & Western and the Chesapeake & Ohio railroads are from the Appalachian field. About 20 per cent of the total railroad shipments (72,536,245 tons in 1912) originate on the Pennsylvania system, principally from Pennsylvania mines. In 1911 the shipments originating on the Pennsylvania system amounted to 64,527,709 tons.

Shipments over the Pennsylvania Railroad were more than the combined shipments over the Baltimore & Ohio and the New York Central systems, which were second and third respectively in the quantity of coal handled. Shipments over the Baltimore & Ohio system amounted in 1912 to 34,376,015 short tons, an increase of nearly 4,000,000 tons over 1911, when the shipments originating on that system amounted to 30,529,624 short tons. Shipments over this system were principally from West Virginia, Pennsylvania, and Ohio in the order named. New York Central lines originated 30,836,347 short tons in 1912, and 28,997,411 tons in 1911. Sixty per cent of these shipments are from Pennsylvania mines. The Chesapeake & Ohio lines received 21,198,718 short tons in 1911 and 22,353,644 tons in 1912, more than 75 per cent of which were from West Virginia mines, and not quite 20 per cent from Ohio mines. Nearly 90 per cent of the shipments over the Norfolk & Western Railroad is from the southern part of West Virginia, 10 per cent is from southwestern Virginia, and relatively smaller quantities from Kentucky. This system handled, in 1912, 21,994,109 short tons, against 19,141,872 tons in 1911. The Frisco system, which ranks sixth in the quantity of coal handled, draws its tonnage from eight different States, namely, Illinois, Indiana, Kansas, Alabama, Arkansas, Oklahoma, Missouri, and Colorado, the first two furnishing about 90 per cent of the total tonnage. In 1912 this system handled 14,494,079 short tons, against 14,451,177 tons in 1911. The Louisville & Nashville system draws its tonnage from Kentucky, Alabama, Tennessee, Illinois, and Virginia, more than half being from Kentucky. The total shipments originating on this system in 1911 were 12,002,646 short tons, and in 1912, 13,916,894 tons. The Illinois Central and the Burlington systems get their principal tonnage from Illinois. The former handled in 1912, 12,169,144 short tons, and the latter 11,737,397 tons. The Wabash system, which gets its principal tonnage from Ohio mines, was the only other which had initial shipments amounting to more than 10,000,000 tons in 1912, shipments over this system amounting in that year to 11,477,818 tons. Other railroads in excess of 5,000,000 tons in 1912 were the Southern, 9,585,748 tons; Buffalo, Rochester & Pittsburgh, 7,666,759 tons; Union Pacific, 6,067,537 tons; Missouri Pacific, 5,673,695 tons; and the Santa Fe, 5,032,994 tons.

Shipments of bituminous coal in the United States, by railroads and waterways, in 1911.

Railroad.	State.	Quantity.	Total.
		Short tons.	
Pennsylvania Railroad system	Pennsylvania	52,724,293	64,527,709
	Ohio	7,460,091	
	Indiana	2,733,963	
	Illinois	929,032	
	West Virginia	666,927	
	Maryland	13,403	
Baltimore & Ohio system	West Virginia	11,624,625	30,529,624
	Pennsylvania	10,319,280	
	Ohio	7,025,625	
	Illinois	1,300,794	
	Maryland	158,000	
	Indiana	101,300	
New York Central lines	Pennsylvania	18,331,373	28,997,411
	Illinois	5,083,070	
	Ohio	4,024,705	
	Indiana	999,105	
	Michigan	559,158	
Chesapeake & Ohio lines	West Virginia	15,962,497	21,198,718
	Ohio	3,884,921	
	Kentucky	1,329,292	
	Virginia	22,008	
Norfolk & Western	West Virginia	16,062,746	19,141,872
	Virginia	2,201,402	
	Kentucky	877,724	
Frisco lines	Illinois	5,416,803	14,451,177
	Indiana	4,842,966	
	Kansas	1,695,727	
	Alabama	1,523,319	
	Arkansas	544,637	
	Oklahoma	235,975	
	Missouri	191,750	
Louisville & Nashville	Kentucky	6,037,722	12,002,646
	Alabama	3,793,381	
	Tennessee	1,401,537	
	Illinois	576,870	
	Virginia	193,136	
Illinois Central	Illinois	7,358,101	10,927,366
	Kentucky	3,201,168	
	Indiana	321,387	
	Alabama	46,710	
Burlington	Illinois	6,421,228	9,827,666
	Wyoming	1,510,179	
	Iowa	1,209,075	
	Colorado	362,655	
	Missouri	324,304	
	Kansas	225	
Southern	Alabama	3,856,981	9,352,972
	Tennessee	2,261,543	
	Virginia	1,153,561	
	Illinois	787,396	
	Indiana	739,972	
	Kentucky	553,519	
Wabash	Ohio	4,020,635	9,195,134
	Illinois	3,025,675	
	Pennsylvania	1,745,069	
	Missouri	316,677	
	Iowa	87,078	
Buffalo, Rochester & Pittsburgh	Pennsylvania	7,143,077	7,143,077
Union Pacific-Southern Pacific lines	Wyoming	4,698,825	5,557,388
	Colorado	464,995	
	Texas	129,704	
	Utah	106,999	
	Washington	105,000	
	Kansas	41,562	
	Missouri	10,303	
Missouri Pacific	Illinois	2,228,462	4,920,263
	Kansas	1,146,113	
	Missouri	783,959	
	Arkansas	759,732	
	Colorado	1,997	
Santa Fe	Kansas	1,431,858	4,555,933
	New Mexico	1,442,427	
	Colorado	864,488	
	Illinois	448,375	
	Missouri	351,914	
	Oklahoma	9,263	
	Texas	7,608	
Denver & Rio Grande	Colorado	2,151,986	4,052,479
	Utah	1,897,893	
	New Mexico	2,600	
Kanawha & Michigan	West Virginia	2,918,049	3,793,795
	Ohio	875,746	

Shipments of bituminous coal in the United States, by railroads and waterways, in 1911—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	
Western Maryland	West Virginia	2,258,324	3,386,525
	Maryland	1,128,201	
Chicago, Milwaukee & St. Paul	Illinois	1,419,749	3,381,849
	Iowa	1,201,130	
	Montana	681,329	
	Washington	75,614	
	North Dakota	4,027	
Northern Pacific	Washington	2,272,068	3,333,369
	Montana	990,487	
	North Dakota	57,085	
	Wyoming	13,729	
Chicago & Alton	Illinois	3,016,604	3,196,937
	Missouri	180,333	
Missouri, Kansas & Texas	Oklahoma	1,396,505	2,844,647
	Kansas	989,617	
	Texas	323,731	
	Missouri	134,794	
Rock Island lines	Iowa	946,020	2,817,481
	Oklahoma	733,006	
	Illinois	560,586	
	Arkansas	228,527	
	Missouri	215,735	
	Texas	57,612	
	Colorado	41,997	
	Kansas	33,998	
North Western line	Iowa	1,610,031	2,789,425
	Illinois	1,028,920	
	Wyoming	150,474	
Colorado & Southern Railway lines	Colorado	2,578,541	2,614,916
	Texas	34,700	
	New Mexico	1,675	
Chicago, Terre Haute & Southeastern	Indiana	2,507,566	2,507,566
Virginian	West Virginia	2,375,283	2,375,283
Cumberland & Pennsylvania	Maryland	2,190,432	2,192,543
	Pennsylvania	2,111	
Macoupin County	Illinois	2,033,860	2,033,860
Bessemer & Lake Erie	Pennsylvania	1,971,484	1,971,484
Erie	....do	1,782,207	1,900,641
	Ohio	118,434	
Buffalo & Susquehanna	Pennsylvania	1,656,507	1,656,507
Pittsburg, Shawmut & Northern	.....do	1,440,063	1,440,063
Mobile & Ohio	Illinois	785,469	1,348,478
	Alabama	563,009	
Nashville, Chattanooga & St. Louis	Tennessee	1,154,635	1,169,435
	Alabama	14,800	
Queen and Crescent	Tennessee	723,044	1,124,187
	Kentucky	401,143	
Minneapolis & St. Louis	Iowa	634,419	1,123,417
	Illinois	488,998	
Carolina, Clinchfield & Ohio	Virginia	1,116,403	1,116,403
Great Northern Railway Lines	Montana	942,737	1,022,831
	North Dakota	36,324	
	Washington	30,041	
	Wyoming	13,729	
St. Louis, Troy & Eastern	Illinois	824,740	824,740
Texas & Pacific	Texas	797,811	797,811
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	750,525	750,525
Litchfield & Madison	Illinois	747,892	747,892
Kansas City Southern	Kansas	680,949	702,579
	Missouri	18,342	
	Arkansas	3,163	
	Oklahoma	125	
Pere Marquette	Michigan	678,366	678,366
Colorado & Southeastern	Colorado	676,240	676,240
Chicago Great Northern	Iowa	395,277	675,336
	Illinois	259,059	
	Missouri	11,338	
	Kansas	9,662	
Columbia & Puget Sound	Washington	618,564	618,564
Birmingham Southern	Alabama	597,906	597,906
Coal & Coke	West Virginia	588,775	588,775
El Paso & Southwestern	New Mexico	571,101	571,101
Huntingdon & Broad Top Mountain	Pennsylvania	568,625	568,625
St. Louis & O'Fallon	Illinois	543,735	543,735
Elgin, Joliet & Eastern	.....do	539,260	539,260
Interstate	Virginia	531,846	531,846
Monon	Indiana	524,714	524,714
Central of Georgia	Alabama	431,860	508,001
	Georgia	76,141	
East Broadtop Railroad & Coal Co	Pennsylvania	493,594	493,594
Midland Valley	Arkansas	410,465	485,875
	Oklahoma	75,410	

Shipments of bituminous coal in the United States, by railroads and waterways, in 1911—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	
Chicago & Illinois Midland	Illinois	480,252	480,252
Missouri & Louisiana	Missouri	458,837	474,988
	Arkansas	16,151	
Western Allegheny	Pennsylvania	465,227	465,227
Chicago, Peoria & St. Louis Railway of Illinois	Illinois	459,645	459,645
International & Great Northern	Texas	426,048	426,048
Springfield Terminal	Illinois	394,510	394,510
St. Paul & Kansas City Short Line	Iowa	310,586	310,586
Toledo, Peoria & Western	Illinois	306,819	306,819
Colorado & Wyoming	Colorado	296,686	296,686
St. Louis, Rocky Mountain & Pacific	New Mexico	290,659	290,659
Colorado Midland	do	282,389	282,389
Detroit, Toledo & Ironton	Ohio	279,797	279,797
Morgantown & Kingwood	West Virginia	275,132	275,132
St. Louis & Belleville Electric	Illinois	266,969	266,969
Peoria & Pekin Union	do	263,423	263,423
Denver, Northwestern & Pacific	Colorado	261,538	261,538
Quincy, Omaha & Kansas City	Missouri	260,856	260,856
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	257,528	257,528
Illinois Southern	Illinois	245,986	245,986
Ligonier Valley	Pennsylvania	233,215	233,215
Tennessee Central	Tennessee	210,645	210,645
Fort Smith & Western	Oklahoma	177,263	177,263
Missouri, Oklahoma & Gulf	do	152,375	152,375
Rock Island Southern	Illinois	139,867	139,867
Puget Sound Electric	Washington	111,247	111,247
Atlanta, Birmingham & Atlantic	Alabama	98,853	98,853
Evansville, Suburban & Newburgh	Indiana	97,259	97,259
Illinois Traction System	Illinois	95,937	95,937
Louisville, Henderson & St. Louis	Kentucky	95,086	95,086
Colfax Northern	Iowa	92,598	92,598
Buffalo Creek & Gauley	West Virginia	87,081	87,081
Fort Dodge, Des Moines & Southern	Iowa	79,833	79,833
Seaboard Air Line	Alabama	77,260	77,260
Ashland Coal & Iron	Kentucky	67,047	67,047
Kanawha & West Virginia	West Virginia	62,565	62,565
Pittsburg & Susquehanna	Pennsylvania	62,043	62,043
Wichita Falls & Southern	Texas	51,514	51,514
San Antonio & Aransas Pass	do	35,000	35,000
Union	Pennsylvania	23,692	23,692
Marietta, Columbus & Cleveland	Ohio	22,785	22,785
Monongahela	Pennsylvania	14,048	14,048
Miscellaneous	Illinois	595,846	1,409,962
	Ohio	155,914	
	Kentucky	149,807	
	Alabama	119,247	
	Michigan	109,620	
	Indiana	62,530	
	Pennsylvania	47,026	
	Oklahoma	35,201	
	Missouri	25,009	
	West Virginia	22,923	
	Arkansas	19,729	
	Oregon	17,645	
	Texas	14,400	
	Washington	13,899	
	Virginia	12,538	
	Iowa	8,158	
	Kansas	450	
	North Carolina	20	
Total railroad shipments		329,744,775	329,744,775
Monongahela River	Pennsylvania	6,968,733	6,968,733
Kanawha River	West Virginia	1,060,061	1,060,061
Ohio River	Kentucky	245,066	557,223
	West Virginia	142,873	
	Ohio	116,106	
	Pennsylvania	53,178	
Allegheny River	do	68,712	68,712
Warrior River	Alabama	8,000	8,000
Various waterways	Maryland	1,039,867	1,088,805
	Illinois	28,878	
	West Virginia	15,298	
	Oregon	4,762	
Total waterway shipments		9,751,534	9,751,534
Grand total		339,496,309	339,496,309

Shipments of bituminous coal in the United States, by railroads and waterways, in 1912.

Railroad.	State.	Quantity.	Total.
		Short tons.	
Pennsylvania Railroad system	Pennsylvania	57,379,312	72,536,245
	Ohio	8,865,812	
	Indiana	4,135,996	
	Illinois	1,388,752	
	West Virginia	751,007	
	Maryland	15,366	
Baltimore & Ohio system	West Virginia	13,540,289	34,376,015
	Pennsylvania	11,018,685	
	Ohio	7,858,167	
	Illinois	1,627,325	
	Maryland	176,315	
	Indiana	155,234	
New York Central lines	Pennsylvania	18,434,865	30,836,347
	Illinois	5,639,307	
	Ohio	5,123,821	
	Indiana	1,089,733	
	Michigan	548,621	
Chesapeake & Ohio lines	West Virginia	16,280,095	22,353,644
	Ohio	4,218,428	
	Kentucky	1,832,121	
	Virginia	23,000	
Norfolk & Western	West Virginia	18,863,182	21,994,109
	Virginia	2,173,323	
	Kentucky	957,604	
Frisco lines	Illinois	5,796,145	14,494,079
	Indiana	4,062,949	
	Kansas	1,971,885	
	Alabama	1,534,915	
	Arkansas	586,651	
	Oklahoma	288,850	
	Missouri	252,255	
	Colorado	429	
Louisville & Nashville	Kentucky	7,033,623	13,916,894
	Alabama	4,252,556	
	Tennessee	1,547,354	
	Illinois	705,010	
	Virginia	378,351	
Illinois Central	Illinois	8,437,621	12,169,144
	Kentucky	3,252,808	
	Indiana	415,437	
	Alabama	63,278	
Burlington	Illinois	7,597,693	11,737,397
	Wyoming	1,593,023	
	Iowa	1,316,035	
	Missouri	771,370	
	Colorado	440,647	
	Kansas	18,629	
Wabash	Ohio	4,757,856	11,477,818
	Illinois	3,657,373	
	Pennsylvania	2,647,668	
	Missouri	324,360	
	Iowa	90,561	
Southern	Alabama	3,959,228	9,585,748
	Tennessee	1,941,536	
	Virginia	1,260,115	
	Illinois	1,063,558	
	Indiana	788,664	
	Kentucky	572,647	
Buffalo, Rochester & Pittsburgh	Pennsylvania	7,666,759	7,666,759
Union Pacific-Southern Pacific lines	Wyoming	5,262,765	6,067,537
	Colorado	362,972	
	Texas	148,688	
	Washington	136,376	
	Utah	94,276	
	Kansas	31,937	
	Oregon	14,361	
	Missouri	12,414	
	California	3,748	
Missouri Pacific	Illinois	2,633,672	5,673,695
	Kansas	1,362,148	
	Arkansas	868,287	
	Missouri	809,288	
	Colorado	300	
Santa Fe	New Mexico	1,893,712	5,032,994
	Kansas	1,346,481	
	Colorado	960,797	
	Illinois	418,228	
	Missouri	398,813	
	Oklahoma	14,963	
Denver & Rio Grande	Utah	2,434,237	4,786,472
	Colorado	2,352,235	

Shipments of bituminous coal in the United States, by railroads and waterways, in 1912—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	
Western Maryland	West Virginia	2,566,512	3,767,387
	Maryland	1,194,066	
	Pennsylvania	6,809	
Chicago, Milwaukee & St. Paul	Illinois	1,500,851	3,621,235
	Iowa	1,182,735	
	Montana	878,802	
	Washington	48,756	
	North Dakota	10,091	
Cumberland & Pennsylvania	Maryland	3,450,644	3,451,028
	Pennsylvania	384	
Virginian	West Virginia	3,382,375	3,382,375
Northern Pacific	Washington	2,109,818	3,380,163
	Montana	1,112,196	
	North Dakota	158,149	
Missouri, Kansas & Texas	Oklahoma	1,420,444	3,211,491
	Kansas	1,264,123	
	Texas	360,279	
	Missouri	166,645	
Chicago & Alton	Illinois	2,983,874	3,131,073
	Missouri	147,199	
Colorado & Southern Railway lines	Colorado	2,913,777	2,941,277
	Texas	27,500	
Kanawha & Michigan	West Virginia	2,624,269	2,799,886
	Ohio	175,617	
Rock Island lines	Oklahoma	1,025,559	2,732,784
	Iowa	925,990	
	Illinois	344,308	
	Arkansas	217,148	
	Missouri	115,690	
	Texas	48,959	
	Colorado	36,500	
	Kansas	18,630	
Chicago & North Western line	Iowa	1,559,075	2,656,509
	Illinois	959,959	
	Wyoming	137,475	
Bessemer & Lake Erie	Pennsylvania	2,617,053	2,617,053
Chicago, Terre Haute & Southeastern	Indiana	2,364,396	2,364,396
Macoupin County	Illinois	2,284,038	2,284,038
Pittsburg, Shawmut & Northern	Pennsylvania	2,062,599	2,062,599
Erie	Pennsylvania	1,664,753	1,861,029
	Illinois	106,132	
	Ohio	90,144	
Buffalo & Susquehanna	Pennsylvania	1,529,007	1,529,007
Birmingham Southern	Alabama	1,527,974	1,527,974
Carolina, Clinchfield & Ohio	Virginia	1,385,132	1,385,132
Nashville, Chattanooga & St. Louis	Tennessee	1,320,440	1,339,683
	Alabama	19,243	
Mobile & Ohio	Illinois	802,255	1,311,842
	Alabama	509,587	
Minneapolis & St. Louis	Iowa	617,165	1,212,711
	Illinois	595,546	
Queen & Crescent	Tennessee	756,614	1,130,886
	Kentucky	322,052	
	Alabama	52,220	
Texas & Pacific	Texas	998,886	1,003,947
	Arkansas	5,061	
St. Louis, Troy & Eastern	Illinois	963,823	963,823
Monon	Indiana	924,476	924,476
Great Northern Railway lines	Montana	827,255	873,024
	North Dakota	42,529	
	Washington	3,240	
Colorado & Wyoming	Colorado	865,477	865,477
Litchfield & Madison	Illinois	863,975	863,975
St. Louis & O'Fallon	do	819,569	819,569
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	815,511	815,511
Interstate	Virginia	797,059	797,059
Central of Georgia	Alabama	637,663	745,798
	Georgia	108,135	
Colorado & Southeastern	Colorado	743,932	743,932
El Paso & Southwestern	New Mexico	726,560	726,560
Huntingdon & Broad Top Mountain	Pennsylvania	707,180	707,180
Kansas City Southern	Kansas	591,931	652,258
	Missouri	60,327	
Columbia & Puget Sound	Washington	610,155	610,155
Coal & Coke	West Virginia	610,092	610,092
Toledo, St. Louis & Western	Illinois	588,048	589,491
	Indiana	1,443	
East St. Louis & Suburban	Illinois	589,202	589,202
Chicago, Peoria & St. Louis Railway of Illinois	do	573,529	573,529
East Broad Top Railroad & Coal Co	Pennsylvania	515,504	515,504

Shipments of bituminous coal in the United States, by railroads and waterways, in 1912—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	
Denver, Northwestern & Pacific	Colorado	512,375	512,375
Missouri & Louisiana	Missouri	510,742	510,742
Elgin, Joliet & Eastern	Illinois	509,104	509,104
Ligonier Valley	Pennsylvania	482,996	482,996
Pere Marquette	Michigan	452,218	452,218
Morgantown & Kingwood	West Virginia	431,188	431,188
International & Great Northern	Texas	426,014	426,014
Chicago Great Northern	Iowa	405,875	425,735
	Missouri	13,517	
	Kansas	6,343	
Midland Valley	Arkansas	310,753	423,218
	Oklahoma	112,465	
Illinois Traction System	Illinois	412,927	412,927
Monongahela	Pennsylvania	384,272	384,272
Union	do	372,696	372,696
Missouri, Oklahoma & Gulf	Oklahoma	339,266	339,266
St. Paul & Kansas City Short Line	Iowa	307,774	307,774
Colorado Midland	Colorado	286,225	286,225
Detroit, Toledo & Ironton	Ohio	285,614	285,614
St. Louis & Belleville Electric	Illinois	266,335	266,335
Rock Island Southern	do	265,814	265,814
Peoria & Pekin Union	do	263,677	263,677
Illinois Southern	do	238,946	238,946
Tennessee Central	Tennessee	226,835	226,835
Kentucky & Tennessee	Kentucky	210,196	210,196
Atlanta, Birmingham & Atlantic	Alabama	204,350	204,350
Quincy, Omaha & Kansas City	Missouri	191,379	191,379
Buffalo Creek & Gauley	West Virginia	154,532	154,532
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	141,697	141,697
Fort Smith & Western	Oklahoma	138,021	138,021
Marietta, Columbus & Cleveland	Ohio	137,959	137,959
Kanawha & West Virginia	West Virginia	128,269	128,269
Evansville, Suburban & Newburgh	Indiana	105,492	105,492
Louisville, Henderson & St. Louis	Kentucky	101,287	102,709
	Arkansas	1,422	
Pittsburgh & Susquehanna	Pennsylvania	95,467	95,467
Seaboard Air Line	Alabama	81,461	81,461
Western Allegheny	Pennsylvania	76,352	76,352
Oklahoma Central	Oklahoma	73,524	73,524
Fort Dodge, Des Moines & Southern	Iowa	69,895	69,895
Ashland Coal & Iron	Kentucky	65,297	65,297
Puget Sound Electric	Washington	64,551	64,551
Wichita Falls & Southern	Texas	63,928	63,928
Philadelphia & Reading	Pennsylvania	40,537	61,023
	Ohio	20,486	
Central Indiana	Indiana	35,794	35,794
Toledo, Peoria & Western	Illinois	30,000	30,000
Miscellaneous	Alabama	461,281	1,412,052
	Kentucky	403,823	
	Illinois	162,168	
	Michigan	79,480	
	Washington	68,381	
	Colorado	48,649	
	Iowa	39,899	
	Ohio	35,038	
	Indiana	28,705	
	West Virginia	27,560	
	Missouri	20,784	
	Kansas	12,686	
	Virginia	10,732	
	Texas	10,000	
	Oklahoma	2,866	
Total railroad shipments		366,864,936	366,864,936
Monongahela River	Pennsylvania	4,988,074	5,037,656
	West Virginia	49,582	
Kanawha River	do	868,542	868,542
Ohio River	Kentucky	331,340	820,812
	West Virginia	271,391	
	Pennsylvania	164,036	
	Ohio	54,045	
Allegheny River	Pennsylvania	164,036	164,036
Illinois River	Illinois	36,017	36,017
Warrior River	Alabama	10,000	10,000
Various waterways	Illinois	66,598	95,333
	Kentucky	28,735	
Total waterway shipments		7,032,396	7,032,396
Grand total		373,897,332	373,897,332

IMPORTS AND EXPORTS.

The following tables have been compiled from official returns to the Bureau of Foreign and Domestic Commerce of the Department of Commerce, and show the imports and exports of coal from 1907 to 1912, 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. Under the tariff act approved August 5, 1909, anthracite is practically excluded. It remains on the free list, but only as coal stores for American vessels, and must not be unloaded. The rate on bituminous coal is placed at 45 cents per long ton, and the rate on slack or culm is fixed at 15 cents per ton.

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 from the United States during 1912 were 18,148,767 long tons (equivalent to 20,326,619 short tons), valued at $56,242,896, compared with 17,432,753 long tons (equivalent to 19,524,683 short tons), valued at $52,593,274, in 1911. Of the exports in 1912, 3,688,789 long tons (4,131,443 short tons), valued at $19,425,263, were anthracite, and 14,459,978 long tons (16,195,175 short tons), valued at $36,817,633, were bituminous coal.

In 1911 the exports of anthracite were 3,553,999 long tons (3,980,479 short tons), and the quantity of bituminous coal exported was 13,878,754 long tons (15,544,204 short tons). The total exports in 1912 exceeded those of 1911 by 716,014 long tons (equivalent to 801,936 short tons) in quantity, and by $3,649,622 in value. The anthracite exports, despite the shortage due to a suspension in the spring of 1912, increased 154,790 long tons (173,365 short tons) in quantity, and $1,331,978 in value. The bituminous exports increased 581,224 long tons (650,971 short tons) in quantity, and $2,317,644 in value.

The imports of anthracite are unimportant, amounting to only 1,670 long tons in 1912, and averaging less than 4,000 tons for the last four years. The imports of bituminous coal and shale amounted to 1,605,873 long tons (equivalent to 1,798,578 short tons), valued at $4,509,066, against 1,234,998 long tons (1,383,198 short tons), valued at $3,604,797, in 1911. The imports in 1912 included 455,587 long tons (510,257 short tons) of slack, or culm, passing through a ½-inch screen, having a value of $901,051. This is used for making coke at Everett, near Boston, Mass. Most of the anthracite imported into the United States is to San Francisco and other points on the Pacific coast, and is brought in principally as ballast in vessels coming for outgoing cargoes. Compared with the domestic production, the total quantity of coal imported into the United States is of little consequence. The imports during the last three years have been less than 0.33 per cent of the production.

Coal of domestic production exported from the United States, 1908–1912, in long tons.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
1908	2,752,358	$13,524,595	9,100,819	$23,361,914
1909	2,842,714	14,141,468	9,693,843	24,300,050
1910	3,021,627	14,785,387	10,784,239	26,685,405
1911	3,553,999	18,093,285	13,878,754	34,499,989
1912	3,688,789	19,425,263	14,459,978	36,817,633

Coal imported and entered for consumption in the United States, 1908–1912, in long tons.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
1908	16,484	$73,778	1,452,662	$3,964,843
1909	3,191	12,918	1,274,903	3,628,533
1910	8,196	42,244	1,986,258	4,761,223
1911	2,463	12,550	1,234,998	3,604,797
1912	1,670	8,329	[a] 1,605,873	4,509,066

[a] Includes 455,587 tons of slack or culm (value, $901,051) passing ½-inch screen.

COASTWISE TRAFFIC IN COAL.

The following table compiled from the records of the Bureau of Foreign and Domestic Commerce of the Department of Commerce shows the quantity of anthracite and bituminous coal shipped from the principal ports on the Atlantic coast and delivered to other United States ports. The total quantity of anthracite shipped by water from New York, Philadelphia, and Baltimore was 16,000,000 long tons, of which 13,800,000 tons, or 86 per cent, were shipped from New York Harbor ports, and 1,987,000 tons, or 12.4 per cent, were shipped from Philadelphia. The total bituminous shipments amounted to a little over 29,200,000 tons, of which 11,657,000 tons, or 41 per cent, were from New York Harbor, and 9,120,000 tons, or 31 per cent, were from Norfolk and Newport News. The total coastwise traffic amounted to approximately 45,210,000 tons, of which a little more than 55 per cent, or 25,460,000 tons, was handled from New York Harbor ports. In addition to the 45,210,000 tons of coal shipped from these Atlantic ports, there were approximately 7,700,000 tons put into bunkers, and of that amount practically two-thirds were handled at New York Harbor ports.

Coastwise shipments of coal by water from the five principal Atlantic seaports in 1912, by months, in long tons.

ANTHRACITE.

Month.	New York.	Philadelphia.	Baltimore.
January	1,462,393	168,910	15,222
February	1,571,766	150,384	21,239
March	1,683,548	220,561	25,656
April	611,803	82,200	7,110
May	433,945	42,250	531
June	1,112,223	170,678	18,329
July	1,130,582	185,180	22,924
August	1,095,977	195,427	20,866
September	1,082,280	183,987	16,721
October	1,331,898	217,278	19,199
November	1,154,718	189,667	16,107
December	1,134,030	180,680	24,000
Total	13,805,163	1,987,202	207,904

BITUMINOUS.

Month.	New York.	Philadelphia.	Baltimore.	Newport News.	Norfolk.
January	875,082	267,451	249,828	212,194	389,781
February	888,281	261,627	264,845	237,682	428,036
March	1,077,789	399,229	377,675	227,257	407,546
April	1,000,838	441,758	358,631	295,272	414,022
May	1,086,509	546,967	283,660	272,775	494,369
June	954,782	416,478	310,550	184,924	436,323
July	892,407	364,625	319,477	246,597	468,763
August	979,405	394,977	338,362	242,902	490,428
September	943,567	405,387	309,235	228,987	513,021
October	1,059,810	443,104	290,860	222,339	480,056
November	953,457	405,228	282,588	179,159	428,267
December	944,985	405,091	295,136	175,194	1,443,767
Total	11,656,912	4,751,922	3,680,847	2,725,282	6,394,379

TOTALS.

Month.	New York.	Philadelphia.	Baltimore.	Newport News.	Norfolk.	Aggregates.
January	2,337,475	436,361	265,050	212,194	389,781	3,640,861
February	2,460,047	412,011	286,084	237,682	428,036	3,823,860
March	2,761,337	619,790	403,331	227,257	407,546	4,419,261
April	1,612,641	523,958	365,741	295,272	414,022	3,211,634
May	1,520,454	589,217	284,191	272,775	494,369	3,161,006
June	2,067,005	587,156	328,879	184,924	436,323	3,604,287
July	2,022,989	549,805	342,401	246,597	468,763	3,630,555
August	2,075,382	590,404	359,228	242,902	490,428	3,758,344
September	2,025,847	589,374	325,956	228,987	513,021	3,683,185
October	2,391,708	660,382	310,059	222,339	480,056	4,064,544
November	2,108,175	594,895	298,695	179,159	428,267	3,609,191
December	2,079,015	585,771	319,136	175,194	1,443,767	4,602,883
Total	25,462,075	6,739,124	3,888,751	2,725,282	6,394,379	45,209,611

The quantities of coal delivered to bunkers at the same ports during 1912 were as follows:

Bunker coal handled at the five principal Atlantic seaports in 1912, in long tons.

Port.	Domestic.	Foreign.	Total.
New York	999,257	3,949,750	4,949,007
Philadelphia	380,728	607,384	988,112
Baltimore	247,613	309,539	557,152
Norfolk	100,034	621,120	721,154
Newport News	111,201	385,225	496,426
Total	1,838,833	5,873,018	7,711,851

WORLD'S PRODUCTION OF COAL.

The United States took first rank among the coal-producing countries of the world in 1899, when it supplanted Great Britain as the premier coal producer. In the 13 years from 1899 to 1912 the production of coal in the United States has increased over 100 per cent, from 253,741,192 short tons in 1899 to 534,466,580 tons in 1912. The production in Great Britain has increased about 20 per cent, from 246,506,155 short tons in 1899 to 304,518,927 short tons in 1911, decreasing to 291,666,299 short tons in 1912. The United States in 1912 produced 242,800,281 short tons, or over 80 per cent, more than Great Britain, and approached within 43,200,000 tons, or 8 per cent, of the aggregate production of Great Britain and Germany. Germany's production, including brown coal, or lignite, amounted in 1912 to 285,974,649 short tons, and the combined production of Great Britain and Germany amounted to 577,640,948 short tons.

The world's production of coal in 1912 amounted to approximately 1,364,000,000 short tons, of which the United States contributed 39 per cent, Great Britain 21.4 per cent, and Germany 21 per cent, these three leading countries producing an aggregate of over 80 per cent of the world's supply. It is of interest to note how closely the production of Germany is approaching that of Great Britain. The difference in 1912 was less than 6,000,000 tons, or about 2 per cent. Twenty years ago the output of Great Britain was twice that of Germany.

The writer is indebted for the figures covering the production of coal in foreign countries, as shown in the following table, to Mr. William G. Gray, statistician of the American Iron and Steel Institute. Where the statistics for 1912 are not available, those for the year nearest 1912 for which they could be obtained are given. For the sake of convenience the quantities are expressed in the measurement customary in each country and are reduced for purposes of comparison to the short ton of 2,000 pounds.

The world's production of coal.

Countries.		Usual unit in producing country.	Equivalent in short tons.
United States (1912)	long tons	477,202 303	534,466,580
Great Britain (1912)	do	260,416,338	291,666,299
Germany (1912)	metric tons	259,434,500	285,974,649
Austria-Hungary (1911)[a]	do	49,859,655	54,960,298
France (1911)	do	39,229,591	43,242,778
Russia and Finland (1911)	do	26,636,818	29,361,764
Belgium (1911)	do	23,053,540	25,411,917
Japan (1911)	do	17,632,710	19,436,536
China (1911)	do	15,000,000	16,534,500
India (1911)	long tons	12,048,726	13,494,573
Canada (1911)	short tons	11,323,388	11,323,388
New South Wales (1911)	long tons	8,691,604	9,734,596
Spain (1910)	metric tons	4,057,532	4,472,618
Transvaal (1911)	long tons	3,878,286	4,343,680
Natal (1911)	do	2,392,456	2,679,551
New Zealand (1910)	do	2,197,362	2,461,045
Mexico (1910)	metric tons	1,500.000	1,653,450
Holland (1911)	do	1,477,000	1,628,097
Asiatic Russia (1910)	do	1,244,000	1,371,261
Chile (1911)	do	1,158,660	1,277,191
Queensland (1911)	long tons	891,568	998,556
Bosnia and Herzegovina (1911)	metric tons	769,763	848,510
Turkey (1911)	do	725,000	799,168
Victoria (1911)	long tons	653,864	732,328
Italy (1911)	metric tons	557,137	614,132
Dutch East Indies (1910)	do	535,226	589,980
Indo-China (1910)	do	498,551	549,553
Orange Free State (Orange River Colony) (1911)	long tons	430,973	482,690
Sweden (1911)	metric tons	311,809	343,707
Peru (1910)	do	307,320	338,759
Servia (1910)	do	276,815	305,133
Western Australia (1910)	long tons	262,166	293,626
Formosa (1911)	metric tons	254,921	280,999
Bulgaria (1909)	do	227,362	250,621
British Borneo (1910)	long tons	171,366	191,930
Rhodesia (1910)	do	160,775	180,068
Roumania (1907–8)	metric tons	160,783	177,231
Korea (1911)	do	123,668	136,319
Tasmania (1910)	long tons	82,455	92,350
Cape Colony (Cape of Good Hope) (1911)	do	79,476	89,013
Spitzberger (1911)	metric tons	40,000	44,092
Brazil (1910)	do	15,000	16,535
Venezuela (1906)	do	14,064	15,503
Portugal (1910)	do	8,149	8,983
Philippine Islands (1912)	do	2,720	2,998
Switzerland	do	2,500	2,756
Greece (1910)	do	1,500	1,653
Unspecified	long tons	50,000	56,000
Total			1,363,937,964
Percentage of the United States			39

[a] Production of coal in Austria in 1912 amounted to 42,078,124 metric tons; 1912 figures for Hungary not available.

As a matter of historical interest the following table, giving the statistics of the production of coal in the more important countries of the world since 1870 is presented. In the 43 years covered by this table the percentage of the total contributed by the United States increased from less than 15 to nearly 40. The largest percentage credited to the United States was in 1907, when this country produced 39.27 per cent of the world's total. In 1912 this proportion was 38.82 per cent.

World's production of coal, by countries, 1870–1912.

Year.	United States.		Great Britain.		Germany.	
	Long tons.	Short tons.	Long tons.	Short tons.	Metric tons.	Short tons.
1870	29,496,054	33,035,580	110,431,192	123,682,935	34,003,004	37,488,312
1880	63,822,830	71,481,570	146,969,409	164,605,738	59,118,035	65,177,634
1890	140,866,931	157,770,963	181,614,288	203,408,003	89,290,834	98,398,500
1900	240,789,310	269,684,027	225,181,300	252,203,056	149,551,000	164,805,202
1910	447,853,909	501,596,378	264,433,028	296,164,991	222,301,660	245,043,120
1911	443,188,505	496,371,126	271,891,899	304,518,927	234,259,061	258,223,763
1912	477,202,303	534,466,580	260,416,338	291,666,299	259,434,500	285,974,649

Year.	Austria-Hungary.		France.		Belgium.	
	Metric tons.	Short tons.	Metric tons.	Short tons.	Metric tons.	Short tons.
1870	8,355,945	9,212,429	13,179,788	14,530,716	13,697,118	15,101,073
1880	14,800,000	16,317,000	19,361,564	21,346,124	16,886,698	18,617,585
1890	27,504,032	30,323,195	26,083,118	28,756,638	20,365,960	22,453,471
1900	39,029,729	43,010,761	33,404,298	36,811,536	23,462,817	25,856,024
1910	48,649,768	53,626,639	38,570,473	42,516,232	23,927,230	26,374,986
1911	49,859,655	54,960,298	39,229,591	43,242,778	23,053,540	25,411,917
1912	....	....	....	....	....	....

Year.	Russia.		Japan.		Other countries.	Total.	Percentage of United States.
	Metric tons.	Short tons.	Metric tons.	Short tons.	Short tons.	Short tons.	
1870	667,806	735,922	....	....	1,063,121	234,850,088	14.07
1880	3,238,470	3,570,413	....	....	3,621,342	364,737,406	19.60
1890	6,016,525	6,633,219	2,653,000	2,923,606	13,025,637	563,693,232	27.99
1900	16,151,557	17,799,016	7,429,457	8,187,262	27,684,964	846,041,848	31.88
1910	a 22,650,000	24,967,095	15,681,324	17,285,523	71,445,828	1,279,020,792	39.22
1911	a 26,636,818	29,361,764	17,632,710	19,436,536	79,436,191	1,310,973,300	37.86
1912	....	....	....	....	b 79,417,143	c 1,363,937,964	39.00

a These figures also include the production of Finland.
b For detailed statement see table on preceding page.
c Latest available figures are used in making up totals for 1912.

COAL-TRADE REVIEW.

It has been the practice in the preparation of the annual report on the production of coal to include reviews of the coal trade in some of the principal cities, and this custom has been followed in the present chapter. These reviews have been contributed chiefly by secretaries of chambers of commerce or other local authorities familiar with the coal trade of their respective communities. They will be found interesting, in that they reflect the conditions which have influenced the markets and the bearing they have had upon production. Acknowledgments of the services rendered is gratefully made and recognition by name is given for each contribution.

NEW YORK CITY.

By Frederick Hobart, associate editor of the Engineering and Mining Journal.

Although the coal trade of New York City in 1912 showed some unusual variations, there was no material change in its methods. In previous reviews reference has been made to the rather wasteful methods of handling coal and distributing it to consumers, and it can not be said that any improvement upon them was brought forward during 1912. The coal docks on the harbor and the west side of Hudson River, to which coal is brought by the railroads, are generally pretty well equipped. In the city itself there are no really modern unloading plants, with the exception of those at a few of the large power plants on the river front, and a Lake shipper from Cleveland or Duluth would look with some wonder at the slow unloading of the barges which carry the coal from the railroad docks to its various destinations in the city.

It is, perhaps, necessary to say that no coal comes into New York City by rail. The great bulk of it is delivered by the railroads at the docks on the west side of the bay and the Hudson, those receiving points being known collectively in the trade as New York Harbor. Thence it is carried to the city docks in barges or car floats. By far the greater part of the coal used comes by rail, only a small quantity, chiefly from Hampton Roads and Baltimore, coming by water. The districts from which New York draws its supplies of bituminous coal are the Clearfield, the Irwin, and the Somerset districts in Pennsylvania, the Cumberland in Maryland, and the Fairmont in West Virginia, for rail coal; the Pocahontas in West Virginia, for water-borne coal, the latter supplying a good part of the bunker coal sold.

The coal consumption of New York in 1912 probably showed no increase over 1911, the natural growth from increase in population, and the manufacturing prosperity being offset by the mild weather in the closing quarter of the year and the actual scarcity of anthracite which existed for several months. Definite statistics, unfortunately, are unavailable, but a close estimate is that New York, including the five boroughs of the city and some adjoining sections of Long Island and Westchester County, consumed during the year about 17,000,000 tons of coal of which 12,000,000 tons were anthracite and 5,000,000 tons bituminous. [Confidential reports to the United States Geological Survey by the railroads delivering coal to New York Harbor ports show that the total quantity of anthracite received in 1912 was 11,287,953 long tons. This agrees very closely with Mr. Hobart's estimate, 12,000,000 tons, as representing the consumption of anthracite in New York City and vicinity. The quantity of bituminous coal delivered by rail in 1912 was 8,113,651 long tons. The quantity of bituminous coal received by water from Baltimore and Hampton Roads does not seem to be obtainable with any degree of accuracy.—E. W. P.]

In addition to the city coal, there were about 4,500,000 tons, chiefly bituminous, handled over the harbor docks and bunkered or supplied to steamships. About 3,500,000 tons of anthracite and 7,250,000 tons of bituminous coal were brought to New York Harbor and from there shipped to eastern New York and New England points. This last is, of course, outside of the city supply.

The trade is naturally divided into anthracite and bituminous; and the review would not be complete without some notice of the coastwise trade, which is an important factor in the city's coal market.

Anthracite trade.—The anthracite trade of New York in 1912 hinged upon the controversy between the miners' union and the operators over the mining agreement which expired on March 31, and the conditions of its renewal. There was no actual strike, but there was a suspension of mining for nearly two months, with all the implied consequences. Although there was no such general apprehension as attended the strike of 1902 the trade was profoundly affected. The general lack of large storage facilities in the New York district, to which reference has been made in previous reviews, was made conspicuously prominent during 1912.

As the year opened, the conditions of a severe winter and the consequent heavy demand for domestic coal were in full evidence. The dealers generally had no surplus stocks and were dependent upon current deliveries to meet the demands of their customers. The consumption of both domestic and steam sizes had been heavy. Production had been heavy also, but the companies had had no opportunity to accumulate stocks in their storage yards. In January, February, and March production was kept up to a high point, but the calls from dealers were equal to or greater than the supplies, and no one—dealer or consumer—was able to get as much stock as he desired. The cold weather lasted well into the spring, and domestic consumers generally were forced to put in additional coal to supplement their usual supplies. As April 1 approached the large current production had been absorbed, and there was little surplus for storage. In many cases premiums were offered for coal, but comparatively little was paid in this way, as the coal was not to be had. As expected, the first negotiations for a new settlement failed, and work at the mines generally ceased on March 31. By April 10 there was practically no new coal to be had and consumers were dependent upon whatever stocks were on hand. Fortunately, the weather moderated and domestic consumers were not obliged to draw heavily on such stocks as they had. There was, however, a scarcity of steam sizes which forced users of those sizes back upon bituminous coal to a large extent. The seaboard rates were nominally unchanged, but naturally the summer discounts, which usually begin with April, were not offered. A few independent operators were able to offer some coal at high prices, and generally disposed of what they had. The quantity, however, was not enough to make much impression upon the market. Retail prices were sharply advanced, as high as $8.50 and $8.75, being charged consumers who needed coal, while the amount to be obtained at those prices was limited.

The suspension continued until May 23, when an agreement between operators and miners was finally reached. It was not until June, when the mines were fully at work that shipments were generally resumed.

The new agreement was followed by an advance in the tidewater prices, which had showed little change for several years. The advance was nominally 25 cents per ton f. o. b. New York Harbor; actually it was from 15 to 45 cents, and the higher rates held for the rest of the year. The advance to the consumer was greater, since the smaller dealers had to pay premiums in many cases to secure coal, and they were not slow in passing these on to their customers. During the second half of the year retail buyers paid from 75 cents to $1.25 per ton advance over any prices since 1903. As late as November $7.75 and $8 per ton was paid by retail buyers of domestic coal, while there were also sharp advances on steam sizes, as high as $4.25 f. o. b. New York Harbor having been paid for pea coal.

From June until November the market was simply a scramble to make up for lost time. A clean cut of over 10,000,000 tons out of the yearly production had been made, and it was necessary to make this up. The Lake and western trade received attention first, and New York dealers complained bitterly that coal was sent to Buffalo when it was so badly needed on the seaboard. The rush of customers to buy had to be met, and up to September local dealers were obliged to restrict their sales to what they were able to furnish. In October the situation began to ease off a little, but it was the first of December before conditions were normal. Then the market began to resume its usual condition, being materially helped by unusually mild weather in the fall and early winter months. These weather conditions continued through December and by the end of the year premiums were only a memory and coal was being distributed quietly and steadily on a normal market.

Retail prices were still on a high level, and were about 50 cents a ton over the average of the last five years. The domestic consumers of New York paid an average of 75 cents a ton for their coal more than in any year since 1904. Retail dealers, however, claim that their profits were small, owing to delay in getting supplies, premiums paid, and the high cost of handling trade generally.

Bituminous coal.—The year 1912 was one of considerable variations in the bituminous coal market, so far as New York was concerned. The consumption was to some extent increased, owing to the shortage in anthracite; on the other hand, there was some diminution on account of the mild weather of the later months of the year. As the consumption of bituminous coal in the New York district is very largely for manufacturing purposes, weather conditions do not affect the trade to a great extent.

The larger consumers in the district are the public utility companies, the gas, electric light and power, electric railroad, and other companies. Their consumption does not vary greatly from year to year, except as it increases with the growth of population. It is, of course, supplied largely by yearly contracts which are generally settled in March and run from April 1. The power plants of these companies are generally located along the river front or out of the densely built up parts of the city where the emission of smoke would cause complaint. A considerable quantity of bituminous coal is also used in the large office buildings and apartment houses, where it is mixed with the steam sizes of anthracite, the furnaces being built and run so that no smoke is observed from the chimneys. This class of business also shows very little variation from year to year. The difference in the trade is due to the factory consumption, which was generally good throughout 1912. The bunker trade was also large, and the consumption of coal was probably as great as, if not greater than, that of any previous year.

The labor difficulties in the bituminous fields tributary to the New York trade in April were quickly arranged and the wage scales settled. They did not greatly affect the trade. Later in the year the labor troubles had a bearing on the trade, which was also affected by an unusually heavy demand for the Lake and western trade. In fact, West Virginia coal movement and prices were a factor of more importance that usual in 1912 in the immediate New York trade. It must be understood that the larger part of the West Virginia coal going to the East is carried by water from Hampton Roads and Baltimore. What is brought to New York by rail is for the city supply and bunker trade and not for reshipment coastwise.

The year 1912 opened in the middle of a severe winter, with supplies kept down by difficulties in transportation. Shippers to this market found difficulty in filling their contract obligations, and few had any surplus to sell on the open market. It was not until March that conditions began to improve and much coal was sold at prices realizing $2 and $2.15 per ton at mine, or nearly double the price often accepted. In March consumers became urgent for supplies, wishing to store as much coal as possible, in view of the reports of a possible general strike in April; and this disposition tended to keep up the price. As already stated, the fear of a strike proved to be much exaggerated, and there was little obstruction to the movement of coal.

When this was realized prices began to fall sharply and through May and June about $1.20 to $1.40 a ton at mine was realized for better grades and $1.10 to $1.15 for the inferior coal. The closing of yearly contracts was rather slow, but the figures obtained were generally from 5 to 10 cents above 1911. The contract base for fair-grade Clearfield coals was about $1.15 to $1.20 per ton at mine; for Somerset and Fairmont, $1.25 to $1.30; and for fancy brands up to $1.40 per ton at mine. These rates were generally considered quite satisfactory, notwithstanding the advances in the mining rates. Cumberland and Georges Creek, as usual, commanded their own special market and prices.

After the contract season was over the market went along smoothly. The scarcity of steam sizes of anthracite, which lasted until well on in the summer, kept up prices of the coal that was on the market outside of contract supplies. The quantity of such coal was at no time excessive, and very little was heard of sales under demurrage at low prices. Thrifty buyers, who look for such bargains at ordinary times, found few or no chances. Business was generally good and the factory demand large throughout the year. The Clearfield and other central Pennsylvania operators who supply the greater part of the bituminous coal used in the New York district must have had a satisfactory year.

In September and October there was some falling off in demand as the anthracite people began to catch up with their orders. About that time, however, the car shortage which is almost always troublesome in the fall began to make its appearance, and supplies were kept down to a point which did not exceed the demand to any marked degree. There has, indeed, seldom been a year in which there has been so little surplus coal affecting the market. In fact, as the year came to an end there was something of a rush to buy coal, especially for the coastwise trade. With the previous heavy winter in mind, people put in all the coal they could carry in their yards, some manufacturers buying considerable quantities in adaiton to their contract receipts. The weather continued mild and there were no delays to transportation except in the matter of car supply. The year closed with prices well maintained at a little above the contract level. There was a general expectation of a sharp rise when really cold weather should set in. As the event has since proved, this did not occur, but the looking for it put the trade in rather a cheerful humor as the year ended.

Coastwise and harbor trade.—The year 1912 served to emphasize further the competition between the barges and the sailing vessels, to which reference has been made in former reviews. The barges have long had the best of this competition in the anthracite shipments to eastern ports from New York Harbor points, but in 1912 they made considerable inroads into the bituminous trade. During April and May, when the anthracite mines were closed down, many barges were unemployed, and bids were made for carrying bituminous coal in them at very low rates. So sharp, in fact, was the competition and so unfavorable the position that quite a number of the sailing vessels sought other employment, some of them taking lumber charters from southern ports, while a few of the larger boats secured grain charters and other freight work. When the anthracite mines started up again toward the end of May, there was rather a scarcity of tonnage, and for a short time high rates were secured. These did not last very long, however, and the high rates collapsed, charters in the last half of the year being made at rather low figures.

At the opening of the year, in January, rates from New York Harbor points were at a high point, $1.05 to $1.15 being paid to Boston and Portland. This was due to stormy weather, which prevailed around the end of the year and the obstructions from ice at some ports. Although that level was not quite maintained, rates were good through a stormy February and the earlier half of March. Toward the close of March there was a heavy demand from eastern buyers who were seeking to pile up stocks as a provision against shortage, and this helped to keep up rates. In April there was a sharp fall, and in May vessels were carrying coal from New York Harbor to points beyond Cape Cod at 65 cents. The starting up of anthracite shipments brought rates up again, and for a time 90 cents to $1 was again demanded. This did not last long, and in July there was another light period when rates fell back to 60 or 65 cents from New York Harbor to Boston.

In the last half of the year, in fact, the rates on coastwise trade about kept pace with the demand for coal. The only exception was that in late October and November, when the rush was on to get coal to the shoal-water ports before they were closed by ice, there was a short supply of small vessels suitable for the trade, and exceptionally high rates were paid. The anthracite barge trade was steady after work had been resumed at the mines; in fact, there was rather a rush in November and December, and the companies which own most of the barges took advantage of it to raise the rate to Boston to 65 cents, an advance of 15 cents over the freight which had been charged for several years.

Upon the whole, the year 1912 was not a profitable one for the sailing vessels in the coastwise trade from New York. The stormy weather in the first quarter of the year, the absence of tonnage in the second quarter, and the variation of rates entailed losses which more than counterbalanced the short periods of high rates. The year also marked a further inroad of the barges and steam colliers on the trade and few vessel owners came through the year with much profit on their books. The insistence of the New Haven road on shipments of coal to western and central New England over the Poughkeepsie Bridge line also reduced the water carriage to Sound ports. Complaints of delays in unloading at those ports were frequent, and these delays are part of the railroad plan to cut off the water shipments, especially those of anthracite.

The barge trade from the New York Harbor ports showed little change during the year. In January and February there were frequent delays, owing to ice and severe weather; in March and April the trade was necessarily light; but for the rest of the year it was up to the usual mark. This trade covers the delivery of coal to the city docks and the yards and factories on the water front, and, of course, varies with the demand for coal and the general condition of the trade. It has no competition except in the delivery of coal cars direct by the car floats owned by the railroad companies to the rail lines east of the Hudson.

It must be understood, as has already been stated, that both anthracite and bituminous coal reaches New York Harbor on the New Jersey side, being delivered at the chain of docks stretching from South Amboy to Weehawken and Edgewater, and must be transported by water to the docks in the various boroughs of the city. With the exception of that carried on car floats, as noted above, the coal is loaded on barges which carry it to its final destination or on the vessels which carry it to the coastwise ports in the East.

PHILADELPHIA, PA.

By Samuel R. Kirkpatrick, Land Title Building.

Notwithstanding the fact that the mines in the anthracite region were idle during the entire month of April and the greater part of May, 1912, the output was well up to the record of recent years, with the exception of 1911, when the maximum output was obtained—only 550,000 tons less than the average of the preceding five years, which included 1911. The production and shipments of anthracite have increased in proportion to the population during the last few years, and at the present time the quantity of coal sent forward seems to be limited only by productive capacity and transportation facilities. As heretofore, the public was the chief sufferer from the effects of the two months' idleness, the producing companies advancing the prices from 25 to 50 cents a ton. These prices have been not only maintained but in some instances still further advanced.

During the idleness the prices of coal at Philadelphia did not fluctuate as much as in some other parts of the country. Large quantities of coal were shipped from the Philadelphia market to the New England States, and $2 or $3 a ton over the selling prices at Philadelphia was obtained. Ample warning of the contemplated suspension had been given through the daily press, and in consequence retailers had stocked up during February and March, and in many cases householders laid in supplies for the ensuing year. This proved to be an economical move, as after the difficulties between the operators and the miners were settled there was an advance of 25 cents a ton on all sizes, and in some localities the price of pea coal was advanced 50 cents a ton.

Some labor troubles were experienced in the bituminous regions at the same time that the anthracite mines were idle, but suspensions were not so general in the bituminous as in the hard-coal region. The somewhat frequent interruption to deliveries of anthracite coal has led many Philadelphia manufacturers to equip their boilers for the use of soft coal. It is safe to state that more soft coal is being used for steam purposes by manufacturing plants at Philadelphia than ever before in the history of the city. The demand for bituminous coal during 1912 was strong, and the consumption considerably larger than in the preceding year.

The larger companies maintained circular prices during the year, except that the usual discounts in March and April were not made. Individual dealers reaped a harvest, first, on account of the apprehension of trouble between the miners and operators, and second, on account of the scarcity in fuel which developed later. The smaller operators had no difficulty in getting rid of their output during February and March, and some of them obtained from 15 to 50 cents a ton above the circular prices. Later in the season, when operations had been fully resumed, these smaller operators were compelled to dispose of their product at somewhat lower prices than were asked by the large companies, owing to their lack of facilities for storing and to the fact that consumers generally had previously stocked up. On the whole, however, the anthracite trade was good during the year. The regular spring prices which did not go into effect until June were even then only partially effective, as consumers were all more or less well supplied with fuel.

The demand for chestnut coal continues to increase in greater proportion than that of other domestic grades, and it is rated at 25 cents a ton above the other sizes. One of the effects of this increased demand for nut coal has been the inclusion of some of the smaller sizes with the chestnut. Pea coal is also being more extensively used for household purposes, and to such an extent has this been true that many of the manufacturers of the country have had much trouble in securing their supplies of this size and have changed their grates in order to enable them to utilize the smaller sizes of buckwheat, rice, and barley. The shipments for export, both of anthracite and bituminous coal, showed a slight gain in 1912 over 1911. There was a steady demand for bituminous coal for export during the year, and as has been the case for some years past, Cuba took the bulk of the soft-coal shipments, 412,697 tons (almost exactly half of the total bituminous exports), valued at $1,159,252. Cuba took also more than half the anthracite exports, 32,149 tons, valued at $142,420, out of a total of 53,754 tons, valued at $248,497.

In anticipation of the suspension in the early part of the year, a big demand for both anthracite and bituminous coal was created. In the New England States prices averaged from $1 to $2 a ton above the selling price at Philadelphia, which greatly increased the coastwise shipments. As a whole, however, there was a slight falling off in both anthracite and bituminous shipments.

Freight rates remained the same throughout the year. The following table shows the rates to Philadelphia from the mines:

Freight rates per long ton on anthracite from coal regions to Philadelphia, Pa.

Region.	Prepared sizes.	Pea.	Buckwheat.
Schuylkill	$1.70	$1.40	$1.25
Lehigh	1.75	1.45	1.30
Wyoming	1.80	1.50	1.35

Through the courtesy of the officers of the Pennsylvania Railroad Co., the Philadelphia & Reading Railway Co., the Lehigh Coal & Navigation Co., and the Baltimore & Ohio Railroad Co., 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 1911 and 1912, in long tons.

Destination.	1911		1912	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.
Export	52,984	791,506	53,754	825,234
Coastwise and harbor	1,933,359	4,287,150	1,794,436	4,140,859
Local	4,194,915	2,625,505	3,952,338	3,060,646
Total	6,181,258	7,704,161	5,800,528	8,026,739

The anthracite shipped to foreign countries in 1912 amounted to 53,754 tons, valued at $248,497. The bituminous shipments amounted to 825,234 tons, with a value of $2,378,299. As stated in in the previous paragraph, Cuba leads both in anthracite and bituminous receipts. Only five countries import anthracite from the United States—Cuba, Canada, Bermuda, Newfoundland, and Jamaica. Mexico ranks next to Cuba as a coal importer, receiving in 1912 89,029 tons of bituminous coal, valued at $244,921. Italy received 47,427 tons, valued at $130,700; the French West Indies, 66,176 tons, valued at $183,852; Brazil, 14,747 tons, valued at $52,410; Panama, 18,897 tons, valued at $70,226; Costa Rica, 24,930 tons, valued at $61,893; and the Netherlands received 45 tons, valued at $226.

The following table shows the average range of retail prices of anthracite and bituminous coal during 1912, by months:

Average prices for anthracite and bituminous coal at Philadelphia in 1912, by months, per long ton.

Month.	Chestnut.	Prepared sizes.	Pea.	Buckwheat.	Rice.	Bituminous.
January	$6.75–$7.00	$6.50–$7.00	$4.75	$3.35–$3.75	$2.75–$3.10	$3.75–$4.00
February	6.75– 7.00	6.50– 7.00	4.75	3.35– 3.75	2.75– 3.10	3.75– 4.00
March	7.00– 7.50	6.50– 7.00	$4.75– 5.00	3.50– 3.80	2.75– 3.25	3.75– 4.50
April	7.00– 7.50	6.75– 7.25	4.75– 5.00	3.50– 4.00	2.75– 3.25	3.75– 4.50
May	6.75– 7.00	6.50– 6.75	4.75– 5.00	3.30– 3.75	2.75– 3.10	3.50– 4.75
June	6.50– 6.75	6.50– 6.75	4.50– 4.75	3.25– 3.50	2.50– 3.00	3.00– 4.00
July	6.75– 6.85	6.50– 6.85	4.50– 4.75	3.25– 3.50	2.50– 3.00	3.00– 4.00
August	6.75– 6.95	6.50– 6.85	4.50– 4.75	3.20– 3.75	2.50– 3.10	3.00– 4.00
September	7.00– 7.25	6.25– 6.75	4.50– 4.75	3.35– 3.75	2.50– 3.10	3.25– 4.00
October	7.00– 7.25	6.50– 7.00	4.50– 4.85	3.35– 3.75	2.50– 3.10	3.25– 4.00
November	7.00– 7.25	6.50– 7.00	4.50– 4.85	3.35– 3.75	2.50– 3.10	3.40– 4.00
December	7.00– 7.25	6.50– 7.00	4.50– 4.85	3.35– 3.75	2.50– 3.10	3.50– 4.00

The production of anthracite during 1912 was not as large as in the previous year. The following table shows the shipments in 1912 and 1911 for comparison:

Anthracite shipments in 1911 and 1912, by months, in long tons.

Month.	1911	1912	Month.	1911	1912
January	5,904,117	5,763,696	August	5,531,796	6,576,591
February	5,070,948	5,875,968	September	5,730,935	5,876,496
March	5,996,894	6,569,687	October	6,269,175	6,665,321
April	5,804,915	266,625	November	6,193,314	6,165,536
May	6,317,352	1,429,357	December	6,115,427	5,944,502
June	6,215,357	6,191,646			
July	4,804,065	6,285,153	Total	69,954,299	63,610,578

The price circular of the Philadelphia & Reading Coal & Iron Co., which is the same as that of other companies, is as follows:

Circular prices for anthracite coal at the mines in 1911 and 1912.

	1911		1912	
	April.	September.	June.	September.
Lump	$3.50	$3.50	$3.50	$3.50
Steamboat	3.00	3.00	3.00	3.00
Broken	3.00	3.50	3.50	3.80
Egg	3.25	3.75	3.75	4.05
Stove	3.25	3.75	4.00	4.30
Chestnut	3.50	4.00	4.15	4.45
Pea	2.00	2.00	2.50	2.80
Buckwheat	1.50	1.50	1.50	1.50

BOSTON, MASS.

By Robert S. Coffin, secretary of the committee on fuel supply, Boston Chamber of Commerce.

Receipts and shipments.—The year 1912 established a new high-water mark for the receipts of coal at the port of Boston. The aggregate tonnage of anthracite and bituminous amounted to 6,578,017 long tons as against 6,418,031 long tons in 1911, an increase of 159,986 long tons. Of the receipts for 1912, 1,719,132 tons were anthracite, 4,549,759 tons were bituminous, and 309,126 tons were foreign bituminous. This was an increase of 378,529 tons of bituminous and of 45,265 tons of foreign bituminous, but a decrease of 263,808 tons of anthracite. A shortage of anthracite coal during the winter of 1911–12 proved very embarassing to the coal dealers; the majority of them were unable to fill their orders or even to supply immediate demands. Many dealers had to purchase coal in the open market to supply their customers and as a result had to pay exorbitant prices.

The net receipts of coal for local consumption in Boston amounted to 1,576,725 tons of anthracite and 3,679,394 tons of bituminous. In addition to the receipts for local consumption, Boston is the distributing center for a considerable tonnage of coal which is forwarded over the railroads to interior New England points. In 1912, 142,407 tons, or about 8 per cent of the anthracite tonnage, and 1,179,491 tons, or about 24 per cent of bituminous tonnage, received at Boston, was forwarded to interior New England points.

The following table shows the receipts of both anthracite and bituminous coal at Boston, by months, for 1912, the quantity forwarded to interior points, the net receipts for local consumption, and the total for 1912 as compared with the totals for the four preceding years:

Receipts and shipments of coal at and from Boston in 1912, by months, in long tons.

Month.	Receipts from all points.		Shipments to New England points.		Net receipts (for local consumption).	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.
January	120,861	338,226	16,355	120,727	104,506	217,499
February	169,210	399,260	26,592	77,085	142,618	322,175
March	195,379	401,391	14,200	93,755	181,179	307,636
April	143,111	378,494	10,702	97,681	132,409	280,813
May	14,920	507,690	1,807	97,837	13,113	409,853
June	100,633	408,295	9,276	70,828	91,357	337,467
July	139,174	369,535	5,463	92,190	133,711	277,345
August	187,984	463,469	5,697	108,876	182,287	354,593
September	174,114	440,111	16,531	121,326	157,583	318,785
October	178,986	433,854	15,898	98,795	163,088	335,059
November	124,009	351,035	11,352	102,425	112,657	248,610
December	170,751	367,525	8,534	97,966	162,217	269,559
Total, 1912	1,719,132	4,858,885	142,407	1,179,491	1,576,725	3,679,394
1911	1,982,940	4,435,091	246,610	1,235,228	1,736,330	3,199,863
1910	1,826,164	4,403,858	241,641	743,635	1,584,523	3,660,223
1909	1,706,659	3,723,308	244,345	1,139,278	1,462,314	2,584,030
1908	1,776,401	3,673,638	255,984	1,130,674	1,520,417	2,542,962

The following table shows the receipts of domestic and foreign coals at the port of Boston for a period of nine years, in long tons. It is interesting to note that during that period the receipts of bituminous coal have shown a steady increase, amounting to nearly 100 per cent for the nine-year period. This may be cited as one of the evidences of industrial growth in the Boston industrial district and in New England generally. On the other hand, the receipts of anthracite coal have remained practically unchanged during the same period.

The only receipts of foreign coal, as usual, were from the bituminous mines of the Dominion Coal Co., Cape Breton. Practically the entire tonnage was consigned to the by-product coking plant at Everett, a suburb of Boston.

Receipts of coal at Boston, Mass., in 1904–1912, in long tons.

Year.	Domestic.				Foreign.	Total.
	By water.		By rail.			
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Bituminous.	
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
1907	2,016,252	3,196,057	37,036	89,927	545,652	5,884,924
1908	1,733,112	3,240,562	43,289	62,367	370,709	5,450,039
1909	1,668,126	3,393,423	38,533	101,588	228,297	5,429,967
1910	1,760,883	3,954,251	65,281	153,043	296,564	6,230,022
1911	1,881,767	4,101,745	101,173	69,485	263,861	6,418,031
1912	1,554,156	4,475,520	164,976	74,239	309,126	6,578,017

Anthracite.—The retail prices of anthracite in 1912 were abnormally high. This was the result of the strike conditions which prevailed at the mines, and in addition it is claimed that the increased labor cost in the handling and distribution of the coal by the dealers tended somewhat to increase the retail prices. During the early months of 1912 two advances in the retail prices were made in addition to the regular winter advances. The first of these went into effect on January 15, when the prices on furnace and egg sizes were increased 25 cents a ton, and the second took place on March 13, when all sizes were advanced 50 cents a ton. The summer prices did not go into effect until May 27, two months later than usual, when the furnace and egg sizes were reduced 75 cents a ton and the other sizes 50 cents a ton. This, however, was 50 cents a ton higher than the summer prices for the preceding year on all kinds with the exception of nut, which was 75 cents a ton higher than the summer price of 1911. On August 26 the prices on all sizes were advanced 25 cents a ton, and a further increase of 50 cents a ton was made on October 1. This made the fall prices in 1912 75 cents a ton higher than in 1911.

Retail prices, per short ton, of anthracite at Boston in 1912, by kinds.

Kind.	Jan. 15.	Mar. 13.	May 27.	Aug. 26.	Oct. 1.
Furnace	$7.00	$7.50	$6.75	$7.00	$7.50
Egg	7.50	8.00	7.25	7.50	8.00
Stove	7.50	8.00	7.50	7.75	8.25
Nut	7.50	8.25	7.75	7.75	8.25
Pea	5.75	6.25	5.75	6.00	6.50
Shamokin	7.75	8.25	7.75	8.00	8.50
Franklin	8.75	9.25	8.75	9.00	9.50

Coastwise freight rates.—The coastwise freight rates in 1912 were considerably higher than in 1911. From Hampton Roads the minimum rate in 1912 was 60 cents a ton and the maximum rate $1.50 a ton, as compared with rates ranging from 55 cents to $1.30 in 1911; the rates from Philadelphia in 1912 ranged from 75 cents to $1.25 a ton, as compared with rates ranging from 55 cents to $1.25 in 1911; from Baltimore the rates in 1912 ranged from 75 cents to $1.25, as against 60 cents to $1.35 in 1911.

The higher rates during the spring of 1912 were occasioned by anxiety on the part of the dealers to get coal forward because of anticipated labor suspension both in the anthracite and the bituminous coal fields at the expiration of the contracts between the miners and the operators, April 1, 1912.

Coal freights to Boston during 1911 and 1912.

1911.

From—	Minimum.		Maximum.	
	Rate.	Date.	Rate.	Date.
New York	[a] $0.50–$0.55		$1.00	Dec. 30.
Philadelphia	.55	Aug. 15–31	1.25	Nov. 30.
Baltimore	.60	Aug. 15–Sept. 10	1.35	Dec. 1–15.
Norfolk and Newport News	.55	May 30–Sept. 15	$1.25–1.30	Nov. 20–Dec. 10.

1912.

From—	Rate.	Date.	Rate.	Date.
New York	[b] $0.50–$0.55		$1.25	Mar. 15–Apr. 15.
Philadelphia	.65	May 20–June 15	1.30	Feb. 26.
Baltimore	.75	June 25	1.25	Feb. 13.
Norfolk and Newport News	.60	June 20	1.50	Mar. 16.

[a] Fifty to fifty-five cents was season rate on anthracite coal-carrying railroad transportation from New York and 75 cents from Philadelphia. Sixty cents was the minimum rate on sail (sailing vessels) tonnage from New York to Boston.
[b] Fifty to fifty-five cents was season rate on anthracite coal-carrying railroad transportation from New York and 75 cents from Philadelphia. Seventy cents was the minimum rate on sail (sailing vessels) tonnage from New York to Boston.

BALTIMORE, MD.

By Samuel G. Wilmer, financial editor of the Manufacturers' Record.

As shown by the receipts of both bituminous and anthracite coal at Baltimore during 1912 there was a decline of over 5½ per cent in the volume of local business in comparison with that of the year 1911. Under normal conditions there would probably have been shown a large increase in the trade, but the year began with labor troubles threatened in the mining regions supplying this market and, as the seasons advanced, the difficulties thus originating increased, although an agreement was early reached in the anthracite fields, while the tense situation in West Virginia was protracted and intensified. The total receipts of bituminous coal were 5,622,265 long tons, or 345,886 tons less than in 1911. Receipts of anthracite also declined, but not in the same ratio, their total being 841,605 long tons, or 39,869 tons less than in 1911. Thus, the total receipts of both kinds of coal were 6,463,870 tons, a falling off amounting to 385,755 tons from the high-record figures of 1911.

These declines showed in all the movement of coal at the port. Coastwise shipments of bituminous totaled 3,617,282 tons, a decrease of 518,611 tons, and similar shipments of anthracite were 217,142 tons, or 59,624 tons less; thus the coastwise shipments for both dropped off 578,235 tons in 1912, the total figures being 3,834,424 tons. Exports of bituminous increased heavily, their total being 628,522 tons, or 149,426 tons more than in 1911, the increase being over 31 per cent in comparison with the figures of the preceding year. Exports of anthracite were 3,876 tons, or 649 tons less than for 1911, but 828 tons more than in 1910. It will be observed, therefore, that the anthracite exports from this port are practically negligible, although bituminous figures show up well in comparison with other tidewater points.

Receipts of coke again displayed a decline, their total being only 138,795 short tons, which was a falling off of 55,871 tons from the figures for 1911. Coke exports also decreased, their total being but 54,614 tons, or 43,671 tons less than in the preceding year.

Although the prices for high-grade bituminous coals were well sustained throughout the period at Baltimore, the market was dull and low in the spring for average and low-grade bituminous, but good prices, accompanied by an almost panicky condition of the business, prevailed toward the end of the twelvemonth, prices improving decidedly by October and then advancing, because of the unfavorable labor conditions that seriously affected the supply. The demand continued with good prices until the new year, with a strong market and the prospect of its remaining so for an indefinite period.

The Baltimore market for anthracite in 1912 was likewise abnormal, owing to the spring suspension of work by the miners in the anthracite region pending negotiations with the operators for a new wage scale, these conditions causing a temporary halt in the supply of this coal. Consequently prices were irregular with a considerable range and difference at times. After fears of a strike were removed and work was resumed at the mines, deliveries were necessarily delayed and the distribution of this fuel to consumers was later than usual. Almost all anthracite marketed at Baltimore is for domestic use, although a little is bought for steaming purposes. Exports of it are exceedingly small.

Receipts and shipments of bituminous and anthracite coals and also of coke are shown in the accompanying tables, these figures including the coal and coke received and used at the large plant of the Maryland Steel Co., at Sparrows Point, and also at the plant of the Central Foundry Co., at Dundalk (post office, St. Helena), both of which have to be reckoned in any statements concerning the coal trade of Baltimore, as their purchases are practically part thereof and their locations are near to the city, although not within its limits.

Receipts and shipments of coal and coke at Baltimore, Md., 1911–1912, in long tons.

Kind.	1911			1912		
	Receipts.	Tidewater shipments.		Receipts.	Tidewater shipments.	
		Coastwise.	Exports.		Coastwise.	Exports.
Bituminous	5,968,151	[a] 4,135,893	479,096	5,622,265	[a] 3,617,282	628,522
Anthracite	881,474	276,766	4,525	841,605	217,142	3,876
Total	6,849,625	4,412,659	483,621	6,463,870	3,834,424	632,398
Coke (short tons)	194,666	....	98,285	138,795	....	54,614

[a] Includes shipments to points on Chesapeake Bay and in Baltimore Harbor.

Coastwise shipments of coal from Baltimore, 1903–1912, 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
1907	266,062	3,804,066	4,070,128
1908	251,739	3,704,851	3,956,590
1909	235,233	3,344,225	3,579,458
1910	272,695	3,891.018	4,163,713
1911	276,766	4,135,893	4,412,659
1912	217,142	3,617,282	3,834,424

Exports of bituminous coal continued to increase in volume, being larger than in any previous year and much greater than in 1911, the next largest annual exports having been in 1907, which were exceeded by more than 68,000 tons. There was a considerable decline in coke exports. The table below exhibits the exports of these two fuels month by month and the total of each for 1912, besides the total exports of each during each of the last seven years.

Exports of bituminous coal and coke from Baltimore in 1912, by months, in long tons.

Month.	Bituminous coal.	Coke.
January	24,555	2,817
February	40,629	7,567
March	98,112	4,382
April	113,834	3,065
May	66,556	4,181
June	40,627	4,537
July	29,800	7,141
August	43,248	9,667
September	41,385	4,800
October	32,800	384
November	41,819	3,031
December	55,153	3,042
Total 1912	628,522	54,614
1911	479,096	98,285
1910	493,416	46,847
1909	332,016	50,446
1908	347,489	105,317
1907	559,880	77,822
1906	458,203	69,230
1905	341,107	32,954

The following statements show the receipts of bituminous coal and coke at the plants of the two large industries previously mentioned:

Maryland Steel Co.—The consumption of bituminous coal at this plant during 1912 amounted to 558,985 long tons. The company made in its own ovens, which are of the by-product type, 262,832 tons of coke, and, in addition to this, purchased 47,720 tons of coke, also for use in the manufacture of steel. In 1911 the company's consumption of bituminous coal was 599,805 long tons and it made 300,266 tons of coke, also purchasing 55,782 tons of coke, which was likewise used by it in making steel.

Central Foundry Co.—The consumption at this plant during 1912 of bituminous coal amounted to 2,890 long tons, and of coke to 2,647 tons. In 1911 its consumption of these fuels was 2,175 tons of bituminous coal and 1,780 tons of coke.

Acknowledgment is due to officers of these industrial enterprises as well as to officers of the Baltimore & Ohio, the Pennsylvania, and the Western Maryland railroad companies for data used in the preparation of the tables presented in this article.

NORFOLK AND NEWPORT NEWS, VA.

The well-known steam and "smokeless" coals mined in the southern part of West Virginia and in the southwestern counties of Virginia reach tidewater at the mouth of Chesapeake Bay over the Chesapeake & Ohio Railway to Newport News, the Norfolk & Western Railway to Lambert Point, and the Virginian Railway to Sewall Point, the last two being on the south side of Hampton Roads, near Norfolk, and the Chesapeake & Ohio terminals being on the north side of "The Roads." The three terminals make this harbor second only to New York as a coal-handling port.

The quantity of coal handled at the Hampton Roads ports in 1912 exceeded the previous high record of 1911 by over 1,500,000 long tons, of which more than 1,050,000 tons was over the Norfolk & Western Railway to Lambert Point. The shipments over the Chesapeake & Ohio increased only about 5,000 tons. The largest increase in the loading was for bunker coal, which in 1912 was 1,659,603 tons against 1,121,665 tons in 1911, a gain of 537,938 tons. Coastwise shipments increased 387,717 long tons, from 7,278,729 tons in 1911 to 7,666,446 tons in 1912, and export shipments increased 449,960 tons, from 1,925,741 tons to 2,365,701 tons.

For the figures included in the table following the writer is indebted to the following officials, namely: Messrs. Joseph W. Coxe, comptroller, Norfolk & Western Railway, at Roanoke; W. A. Young, superintendent coal terminals, Virginian Railway, at Sewall Point, Norfolk; E. D. Hotchkiss, general freight agent, Chesapeake & Ohio Railway, at Richmond.

The coal receipts at Hampton Roads in 1911 and 1912 are shown in the following table:

Coal receipts at Hampton Roads in 1911 and 1912, in long tons.

1911.

Destination.	Norfolk & Western Ry.	Chesapeake & Ohio Ry.	Virginian Ry.	Total.
Coastwise	2,494,165	3,168,864	1,615,700	7,278,729
Export	915,651	859,055	151,035	1,925,741
Bunker	513,282	362,635	245,748	1,121,665
Total	3,923,098	4,390,554	2,012,483	10,326,135

1912.

Destination.	Norfolk & Western Ry.	Chesapeake & Ohio Ry.	Virginian Ry.	Total.
Coastwise	3,186,956	2,637,000	1,842,490	7,666,446
Export	1,193,711	917,514	254,476	2,365,701
Bunker	600,317	682,200	377,086	1,659,603
Local		158,956		158,956
Total	4,980,984	4,395,670	2,474,052	11,850,706

The monthly shipments over the Virginian Railway in 1912, as reported by Mr. Young, were as follows:

Statement of coal dumped over Sewall Point Pier, 1912, by months, in long tons.

Month.	Coastwise.	Export.	Bunker.	Total.
January	133,351	9,554	34,395	177,300
February	133,956	29,319	32,176	195,451
March	124,515	52,671	30,913	208,099
April	92,343	29,903	44,015	166,261
May	144,681	13,180	31,927	189,788
June	133,100	21,043	21,588	175,731
July	178,809	9,339	27,484	215,632
August	186,092	14,169	22,969	223,230
September	215,290	4,035	23,945	243,270
October	169,495	29,337	41,757	240,589
November	144,440	7,114	30,640	182,194
December	186,418	34,812	35,277	256,507
Total	1,842,490	254,476	377,086	2,474,052

The shipments over the Norfolk & Western Railway to Lambert Point piers, as reported by Mr. Coxe, were as follows:

Statement of coal dumped over Lambert Point piers, 1912, by months, in long tons.

Month.	Coastwise.	Export.	Bunker.	Total.
January	222,235	100,183	60,973	383,391
February	257,699	96,152	49,041	402,892
March	251,198	130,464	65,331	446,993
April	281,806	199,306	59,738	540,850
May	338,156	111,134	50,627	499,917
June	266,434	108,904	43,580	418,918
July	273,327	103,875	45,423	422,625
August	276,387	66,932	44,633	387,952
September	293,956	61,315	38,895	394,166
October	280,544	72,154	46,630	399,328
November	219,858	68,218	48,341	336,417
December	225,356	75,074	47,105	347,535
Total	3,186,956	1,193,711	600,317	4,980,984

The total shipments from Virginia and southern West Virginia coal mines to Hampton Roads during the last five years have been as follows:

Shipments of coal to Hampton Roads, 1908–1912, in long tons.

Year.	Norfolk & Western Ry. to Lambert Point.	Chesapeake & Ohio Ry. to Newport News.	Virginian Ry. to Sewall Point.
1907	3,221,010	3,887,804	....
1908	2,401,223	3,997,121	....
1909	3,228,854	4,985,426	241,644
1910	4,040,649	4,409,848	1,147,077
1911	3,923,098	4,390,554	2,012,483
1912	4,980,984	4,395,670	2,474,052

PITTSBURGH, PA.

The Pittsburgh district of Pennsylvania is the largest consumer of fuel in the world, and the magnitude of its additional coal traffic makes its preeminence all the more pronounced. In population Pittsburgh ranks eighth among the cities of the United States, having only about one-ninth that of Greater New York, but in the consumption of coal alone Pittsburgh nearly equals the largest city in the country. It is estimated (no accurate data being available) that Greater New York consumes annually between 18,000,000 and 20,000,000 short tons of coal. The Pittsburgh district in 1912 consumed 17,721,783 tons of coal and about 5,000,000 tons of coke, or a total of about 22,700,000 short tons, over 10 per cent more than all the boroughs of Greater New York. Moreover, Pittsburgh also consumes millions of cubic feet of natural gas, which, added to the coal and coke consumed, gives it still more prominence as a fuel consumer. The total quantity of coal sent to New York Harbor ports for local consumption, for bunker trade, and for transshipment to coastwise and foreign ports is between 35,000,000 and 40,000,000 short tons. In 1912 the total coal business of the Pittsburgh district, including local consumption and shipments east and west, amounted to 59,150,179 short tons. The coke used and handled was approximately 14,000,000 tons, making a total of about 73,000,000 tons, or nearly twice as much as the coal going to New York Harbor.

The quantity of coal shipped by rail and water to Pittsburgh and through Pittsburgh to points west in 1912 was 43,801,134 short tons, an increase of 4,160,226 tons over 1911. All of this increase was in rail shipments, as those by water fell off slightly, about 100,000 tons. The shipments to Pittsburgh were by rail 7,778,450 tons and by water 9,943,333 tons. The shipments to points west of Pittsburgh were by rail 24,086,001 tons and by water 1,993,350 tons. The shipments from the Pittsburgh district to eastern points, all rail, which do not go through the city, amounted in 1912 to 15,349,045 tons, against 13,169,866 tons in 1911. The shipments of coke in 1912 were to Pittsburgh 4,962,207 tons, to points west 5,684,566 tons, and from the Pittsburgh district to eastern points 3,294,656 tons. The following statement showing the quantity of coal received in Pittsburgh and vicinity by rail and water and the shipment of coal to and from the Pittsburgh district and to western points during the last five years has been compiled from reports made to the Survey by the officials of railroads entering Pittsburgh and by the United States Army officer in charge of the slack-water navigation on Monongahela River and of the improvements at the Davis Island Dam in Ohio River below Pittsburgh. The railroad officials to whom special acknowledgment is due for the information contained in the tables are Messrs. R. H. Large, coal freight agent of the Pennsylvania Railroad at Philadelphia; James P. Orr, assistant freight traffic manager of the Pennsylvania lines west of Pittsburgh at Pittsburgh; W. L. Cromlish, coal and coke agent of the Baltimore & Ohio Railroad at Pittsburgh; J. B. Nessle, general freight agent of the Pittsburgh & Lake Erie Railroad at Pittsburgh; J. B. Safford, superintendent of the Pittsburgh, Chartiers & Youghiogheny Railway at Pittsburgh; and S. P. Woodside, general freight agent of the Wabash-Pittsburgh Terminal Railway at Pittsburgh. The statistics of the movement of coal through the Monongahela River locks and at the Davis Island Dam have been furnished by Lieut. Col. Francis R. Shunk, Corps of Engineers, United States Army.

The rail and water shipments to and from the Pittsburgh district during the last six years are shown in the following table:

Movement of coal to and through Pittsburgh, 1907–1912, in short tons, showing totals by rail and water.

Destination.	1907	1908	1909	1910	1911	1912
By rail:						
To Pittsburgh district	4,774,977	3,494,905	4,654,249	6,139,959	5,142,412	7,778,450
To west of Pittsburgh	20,817,263	18,970,848	18,981,995	a22,683,276	a22,474,289	24,086,001
Total by rail	25,592,240	22,465,753	23,636,244	28,823,235	27,616,701	31,864,451
By Monongahela River locks:						
To Pittsburgh district	7,611,680	6,435,851	9,737,505	9,460,695	9,207,232	9,943,333
To west of Pittsburgh	3,204,129	1,742,339	2,463,385	1,770,305	2,816,975	1,993,350
Total by water	10,815,809	8,178,190	12,200,890	11,231,000	12,024,207	11,936,683
Total shipments	36,408,049	30,643,943	35,837,134	40,054,235	39,640,908	43,801,134

a Includes a small quantity of coal sent to Lake Erie points.

Movement of coal to and through Pittsburgh, 1907–1912, in short tons, showing totals to Pittsburgh district and west of Pittsburgh.

Destination.	1907	1908	1909	1910	1911	1912
To Pittsburgh district:						
By rail	4,774,977	3,494,905	4,654,249	6,139,959	5,142,412	7,778,450
By water	7,611,680	6,435,851	9,737,505	9,460,695	9,207,232	9,943,333
Total to Pittsburgh district	12,386,657	9,930,756	14,391,754	15,600,654	14,349,644	17,721,783
To west of Pittsburgh:						
By rail	20,817,263	18,970,848	18,981,995	22,683,276	22,474,289	24,086,001
By water	3,204,129	1,742,339	2,463,385	1,770,305	2,816,975	1,993,350
Total to west of Pittsburgh	24,021,392	20,713,187	21,445,380	24,453,581	25,291,264	26,079,351
Total shipments to Pittsburgh and points west	36,408,049	30,643,943	35,837,134	40,054,235	39,640,908	43,801,134
Shipments, all rail, to points east of Pittsburgh	12,202,530	11,666,160	11,300,162	10,781,544	13,169,866	15,349,045

BUFFALO, N. Y.

By JOHN W. CHAMBERLIN, trade press correspondent.

The anthracite situation in 1912 was in reality without material change, though accidental conditions were for a great part of such a nature that they affected the trade of the entire year. The mining suspension, lasting about two months, entirely shut off the shipments to Buffalo for practically that time, April and May, so that on June 1 only 40,000 tons had been shipped from this port by Lake and the rail-line movement was also small during this period.

This state of things produced a great activity on the part of Buffalo bituminous jobbers who had connections in the independent anthracite trade. All of them at once increased their handling of this coal very rapidly, advancing the price from time to time according as consumers became more uneasy, till they were able to obtain a premium of $2.50 over the regular circular. This trade lost its excess price when the mining suspension in the leading districts ended, but the trade did not return to its former rather small proportions, so that the Buffalo jobbers are still selling much more independent anthracite than they did prior to the suspension.

A very marked effect was also produced on the bituminous trade. Prices did not advance as far as they were expected to, the limit being, possibly, $1.50 a ton, but the trade was much more satisfactory to the mine owner and jobber. It has been common to speak of bituminous coal as unprofitable to the producer and only moderately profitable to the jobber, as it was so plenty that the consumer usually made the price, but the old level has not been resumed since the flurry created by the suspension. In fact it is becoming common to report that the business is entirely satisfactory to the producer and seller. Members of the trade in the Allegheny Valley have laid aside their old feeling of despondency and have for some time complained rather of their inability to meet the demand. Buffalo has long sold not only a great part of the coal mined in the Allegheny Valley and neighboring districts, but also large amounts of coal from the Pittsburgh district, which commonly controls the Buffalo market. Of late, however, Pittsburgh coal has been as scarce as any and merely shares with Allegheny Valley the shaping of the trade. Buffalo has miners and sellers of Clearfield coal, but the market for it is elsewhere, on account of adverse freight rates.

The car-ferry problem is still unsolved. The Grand Trunk Railway ferry from Ohio across Lake Erie to Canada has not developed, but the ferry it operates across Lake Ontario in conjunction with the Buffalo, Rochester & Pittsburgh Railway is to increase its handling, and another ferry from Olcott to Whitby is projected by other Canadian railways.

Statistics of coal receipts at Buffalo by rail are still unobtainable, beyond the mere estimate that about 8,000,000 tons of bituminous and 7,000,000 tons of anthracite come into the Buffalo territory, of which about half the bituminous and all but about 400,000 tons of anthracite is shipped northward and westward by Lake and rail. In spite of the poor start in Lake shipments of anthracite from the port the end of the season saw a deficiency of only 35,000 tons as compared with 1911, the total for 1912 being 3,629,784 long tons.[1] From Lake Ontario ports the anthracite shipments in 1912 were 739,879 tons, divided as follows: To New York State ports, 35,475 tons; to Canadian ports, 533,200 tons; to upper Lake ports, 171,204 tons. Of this entire amount 6,643 tons were shipped from Charlotte, 9,189 tons from Sodus Point, 159,474 tons from North Fair Haven, and 564.573 tons from Oswego. The anthracite shipment from the port of Erie, Pa., the only other port that ships anthracite by Lake, was 543,000 tons, making a total of 4,912,663 long tons. or about an even 5,500,000 short tons of anthracite shipped by lake in the season of 1912.

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[1] Confidential reports to the United States Geological Survey by the railroads delivering anthracite at Buffalo show a total of 7,091,521 long tons delivered in 1912, of which 460,189 tons were for local consumption, 1,678,515 tons for export to Canada, and 3,831,344 tons for upper Lake ports. The ultimate destination for something over 1,000,000 tons was not reported, but these figures agree closely with Mr. Chamberlin's estimates. Complete statistics of the receipts of bituminous coal were not obtained.

There has been small change in the Buffalo trade as a whole. In anthracite circles there are now three branch offices of independent companies established in the city, those of the Skeele Coal Co., Whitney & Kremmerer, and Thorne, Neal & Co., showing the tendency in that direction. In bituminous progress the Shawmut interest has led, one of its auxiliary companies at Furnace Run on Allegheny River being engaged in opening extensive new mines. As a rule other Buffalo bituminous mining interests are without material change.

Shipments of coal and coke to Canada through Buffalo by Lake and rail show steady increase. As the figures furnished by the customhouse are for valuations they should be exact. This movement for the last six years is as follows:

Export of coal and coke from Buffalo to Canada, 1907–1912, in long tons.

Year.	Anthracite.	Bituminous.	Coke.	Total.
1907	809,192	2,036,914	204,821	3,050,947
1908	786,063	1,726,332	213,712	2,726,107
1909	800,741	1,748,759	350,085	2,899,585
1910	931,378	2,014,762	420,805	3,366,945
1911	1,695,035	2,620,727	416,069	4,231,831
1912	1,234,564	2,609,702	423,524	4,267,790

Strictly speaking, Buffalo does not make either coal or coke prices, but follows the circular in the anthracite market and adds the Pittsburgh freight rate of $1.25 for bituminous and $1.85 for coke to the regular Pittsburgh prices, Allegheny Valley coal selling at about 25 cents less than Pittsburgh. The Allegheny Valley coal rate is $1.10, which reduction is thus in part given to the consumer.

CINCINNATI, OHIO.

[From the annual report of W. C. Culkins, superintendent and executive secretary of the Cincinnati Chamber of Commerce.]

A number of circumstances were favorable to the coal trade in 1912. A good stage of water in the river almost throughout the year made navigation easy and minimized the losses from wrecks. The revival of manufacturing industry created a demand for steam coal, which was accentuated by the scarcity caused by the strike in the Kanawha region. The year 1911 closed with a rather unsatisfactory condition, the visible supply was large and the weather conditions unfavorable, but 1912 opened with a change which improved the situation materially. The threatened strike in the anthracite fields was averted, but in April the labor situation led to a stocking up and an increase in prices. The first half of the year, however, was not so good as the latter half, when the revival of trade set fires burning that had been idle for some time.

It is probable that the coal shipped through the Cincinnati railroads gateway to the Lakes and the West was a record breaker. Connecting railroads were up to capacity, and the annual car shortage was more embarrassing than usual all along the line. The demand from these regions is increasing, and in anticipation of the continued revival of business dealers from the South and other sections are arranging orders in this market.

There was little change in prices in 1912 as compared with 1911. Coal delivered, per ton, ranged from $3.25 to $3.50 almost until November. The average price in 1911 was $3.34, and in January, the opening of 1912, it was $3.32. This went to $3.375 in February, and in April it reached $3.437. It dropped back to $3.375 where it remained until October; it went to $3.50 in November and closed at $3.50.

Lump coal afloat ranged from 9 to 9¼ cents from January to May, when it dropped to 8 cents where it remained. Coal on cars beyond the slight advance in April remained steady at $2.50 a ton until October when it advanced to $2.65 and closed the year at $2.70 a ton.

Anthracite delivered was quoted at $7.25 a ton, at the beginning of the year, advanced to about $7.75 in April, and ranged from $7.50 to $8 until July, when the range became $7.50 to $7.75 until November, when $7.75 was quoted.

The annual receipts of coal, in short tons, at Cincinnati, according to reports of gagers, private returns, and records of the Chamber of Commerce, for the last five years have been as follows:

Receipts of coal at Cincinnati, 1908–1912, in short tons.

Year.	By river.			By rail.	
	Pittsburgh.	Kanawha.	Other kinds.	Receipts.	Anthracite.
1908	516,447	874,097	40,056	2,915,400	34,200
1909	839,952	1,000,336	1,952	3,053,760	18,840
1910	514,140	949,160	1,460	4,384,240	13,480
1911	729,748	1,536,551		5,212,701	6,280
1912	501,640	1,313,981		6,017,893	8,640

Total annual receipts, by river and by rail, and aggregate receipts, with total annual shipments, by river and by rail, and aggregate shipments, for five years:

Movements of coal at Cincinnati, 1908–1912, in short tons.

Year.	Receipts.			Shipments.		
	By river.	By rail.	Aggregate.	By river.	By rail.	Aggregate.
1908	1,430,600	2,915,400	4,346,000	135,200	2,434,160	2,569,360
1909	1,842,240	3,053,760	4,896,000	269,080	2,528,440	2,797,520
1910	1,464,760	4,384,240	5,849,000	170,240	4,036,800	4,207,040
1911	2,266,299	5,212,701	7,479,000	246,076	4,077,342	4,323,418
1912	1,815,621	6,026,533	7,842,154	279,842	4,396,859	4,676,701

CLEVELAND, OHIO.

The total coal and coke receipts at Cleveland, as reported by Mr. Munson A. Havens, secretary of the Cleveland Chamber of Commerce, amounted in 1912 to 8,577,834 short tons. This was the record for coal and coke business at this port, exceeding the receipts of 1911 by 1,255,239 tons, and the previous maximum of 1910 by 142,525 tons, The increased business in 1912 was altogether in the quantity of coal shipped through Cleveland by Lake and rail to other points, as local consumption fell off about 20,000 tons. The year 1911 was exceptional in the latter regard, however, having shown an increase of more than 1,000,000 tons over 1910, and that 1912 practically maintained that record is an indication of healthful trade conditions. The local consumption of coke showed a decided increase in 1912 over 1911, the receipts being 1,753,247 tons in 1912 against 937,714 tons in 1911, and the quantity forwarded increased only 15,000 tons, indicating an increase in local consumption of coke of practically 800,000 tons.

Coal and coke receipts and shipments at Cleveland, Ohio, 1908–1912, in short tons.

RECEIPTS.

Kind.	1908	1909	1910	1911	1912
Bituminous	5,715,781	6,264,998	7,097,170	6,242,910	6,673,940
Anthracite	515,717	363,162	400,425	168,208	150,647
Coke	690,742	1,034,649	937,714	911,477	1,753,247
Total	6,922,240	7,662,809	8,435,309	7,322,595	8,577,834

SHIPMENTS.

Kind.	1908	1909	1910	1911	1912
Anthracite by rail	41,428	25,383	18,020	....	....
Bituminous by rail	82,542	122,814	383,408	....	118,623
Bituminous by lake	3,350,830	4,602,275	5,023,368	3,108,741	4,249,666
Coke by rail	75,559	102,375	197,784	273,313	288,238
Total	3,550,359	4,852,847	5,622,580	3,382,054	4,656,527

Total coal and coke receipts and shipments, with local consumption, at Cleveland, Ohio, 1908–1912, in short tons.

Year.	Receipts.	Shipments.	Local consumption.
1908	6,922,240	3,550,359	3,371,881
1909	7,662,809	4,852,847	2,809,962
1910	8,435,309	5,622,508	2,812,801
1911	7,322,595	3,382,054	3,940,541
1912	8,577,834	4,656,527	3,921,307

MILWAUKEE, WIS.

[From the annual report of H. A. Plumb, secretary of the Milwaukee Chamber of Commerce.]

The quantity of coal received in 1912 was the largest in Milwaukee's history, exceeding by 111,056 tons the quantity received in 1910, the year of largest arrivals prior to 1912. The receipts by Lake were not as large as in 1911, the increased traffic coming entirely from the rail business, in which is included the coal carried by the two car-ferry lines. Including the quantity carried by the car ferries, there were 4,906,393 tons received at Milwaukee by water, although the car-ferry receipts are classed as rail business. Shipments of coal for the year, as reported to the chamber of commerce, are believed to be to some extent inaccurate. The strike among the railroad employees during May and June interrupted business, and for a considerable length of time the reports of receipts were meager and it was found impossible to have the deficiencies made up. There were altogether 715 cargoes of coal which arrived at the port of Milwaukee during the 1912 season of navigation. They consisted of 172 cargoes of anthracite, each averaging 5,077 tons, and 543 cargoes of bituminous coal averaging 6,647 tons. During the season there were 73 cargoes consisting of 10,000 tons each, and 13 cargoes of over 11,000 tons each. Prices ruled higher than in the preceding year, the best grades of anthracite ranging from 25 to 45 cents above the 1911 schedule f. o. b. cars. The freight rates by Lake were 5 cents per ton lower than prevailed during 1911, were on a parity with the rates from Duluth to Superior, and were from 5 to 10 cents per ton lower than the Chicago rates. The most improved methods are in use at the 27 receiving plants in operation at Milwaukee, and the superior harbor facilities, combined with the excellent handling machinery, enabled the carriers to discount the rate in favor of Milwaukee.

The receipts of coal at and shipments from Milwaukee during the last five years, and the total receipts for a series of years since 1865, are shown in the following table:

Receipts of coal at Milwaukee, Wis., 1908–1912, in short tons.

Source.	1908	1909	1910	1911	1912
By lake from—					
Buffalo	1,005,594	778,392	810,409	909,080	834,131
Erie	17,359	80,980	82,072	90,342	367,527
Oswego	58,285	56,588	68,983	65,166	64,213
Cleveland	520,244	382,828	436,057	219,852	357,232
Ashtabula	167,851	212,314	520,376	446,330	242,297
Lorain	337,465	610,444	671,656	848,687	766,897
Sandusky	451,807	393,869	388,467	369,601	532,065
Toledo	891,626	1,057,076	1,311,786	1,453,631	1,180,596
Fairport	77,001	108,210	61,737	107,803	48,037
Huron, Ohio	22,425	26,015	86,046	64,780	144,966
Other ports	111,510	115,358	173,743	30,150	44,727
Total lake	3,661,167	3,822,074	4,611,332	4,605,422	4,582,688
By railroad	[a] 380,759	[b] 353,948	[c] 449,869	[d] 409,489	589,569
Total receipts	4,041,926	4,176,022	5,061,201	5,014,911	5,172,257

[a] Including 168,205 tons by car ferry.
[b] Including 205,669 tons by car ferry.
[c] Including 327,415 tons by car ferry.
[d] Including 265,572 tons by car ferry.

Shipments of coal from Milwaukee, Wis., 1908–1912, in short tons.

Shipped by—	1908	1909	1910	1911	1912
Chicago, Milwaukee & St. Paul Ry	632,184	776,010	1,019,330	765,980	248,768
Chicago & North Western Ry	471,101	483,250	530,010	543,840	577,225
Wisconsin Central Ry.[a]	99,411	123,500	139,435	119,135	129,607
Lake	....	....	360	60	178
Total	1,202,696	1,382,760	1,689,135	1,429,015	955,778

[a] The Wisconsin Central Railway is now part of the "Soo line."

Receipts of coal by lake at Milwaukee, Wis., 1908–1912, by kinds, in short tons.

Kind.	1908	1909	1910	1911	1912
Anthracite	1,063,879	834,980	930,472	1,013,907	973,388
Bituminous	2,597,288	2,987,094	3,680,860	3,591,515	3,609,300
Total	3,661,167	3,822,074	4,611,332	4,605,422	4,582,688

Receipts of coal at Milwaukee, Wis., by lake and rail, in 1865, 1870, 1880, 1890, 1900, 1905, and annually from 1910 to 1912, in short tons.

1865	36,369	1905	3,157,464
1870	122,865	1910	5,061,201
1880	368,568	1911	5,014,911
1890	999,657	1912	5,172,257
1900	1,808.593		

Lake freights on coal from Buffalo to principal upper Lake ports during the season of 1912, as compared with those of 1911, were as follows:

Freight rates per ton on coal from Buffalo to principal upper lake ports, 1911 and 1912, by months.

Month.	To Milwaukee.		To Chicago. North Branch.		To Chicago. South Branch.		To Duluth.	
	1911	1912	1911	1912	1911	1912	1911	1912
March	$0.35	$0.30	$0.40	$0.35	$0.45	$0.40	$0.30	$0.30
April	.35	.30	.40	.35	.45	.40	.30	.30
May	.35	.30	.40	.35	.45	.40	.30	.30
June	.35	.30	.40	.35	.45	.40	.30	.30
July	.35	.30	.40	.35	.40	.40	.30	.30
August	.35	.30	.40	.35	.40	.40	.30	.30
September	.35	.30	.40	.35	.40	.40	.30	.30
October	.35	.30	.40	.35	.40	.40	.30	.30
November	.35	.30	.40	.35	.40	.40	.30	.30
December	1.00	.50	1.00	1.00	1.00	1.00	1.00	1.00

ST. LOUIS, MO.

According to Mr. Wm. F. Saunders, secretary and general manager of the Business Men's League of St. Louis, there was a marked increase in the consumption of bituminous coal in St. Louis during 1912, with a decided falling off in the use of anthracite. The latter is readily attributable to the suspension of mining operations in the anthracite fields of Pennsylvania during April and May, 1912, and the consequent scarcity in the supply of that fuel, particularly for points as distant from the producing centers as is St. Louis. The consumption of bituminous coal increased from 7,798,309 short tons in 1911 to 8,942,872 tons in 1912. The receipts of anthracite, on the other hand, decreased from 487,030 short tons to 277,683 tons. The coke receipts showed a slight decline, from 192,425 tons in 1911 to 190,370 tons in 1912.

St. Louis is favorably situated for securing cheap fuel, being within a short distance of the coal fields of southwestern Illinois. The increased consumption of bituminous coal in 1912 is indicative of manufacturing activities in the city during that year.

The receipts of coal and coke at St. Louis during the last six years, and the high, low, and closing prices in 1911 and 1912, are shown in the following tables:

Coal and coke receipts at St. Louis, Mo., 1907–1912, in short tons.

Year.	Bituminous.	Anthracite.	Coke.	Year.	Bituminous.	Anthracite.	Coke.
1907	8,477,476	265,571	826,400	1910	7,945,680	289,463	191,190
1908	7,129,055	236,036	357,016	1911	7,798,309	487,030	192,425
1909	7,418,268	236,040	171,570	1912	8,942,872	277,683	190,370

Coal prices at St. Louis, Mo., during 1911 and 1912, in short tons.

Kind.	1911			1912		
	Highest.	Lowest.	Closing.	Highest.	Lowest.	Closing.
Standard Illinois lump coal	$1.77	$1.27	$1.62	$2.02	$1.27	$1.62
High-grade Illinois lump coal	2.42	1.67	1.92	2.92	1.67	2.22
Anthracite, large, E-99	6.70	6.20	6.70	6.95	6.45	6.95
Anthracite, small, E-99	6.95	6.45	6.95	7.20	6.70	7.20
Connellsville coke	6.15	5.00	6.10	6.80	5.30	6.80
New River coke	5.70	4.85	5.65	6.80	5.30	6.80
Kentucky coke	3.95	3.65	3.95	4.75	3.25	4.75
Gas coke	4.90	4.40	4.90	5.00	4.25	5.00

SAN FRANCISCO, CAL.[1]

In San Francisco, as in other cities of the Pacific coast, the use of petroleum for steam purposes by railroads and manufacturers has largely supplanted coal, which is at the present time confined almost entirely to domestic consumption. The total quantity of coal consumed in San Francisco and the neighboring cities on the eastern shore of San Francisco Bay in 1912 was apparently considerably less than 500,000 short tons. The three railroads entering California—the Southern Pacific, the Western Pacific, and the Atchison, Topeka & Santa Fe—carried into the State in 1912 a total of 268,494 short tons, chiefly from New Mexico, Utah, and Wyoming. Of that quantity, 45,184 tons went to San Francisco and 223,310 tons to other points in the State. The receipts by water at San Francisco amounted to 450,179 long tons (504,200 short tons), of which 122,090 long tons (136,741 short tons) were from Eastern States, for use chiefly by the naval vessels of the United States in Pacific waters. The receipts by water in 1912 were 109,917 long tons less than in 1911, and this decrease was nearly altogether in the receipts from Australia and bore out the prediction in the report for 1911 that the quantity of coal shipped from that country in 1912 would not exceed 100,000 tons. Receipts of coal from Australia depend principally upon the exports of wheat from California, the vessels carrying the wheat

[1] For statements of railroad shipments to San Francisco and other points in California, the Survey is indebted to Mr. H. M. Adams, freight traffic manager, Western Pacific Railway; Mr. W. G. Barnwell, assistant freight traffic manager, Atchison, Topeka & Santa Fe Railway; and Mr. G. W. Luce, freight traffic manager, Southern Pacific Co. The figures of coal and coke receipts by water have been compiled by Mr. James B. Smith, of San Francisco.

bringing the return cargoes of coal for ballast. Receipts of British Columbian coal decreased from 207,203 long tons in 1911 to 181,138 tons in 1912, and those from Washington fell off from 57,298 long tons to 49,829 tons. These decreases were offset by an increase of nearly 42,000 long tons in the coal from Eastern States.

It is estimated that the total consumption of oil for fuel, including that used in the manufacture of gas, in California is between 50,000,000 and 55,000,000 barrels, equivalent, approximately, to 15,000,000 tons of coal, or about twenty times as much as the coal consumed within the State. The total consumption of coal in 1912, estimated from the rail and water receipts, was about 770,000 short tons.

Sources of coal consumed in California, 1907–1912, in long tons.

[Includes arrivals by water only at port of San Francisco.]

Sources.	1907	1908	1909	1910	1911	1912
British Columbia	243,677	165,204	188,125	157,489	207,203	181,138
Australia	142,924	452,819	68,086	115,179	198,730	92,033
Great Britain	31,359	21,805	3,105		2,639	1,429
China					6,170	822
Japan	33,598	58,170	546	38,817	279	1,638
Oregon	32,645	22,205	24,125	23,293	7,439	1,200
Washington	85,738	69,947	16,940	50,342	57,298	49,829
Eastern	34,333	188,110	69,696	101,265	80,338	122,090
Total	604,274	978,260	370,623	486,385	560,096	450,179

SEATTLE, WASH.

According to F. E. Saward's annual report, "The Coal Trade," the receipts of coal at Seattle in 1912 were 433,633 short tons. The exports were 95,785 tons. When these figures are compared with those of 1903 the influence of fuel oil on the coal-mining industry of Washington is apparent. In the earlier year the receipts of coal amounted to 1,001,798 short tons, and the exports, including bunker coal, were 463,186 tons. The receipts in 1903 were nearly two and one-half times what they were in 1912, and the exports in 1903 were nearly five times what they were in 1912. The bunker trade is practically extinct, for with the exception of vessels engaged in oriental or other foreign trade, all the boats entering this port use oil, and the foreign coal burners take their supplies of fuel at Vancouver, B. C. The following table, taken from "The Coal Trade," gives the receipts and exports of coal at Seattle as closely as the former can be estimated for the last 10 years:

Receipts and exports of coal at Seattle, by years, since 1903, in short tons.

Year.	Receipts.	Exports.	Year.	Receipts.	Exports.
1903	1,001,798	463,186	1908	600,000	377,533
1904	945,000	392,520	1909	600,000	353,290
1905	900,000	423,613	1910	785,080	574,968
1906	927,500	463,719	1911	450,000	101,229
1907	950,000	564,413	1912	433,633	95,785

PRODUCTION OF COAL BY STATES.

ALABAMA.

Total production in 1912, 16,100,600 short tons; spot value, $20,829,252.

The great Appalachian coal region which furnishes over two-thirds of the coal production of the United States and which extends from Ohio and Pennsylvania on the north in a gradually narrowing belt through eastern Kentucky and Tennessee has its southern terminus in a considerably broadened area that occupies a large part of the northern half of Alabama. The coal-bearing formations of Alabama underlie about 8,400 square miles and are divided into four distinct basins, the Coosa, the Cahaba, and the Warrior, named from the rivers which drain them, and the Plateau, which includes Blount, Lookout, and Sand or Raccoon Mountains. By far the most important basin in area and in production is the Warrior, which includes all of Walker County, most of Jefferson, Tuscaloosa, and Fayette counties, and smaller parts of Blount, Cullman, Winston, and Marion counties. The area known to contain coal is approximately 4,000 square miles, or one-half the total coal area of the State, and contributes about 80 per cent of the total production.

There are several distinct coal groups in the basin, the most important of which are the Brookwood, the Pratt, and the Mary Lee, designated by the names of their principal beds. The Mary Lee group includes the Blue Creek, the Jagger, and the Newcastle beds, most of which are mined in places. The Brookwood, the Pratt, and the Mary Lee produce most of the coking coal mined in the State, and more than half of all of the coal mined in the district.

The Cahaba Basin, second in importance, is a long narrow syncline, 68 miles long and about 6 miles wide, southeast of the Warrior, and occupies parts of St. Clair, Jefferson, Shelby, and Bibb counties. There are many workable beds and the total quantity of coal in the basin is large. The production is something over 10 per cent of the total for the State.

The Coosa Basin is a deep syncline east of the Cahaba and parallel with it, extending across Shelby and St. Clair counties. It is also long and narrow, 60 miles long by 6 miles wide. It has not been thoroughly explored, but in different parts of the area from two to twelve beds, 3 or more feet in thickness, have been reported.

The Plateau field embraces parts of Blount, Etowah, Dekalb, Cherokee, Marshall, and Jackson counties, and although it has an area underlain by coal four times that of the Cahaba and the Coosa combined, the resources in Alabama are comparatively small. There are four to six beds locally workable.

The returns to the Survey for the calendar year 1912 show that the preliminary estimates of the production published early in the year were considerably in excess of the actual output. The preliminary estimates indicated that the production would exceed the record of 16,111,462 short tons made in 1910. The final results show that it fell about 10,000 tons short of that figure, and amounted to 16,100,600 short tons. This was an increase of 1,079,179 tons, or 7.18 per cent, over 1911, when it amounted to 15,021,421 tons. The value increased somewhat more in proportion—$1,749,303, or 9.17 per cent—from $19,079,949 in 1911 to $20,829,252. The value of the 1912 production exceeded that of the slightly larger tonnage of 1910 by nearly $600,000. The principal local increases in 1912 were in Walker County, 444,367 tons; Jefferson County, 398,459 tons; St. Clair County, 220,542 tons, and Bibb County, 148,138 tons. Two counties showed decreases, Tuscaloosa, 150,691 tons, and Etowah, 84,552 tons

The evolution in making coke in the United States and the gradual shifting of this related industry from the coal-mining regions to the centers of population and manufacture is interestingly shown in the statistics of coal production of Alabama. According to the returns the quantity of coal made into coke decreased from 4,417,443 tons in 1910 to 3,129,332 tons in 1911, and to 1,916,474 tons in 1912, whereas the actual quantities of coal made into coke in the State were 5,272,322 tons in 1910, 4,411,298 tons in 1911, and 4,585,498 tons in 1912. The reason for this apparent discrepancy lies in the fact that in the two later years the proportion of coal made into coke in by-product ovens has materially increased and as these ovens are located at the blast furnaces, or in or near the larger cities, the coal shipped to them appears as a part of the product "loaded at mines for shipment" and not as coal made into coke at the mines. The quantity of Alabama coal made into coke in 1912 at points distant from the mines was nearly one and a half times that used at ovens near the mines.

Coal mining in Alabama in 1912 gave employment to 22,613 men for an average of 245 days, against 22,707 men for 227 days in 1911, the larger production in 1912 being accomplished through the additional working time. The average production per man in 1912 was 712 tons against 662 in 1911, but the average daily production per man was lower in 1912, 2.91 tons against 2.92 tons in 1911. Most of the mines in Alabama are operated 10 hours a day.

The production by machines increased from 2,936,512 tons in 1911 to 3,742,549 tons in 1912, and the percentage of machine-mined coal to the total increased from 19.6 to 23.2. There were 353 machines in use in 1912, an increase of 81 over 1911 and of 36 over 1910. Several mines equipped with machines were either idle or did not use their full equipment in 1911. Of the 353 machines in 1912, 222 were punchers, 60 were chain breast, 12 were long wall, and 59 short wall.

Of the Alabama production not mined by machines, 5,658,457 tons, or 35.1 per cent of the total, were shot off the solid, and 6,658,732 tons, or 41.4 per cent, were mined by hand. There were 7,187,211 tons of coal washed in 1912, yielding 6,325,946 tons of cleaned coal and 861,265 tons of refuse. A large part of the washed coal is used for making coke.

According to the United States Bureau of Mines there were 121 fatal accidents in the coal mines of Alabama in 1912, a decided improvement over 1911, when, because, of several explosions and frequent deaths from windy shots, the aggregate number of fatalities was 209. Of the 121 deaths in 1912, 110 occurred underground, 61 of them due to falls of roof and coal, 25 to explosions of gas and dust, 11 to mine cars and locomotives, 9 to electrical shocks and burns, and 3 to explosives, including premature blasts, etc. Four deaths occurred in shafts and 7 on the surface.

There were no strikes of serious consequence during the year, the record showing 384 men idle for an average of 32 days.

The statistics of the production of coal in Alabama in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Alabama in 1911 and 1912, 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.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
1911.									
Bibb	1,515,976	9,592	107,629	....	1,633,197	$2,407,918	$1.47	239	2,631
Blount	80,266	1,900	100	....	82,266	98,599	1.20	225	189
Etowah	252,866	720	2,274	....	255,860	360,307	1.40	189	492
Jefferson	4,804,221	86,017	307,265	2,578,887	7,776,390	9,668,726	1.24	246	10,665
St. Clair	509,120	1,584	18,507	....	529,211	673,576	1.27	240	682
Shelby	430,505	2,723	29,861	....	463,089	757,772	1.64	240	866
Tuscaloosa	585,666	9,310	61,624	375,058	1,031,658	1,288,235	1.25	265	1,445
Walker	2,820,521	25,077	82,610	175,387	3,103,595	3,598,720	1.16	180	5,360
Winston	16,074	350	....	....	16,424	25,185	1.50	67	129
Other counties [a] and small mines.	120,348	3,918	5,465	....	129,731	200,911	1.55	170	248
Total	11,135,563	141,191	615,335	3,129,332	15,021,421	19,079,949	1.27	227	22,707
1912.									
Bibb	1,662,198	9,823	109,314	....	1,781,335	$2,621,682	$1.47	272	2,948
Blount	143,603	1,139	1,600	....	146,342	181,036	1.24	211	282
Etowah	166,366	3,067	1,875	....	171,308	249,749	1.46	265	260
Jefferson	6,168,715	81,368	339,211	1,585,555	8,174,849	10,433,728	1.28	251	10,922
St. Cair	722,276	2,456	25,021	....	749,753	959,219	1.28	291	725
Shelby	463,788	3,501	29,660	....	496,949	872,501	1.76	250	878
Tuscaloosa	631,114	12,038	48,863	188,952	880,967	1,091,882	1.24	239	1,220
Walker	3,271,284	32,030	102,681	141,967	3,547,962	4,158,094	1.17	211	5,079
Winston	18,550	105	75	....	18,730	27,793	1.48	220	57
Other counties [b] and small mines.	124,627	2,059	5,719	....	132,405	233,568	1.76	229	242
Total	13,372,521	147,586	664,019	1,916,474	16,100,600	20,829,252	1.29	245	22,613

[a] Cullman, Dekalb, Jackson, and Marion. [b] Cullman, 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 increase and decrease in 1912 as compared with 1911:

Coal production of Alabama, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Bibb	1,166,548	1,338,243	1,580,564	1,633,197	1,781,335	+ 148,138
Blount; Cullman	[a] 181,062	[a] 186,261	[a] 235,456	[c] 210,070	[a] 276,429	+ 66,359
Etowah	8,880	46,194	172,465	255,860	171,308	− 84,552
Jefferson	5,914,129	7,176,922	8,298,702	7,776,390	8,174,849	+ 398,459
St. Clair	193,434	354,005	428,409	529,211	749,753	+ 220,542
Shelby	407,547	524,925	488,141	463,089	496,949	+ 33,860
Tuscaloosa	712,101	1,006,989	1,081,219	1,031,658	880,967	− 150,691
Walker	2,941,836	2,973,776	3,788,479	3,103,595	3,547,962	+ 444,367
Winston	28,408	32,278	16,442	16,424	18,730	+ 2,306
Other counties and small mines	50,648	63,857	21,585	1,927	2,318	+ 391
Total	11,604,593	13,703,450	16,111,462	15,021,421	16,100,600	+ 1,079,179
Total value	$14,647,891	$16,306,236	$20,236,853	$19,079,949	$20,829,252	+$1,749,303

[a] Includes production of Marion County.

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 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 more than 10,000,000 tons, and reached the maximum of 16,111,462 tons in 1910.

The statistics of production in Alabama from 1840 to the close of 1912 are shown in the following table:

Production of coal in Alabama from 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	946	1859	9,000	1878	224,000	1897	5,893,770
1841	1,000	1860	10,200	1879	280,000	1898	6,535,283
1842	1,000	1861	10,000	1880	323,972	1899	7,593,416
1843	1,200	1862	12,500	1881	420,000	1900	8,394,275
1844	1,200	1863	15,000	1882	896,000	1901	9,099,052
1845	1,500	1864	15,000	1883	1,568,000	1902	10,354,570
1846	1,500	1865	12,000	1884	2,240,000	1903	11,654,324
1847	2,000	1866	12,000	1885	2,492,000	1904	11,262,046
1848	2,000	1867	10,000	1886	1,800,000	1905	11,866,069
1849	2,500	1868	10,000	1887	1,950,000	1906	13,107,963
1850	2,500	1869	10,000	1888	2,900,000	1907	14,250,454
1851	3,000	1870	11,000	1889	3,572,983	1908	11,604,593
1852	3,000	1871	15,000	1890	4,090,409	1909	13,703,450
1853	4,000	1872	16,800	1891	4,759,781	1910	16,111,462
1854	4,500	1873	44,800	1892	5,529,312	1911	15,021,421
1855	6,000	1874	50,400	1893	5,136,935	1912	16,100,600
1856	6,800	1875	67,200	1894	4,397,178		
1857	8,000	1876	112,000	1895	5,693,775	Total	237,275,836
1858	8,500	1877	196,000	1896	5,748,697		

ALASKA.

The production of coal in Alaska, as reported to the Survey, was 355 tons, valued at $2,840, a decrease from 900 tons, valued at $7,200 in 1911. The production in 1912 does not include the coal mined under the direction of the United States Bureau of Mines for testing purposes, which amounted to about 900 tons, but was without commercial value.

The following table shows the annual coal production of Alaska since 1897 and an estimate of the output between 1888 and 1896. A little coal was mined prior to 1884 by the crews of vessels that ran short of fuel, but this probably did not aggregate more than a few hundred tons. The total output of coal prior to 1889, including that mined by the Russians, was probably less than 10,000 tons.

Production of coal in Alaska, 1888–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1888–1896	6,000	$84,000	1906	5,541	$17,974
1897	2,000	28,000	1907	10,139	53,600
1898	1,000	14,000	1908	3,107	14,810
1899	1,200	16,800	1909	2,800	12,300
1900	1,200	16,800	1910	1,000	15,000
1901	1,300	15,600	1911	900	7,200
1902	2,212	19,048	1912	355	2,840
1903	1,447	9,782			
1904	1,694	7,225	Total	45,669	348,229
1905	3,774	13,250			

NOTE.—The production for 1888–1896 is estimated on the best data obtainable. The figures for 1897 to 1912 are based for the most part on data supplied by operators.

Coal consumption of Alaska, by sources, 1899 to 1912, in short tons.

Year.	Imported from States, chiefly from Washington.		Produced in Alaska, chiefly sub-bituminous and lignite.[b]	Total domestic.[b]	Total foreign coal, chiefly bituminous from British Columbia.[c]	Total coal consumed.
	Bituminous.	Anthracite.				
1899	[a] 10,000	....	1,200	11,200	50,120	61,320
1900	15,048	....	1,200	16,248	56,623	72,871
1901	[a] 24,000	....	1,300	25,300	77,674	102,974
1902	[a] 40,000	....	2,212	42,212	68,363	110,575
1903	64,625	1	1,447	66,073	60,605	126,678
1904	36,689	....	1,694	38,383	76,815	115,198
1905	67,707	6	3,774	71,487	72,567	144,054
1906	68,960	533	5,541	75,034	47,590	122,624
1907	45,130	1,116	10,139	56,385	88,596	144,981
1908	23,402	491	3,107	27,000	72,831	99,831
1909	33,112	....	2,800	35,912	74,316	110,228
1910	32,138	....	1,000	33,138	73,904	107,042
1911	32,255	....	900	33,155	88,573	121,728
1912	27,767	....	355	28,122	59,804	87,926
Total	520,833	2,147	36,669	559,649	968,381	1,528,030

[a] Estimated. [b] By calendar years. [c] By fiscal years ending June 30.

ARKANSAS.

Total production in 1912, 2,100,819 short tons; spot value, $3,582,789.

Arkansas contains two coal fields—one of high-grade fuel, in the western part of the State, and the other of lignite, in the lowlands southeast of Hot Springs and Little Rock. The latter has never been adequately developed, because lignite has had little or no commercial value, and it is probable that this field will not be an important factor in the fuel production of the State for some time to come.

The field of high-grade fuel lies along Arkansas River, extending from the Oklahoma State line on the west to Russellville on the east, a distance of about 75 miles. In the north-south direction its width, though differing much in different localities, probably averages about 20 miles. It includes in whole or in part the counties of Sebastian, Franklin, Johnson, Pope, Logan, Scott, and Crawford, but nearly all of the coal at present mined comes from the four counties standing at the head of the list.

Only a few coal beds occur in this field. The most important, from which probably 99 per cent of the coal mined in the State is derived, corresponds with the Hartshorne coal of Oklahoma, and in fact is the direct eastward extension of that bed. This coal is mined extensively at Huntington, Hartford, Midland, Bonanza, Jenny Lind, Greenwood, and other places in Sebastain County; at Denning and Altus, in Franklin County; at Clarksville, in Johnson County; and in the vicinity of Russellville, in Pope County.

The Charleston coal bed, about 700 feet higher than the Hartshorne bed, is mined in a small way about Charleston, Franklin County; and the Paris bed, about 300 feet higher than the Charleston, is mined locally in the vicinity of Paris, Logan County. Another small coal bed lies about 500 feet below the Hartshorne, but it is irregular and of little value, and at the present time is not mined on a commercial scale at any place in the State.

In quality the coal increases from west to east. The fuel ratio (fixed carbon divided by volatile matter) ranges from about 3.5 in the vicinity of the State line on the west to 5 at Denning and Coal Hill, 6.5 at Spadra, and about 8 at Russellville. In other words, the coal in the western part of the field belongs to the class called semibituminous, and that of the east to the class called semianthracite. The semibituminous coal of the western half of the field is exceedingly tender and friable and, as delivered at the mine mouth, consists of from 30 to 40 per cent fine coal. This fine coal is of excellent quality, but does not find a ready market, and frequently can not be disposed of at any price. This condition makes mining expensive and unsatisfactory. The custom of paying for mining coal on the mine-run basis and the practice of solid shooting have aggravated this trouble to a marked degree in the last few years. The unfavorable conditions under which coal mining is carried on in Arkansas is shown by the fact that the industry has practically made no progress in the last 10 years. In fact, during the first half of the last decade the production was larger than in the second half. In the five years from 1903 to 1907, inclusive, the coal production of Arkansas was 10,708,002 short tons, and in the five years ending with 1912 it was 10,569,080 tons. The output in 1912 was, on account of the suspension on April 1, 5,970 tons less than in 1911, the figures for the two years being, respectively, 2,100,819 tons and 2,106,789 tons. The smaller production was, however, compensated for by an advance in price from an average of $1.61 in 1911 to $1.71 in 1912, which resulted in an increase in the total value of $185,940, from $3,396,849 to $3,582,789. As stated in the report for 1911, the prospects for any expansion in the coal trade of Arkansas are not bright. In addition to the mining difficulties with which operators have to contend, competition with fuel oil and natural gas from the Mid-Continent field and with the more cheaply mined coals of Alabama, Kentucky, Illinois, and Colorado has restricted the markets for Arkansas (and Oklahoma) coals to comparatively narrow limits. Operators in both States make vigorous complaint against the high mining rates which they are compelled to pay and which put them at additional disadvantage. The complaints appear to be justified by the statistics presented in this report. The miners, however, contend that even with the high mining rate they are not able to earn good yearly wages, and this contention appears justified by the fact that in Arkansas at least the men have not averaged 140 days a year, taking the mean of the averages for the last three years. The best of the three years was 1912, when they averaged 157 days, whereas they made only 133 days in 1911 and 128 days in 1910. But in 1912 labor was unusually short, the number of men being fewer by 1,121, or 20 per cent, than in 1911—4,536 as compared with 5,657. The average production per man was 463 tons for the year and 2.95 tons per day in 1912, against 372 tons and 2.8 tons, respectively, in 1911. During the suspension in the spring of 1912, 403 men were idle for an average of 94 days.

The law of Arkansas, which compels the payment for mining on the mine-run basis, encourages the dangerous, uneconomical, and altogether reprehensible practice of shooting off the solid, when it should be prohibited. In this particular regard Arkansas is the chief among sinners, exhibiting in 1911 and 1912 a powder-mined production equivalent to 90 per cent of the total. In 1911, 1,903,728 tons out of a total of 2,106,789 tons were shot off the solid, and in 1912 there were 1,937,817 tons out of a total of 2,100,819 tons. Mining machines are employed only to a slight extent, the production by them being 27,029 tons in 1911 and 76,611 tons in 1912.

According to the United States Bureau of Mines, there were 6 men killed in the coal mines of Arkansas in 1912, 5 of them by falls of roof. The death rate per 1,000 was 1.3, and there were 350,137 tons mined for each life lost.

The statistics of production, by counties, for 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Arkansas in 1911 and 1912, by counties, in short tons.

1911.

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.
Franklin	401,081	2,560	17,950	421,591	$650,634	$1.54	184	851
Johnson	127,806	1,768	7,507	137,081	353,111	2.58	85	771
Logan	10,393	1,101	480	11,974	29,422	2.46	119	58
Sebastian	1,414,814	8,974	60,744	1,484,532	2,208,611	1.49	129	3,740
Other counties [a] and small mines	42,709	2,157	6,745	51,611	155,071	3.00	188	237
Total	1,996,803	16,560	93,426	2,106,789	3,396,849	1.61	133	5,657

1912.

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.
Franklin	355,637	2,390	15,287	373,314	$609,453	$1.63	172	750
Johnson	184,110	3,391	4,825	192,326	441,226	2.29	105	698
Logan	12,622	2,500	150	15,272	40,203	2.63	156	44
Sebastian	1,388,037	5,467	60,624	1,454,128	2,301,904	1.58	164	2,869
Other counties [b] and small mines	56,416	1,363	8,000	65,779	190,003	2.89	200	175
Total	1,996,822	15,111	88,886	2,100,819	3,582,789	1.71	157	4,536

[a] Pope, Scott, and Washington. [b] Pope and Washington.

A statement of the production of coal in Arkansas, by counties, for the last five years, with increase and decrease in 1912 as compared with 1911, is shown in the following table:

Coal production of Arkansas, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Franklin	[a] 400,995	281,399	296,725	421,591	373,314	− 48,277
Johnson	....	171,102	133,365	137,081	192,326	+ 55,245
Logan	30,723	25,169	15,492	11,974	15,272	+ 3,298
Pope	35,481	56,344	13,240	45,935	64,216	+ 18,281
Sebastian	1,580,778	1,818,781	1,425,347	1,484,532	1,454,128	− 30,404
Other counties and small mines	30,380	24,362	21,789	5,676	1,563	− 4,113
Total	2,078,357	2,377,157	1,905,958	2,106,789	2,100,819	− 5,970
Total value	$3,499,470	$3,523,139	$2,979,213	$3,396,849	$3,582,789	+$185,940

[a] 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 Missisippi River in that year, and for the next twenty years they 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 tons. From 1881 to 1902 production increased quite regularly, but for the last 11 years has remained practically stationary. The maximum of 2,670,438 short tons was attained in 1907.

The annual production of coal in Arkansas from 1840 to the close of 1912 will be found in the following table:

Production of coal in Arkansas from 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	220	1888	276,871	1897	856,190	1906	1,864,268
1860	200	1889	279,584	1898	1,205,479	1907	2,670,438
1880	14,778	1890	399,888	1899	843,554	1908	2,078,357
1881	20,000	1891	542,379	1900	1,447,945	1909	2,377,157
1882	25,000	1892	535,558	1901	1,816,136	1910	1,905,958
1883	50,000	1893	574,763	1902	1,943,932	1911	2,106,789
1884	75,000	1894	512,626	1903	2,229,172	1912	2,100,819
1885	100,000	1895	598,322	1904	2,009,451		
1886	125,000	1896	675,374	1905	1,934,673	Total	34,325,481
1887	129,600						

CALIFORNIA.

Total production in 1912, 10,978 short tons; spot value, $23,601.

There are in California a number of small, widely separated coal fields, chief among which are the Mount Diablo field of Contra Costa County, the Corral Hollow field of Alameda County, the Priest Valley and Trafton fields of San Benito County, and the Stone Canyon field of Monterey County. The first two, which are on the eastern border of San Francisco Bay and consequently in the west-central part of the State, produce black lignite or subbituminous coal. The areas in Monterey County are more to the south and in or near a region which has been considerably distorted. The coals are of the same geologic age as those farther north, but they have been altered into true bituminous coals. The alteration in the San Benito County areas has not progressed so far as in the case of the Monterey County coals, but they closely approach the bituminous grade. None of them possesses coking qualities.

At various times during the last 10 years efforts have been made to exploit these fields, but they have not been successful, and at present all are idle, with little prospect of resumption of operations. The field which was last exploited is the Stone Canyon, where a large sum of money was invested in building a railroad, opening the mine, and constructing tipple, miners' houses, etc. Unfortunately before this was completed a flood washed away a part of the branch railroad line, and the company was obliged to suspend operations. In addition to that misfortune, the prospective markets were practically taken away by the great influx of fuel oil, and there was no encouragement to secure the necessary additional capital for repairs and continued exploitation. The coal of the Stone Canyon field is the best so far discovered in the State, and it is unfortunate that efforts to develop it have proved unsuccessful.

On account of the large production of petroleum in California and its use for fuel, coal mining has practically ceased, the production in each of the last two years being only a little over 10,000 tons—10,747 tons in 1911 and 10,978 tons in 1912. The latter was almost equally divided among shipments, local trade, and colliery consumption.

The production of petroleum in California in 1912 was 86,450,767 barrels, of which not less than 50,000,000 barrels were used directly for fuel. Large quantities are also used in place of coal for gas making, and if 3½ barrels of petroleum are estimated as equivalent to 1 ton of ordinary bituminous coal, it is probable that from 14,000,000 to 15,000,000 tons of coal would be required to perform in California the service now rendered by petroleum in the production of heat, light, and power. California oil is the principal fuel for locomotives as far north as Washington and across the Sierras and the Cascades, its freedom from sparks serving as a great protection against forest fires, as compared with coal or wood fuel. It is used almost exclusively on inland and coastwise steamers and to an increasing extent by the trans-Pacific steamers. It has even displaced coal on Puget Sound, many of the steamers of the Canadian Pacific fleet plying between Vancouver, Victoria, and other points having been equipped for oil burning. These conditions are discussed at length in the review of the coal trade of the Pacific coast in the section devoted to coal-trade reviews. There is still, however, some demand for coal in California, particularly for domestic use and for bunker trade at San Francisco, but it is almost exclusively supplied by coals from other States—Washington, Utah, Wyoming, and New Mexico—and from foreign countries, chiefly British Columbia, with small quantities of anthracite and high-grade bituminous coals from the Eastern States. The railroads entering California brought from the Rocky Mountain States in 1912 a total of 268,494 short tons; the receipts by water at San Francisco from Oregon, Washington, and Eastern

States were 193,893 short tons; and the imports into San Francisco, Los Angeles, and San Diego, reported by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, were 330,244 short tons—a total of 792,631 short tons. The total producton of coal in California in 1912 was therefore only about 1.4 per cent of the consumption.

The statistics of coal production in California during the last six years, with the distribution of the product for consumption, are shown in the following table:

Distribution of the coal product of California, 1907–1912, 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.
1907	7,910	2,680	3,360	13,950	$38,213	$2.74	258	32
1908	12,400	1,955	4,400	18,755	54,840	2.93	250	34
1909	34,888	3,297	7,651	45,836	95,042	2.07	....	14
1910	6,679	3,985	500	11,164	18,336	1.64	192	14
1911	4,981	5,266	500	10,747	16,097	1.50	254	45
1912	3,748	3,630	3,600	10,978	23,601	2.15	184	52

The production of coal in California from 1861 to the close of 1912 is shown in the following table:

Production of coal in California from 1861 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1861	6,620	1875	166,638	1889	119,820	1903	104,673
1862	23,400	1876	128,049	1890	110,711	1904	78,888
1863	43,200	1877	107,789	1891	93,301	1905	77,050
1864	50,700	1878	134,237	1892	85,178	1906	25,290
1865	60,530	1879	147,879	1893	72,603	1907	13,950
1866	84,020	1880	236,950	1894	67,247	1908	18,755
1867	124,690	1881	140,000	1895	75,453	1909	45,836
1868	143,676	1882	112,592	1896	78,544	1910	11,164
1869	157,234	1883	76,162	1897	87,992	1911	10,747
1870	141,890	1884	77,485	1898	145,888	1912	10,978
1871	152,493	1885	71,615	1899	160,915		
1872	190,859	1886	100,000	1900	171,708	Total	5,128,425
1873	186,611	1887	50,000	1901	151,079		
1874	215,352	1888	95,000	1902	84,984		

COLORADO.

Total production in 1912, 10,977,824 short tons; spot value, $16,345,336.

The coal fields of Colorado are divided by the major ranges of the Rocky Mountains into three general groups designated as the eastern, the park, and the western. The eastern group, the most highly developed of the three, comprises the Denver region and the Canon City and Trinidad fields. The park group includes the little known and almost undeveloped fields of the South, Middle, and North parks. The western group, the largest in area, which contains the greatest amount of coal, includes the Yampa field on the north, the Danforth Hills, White River, and Grand Hogback fields north of Grand River, the Glenwood Springs, Crested Butte, and Grand Mesa fields south of Grand River, the

Book Cliffs field west of Grand Junction, and the Durango field in the southwestern part of the State. All of these fields of the western group, with the exception of the Yampa field, in the extreme north, and the Durango field, in the south, belong to the great Uinta region, or basin, which extends from Gunnison County, Colo., on the east, to Carbon and Emery counties, in the central part of Utah, on the west.

In quality the coals of Colorado range from subbituminous ("black lignite"), in the Denver region, through various grades of bituminous, including the high-grade coking coal of the Trinidad and Glenwood Springs fields, to true anthracite, in the Crested Butte and Yampa fields. Some of the coal beds of Colorado attain enormous thickness. This is especially true in the Glenwood Springs field, and some of the beds in the North Park field are also said to be of great thickness. The total area underlain by coal in Colorado is estimated at 17,130 square miles, and about 60 per cent of that entire area is believed to contain coal workable under present conditions. There is an extent of territory embracing over 4,000 square miles about which little is known, but which may contain workable coal, and nearly 3,000 square miles of territory in which the coal lies under heavy cover and is not workable on that account at the present time.

From the standpoint of production the most important is the Trinidad field, underlying considerable portions of Huerfano and Las Animas counties, which in its southern extension into New Mexico is, as the Raton field, the most important producer in that State. As in New Mexico, the coal of the Trinidad field is a high-grade coking coal, probably the best coal of that grade in the Rocky Mountain States. The combined production of Huerfano and Las Animas counties in 1912 was 6,608,236 short tons, or more than 60 per cent of the total for the State. Second in importance is the Denver region, the deposits of which although subbituminous in quality and low-grade as compared with the other coals of the State, have, because of their nearness to Denver and other important markets, been extensively developed. The producing counties of the field are Weld, Boulder, Jefferson, and El Paso, the first being at the extreme north and the last at the extreme south end of the field. These four counties in 1912 produced 1,931,435 short tons, or nearly 20 per cent of the State's total. The Canon City field is small in area but is an important producer, with a total in 1912 of 738,833 tons. These three fields belong to the eastern group. The park groups are not well known, the only production at present being from Jackson County in North Park. In the western group the principal developments are (1) in the Crested Butte and Glenwood Springs fields of Gunnison, Pitkin, and Garfield counties, which produced 817,820 tons in 1912; (2) in the Book Cliffs field in Mesa County, which produced 114,493 tons; (3) in the Durango field of Archuleta, La Plata, and Montezuma counties, which produced 134,987 tons; and (4) in the Routt County part of the Yampa field, which produced 448,261 tons. The last-mentioned field is the one which now attracts the most attention and shows the most active development, owing to the construction from Denver to Salt Lake City of a new trans-mountain railroad, the Denver, Northwestern & Pacific. This field showed the largest percentage of gain in the year (1912) of the important fields of the State, Routt County having an increase of nearly 30 per cent over 1911.

Colorado is the most important coal-producing State west of Mississippi River, and ranks seventh among all the States in this particular. The production in 1912 was 10,977,824 short tons, an increase of 820,441 tons, or 8.08 per cent, over 1911, but still nearly a million tons short of the output in 1910 when the maximum output was recorded. The increased production in 1912 over 1911 was accompanied by a larger proportionate gain in value, which increased $1,597,572, or 10.83 per cent, from $14,747,764 to $16,345,336. The increased production in Colorado may be attributed to bountiful crops and general prosperity throughout the State, which naturally created an improved condition in the coal trade, particularly in the last four months of the year. There was much complaint of deficiencies in labor and car supplies.

Of the 13 important coal-producing counties, 10 showed increase in 1912 and 3 showed decrease. The largest gain is credited to the most important producing county, Las Animas, which increased its production of coal 249,945 short tons. The next largest gain in quantity, and the largest gain in percentage, was from Routt County—130,470 tons. Huerfano County increased 112,884 tons and Boulder County 100,173 tons. No other county showed a gain exceeding 100,000 tons. The three counties in which production declined were Gunnison, Pitkin, and Weld, but the losses were small, aggregating less than 75,000 tons.

The complaints of labor shortage in the Colorado coal fields appears justified by the returns for 1912, which show a decrease of over 1,300 in the average number of men employed, as compared with 1911. In the earlier year the number of men reported was 14,316; in 1912 there were 13,000. There was, however, a notable gain in the efficiency record of the employees, the returns for 1912 showing an average production per man of 844 tons for the year, and 3.7 tons for each working day. The corresponding figures for 1911 were 710 tons and 3.42 tons, and for 1910 they were 755 tons and 3.2 tons. A part of the improved efficiency in 1912 was due to the increased production by the use of machines. In 1912 this item amounted to 2,552,168 short tons, or 23.2 per cent, of the total, against 1,975,411 tons, or 19.5 per cent of the total in 1911. The number of machines reported in use increased from 242 to 304. The pick or puncher type of machine is in greatest favor, 187 of this type being reported in 1912. Short-wall machines are growing in popularity, the number of this type increasing from 17 in 1911 to 57 in 1912. The other machines in use in 1912 were 33 chain-breast, 16 long-wall, and 11 radialaxe or post-punchers.

It is gratifying to note a decrease in the percentage of coal shot off the solid, though the "powder-mined" product in 1912 was a little more than in 1911, the figures being 1,309,544 tons, or 11.9 per cent of the total, in 1912, against 1,260,191 tons, or 12.4 per cent, in 1911. By far the larger part of the coal produced in Colorado is hand mined, 7,076,131 tons, or 64.5 per cent of the total, in 1912.

The coal-mining industry of Colorado was singularly free from labor troubles in 1912, an output of practically 11,000,000 tons being won without an instance of strike or suspension being reported.

The United States Bureau of Mines reports a total of 95 deaths in the coal mines of Colorado in 1912, an increase of 4 over 1911. Falls of roof and coal were responsible for 50 deaths. Explosions or burns by gas killed 15 men and haulage accidents exacted a toll of 14 lives. In all there were 91 deaths under ground, 2 in the shafts, and 2 on the surface. The death rate per thousand was 7.3, and the number of tons mined for each life lost was 115,556.

The statistics of production in Colorado in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Colorado in 1911 and 1912, by counties, in short tons.

1911.

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	898,308	13,675	42,769	....	954,752	$1,599,710	$1.68	177	1,269
Delta	54,692	16,257	450	....	71,399	125,133	1.75	230	77
El Paso	226,078	94,822	11,255	....	332,155	434,353	1.31	263	360
Fremont	616,068	19,951	25,221	....	661,240	1,476,760	2.23	189	1,435
Garfield	145,138	12,698	8,072	....	165,908	230,593	1.39	248	191
Gunnison	517,149	2,302	21,079	35,118	575,648	856,168	1.31	210	785
Huerfano	1,700,377	12,885	73,392	....	1,786,654	2,994,481	1.67	191	2,973
La Plata	85,103	10,310	1,336	....	96,749	166,538	1.72	207	161
Las Animas	2,924,569	50,267	94,784	1,389,133	4,458,753	5,206,556	1.17	228	5,563
Mesa	67,634	25,247	....	....	92,881	156,046	1.68	217	130
Routt	305,361	1,830	10,600	....	317,791	563,306	1.77	139	639
Weld	469,484	23,883	27,029	....	520,396	760,476	1.46	258	572
Other counties [a]	94,751	7,951	8,960	....	111,662	157,830	1.41	196	161
Small mines	....	11,395	....	....	11,395	19,814	1.74	....	....
Total	8,104,712	303,473	324,947	1,424,251	10,157,383	14,747,764	1.45	207	14,316

1912.

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	981,784	18,618	54,523	....	1,054,925	$1,707,385	$1.62	190	1,316
Delta	57,329	16,030	1,684	....	75,043	138,784	1.85	163	83
El Paso	206,341	118,873	9,690	....	334,904	479,053	1.43	262	412
Fremont	689,860	23,918	25,055	....	738,833	1,603,259	2.17	198	1,340
Garfield	175,619	2,520	7,313	....	185,452	254,687	1.37	250	178
Gunnison	501,147	2,080	20,594	33,864	557,685	831,733	1.49	201	661
Huerfano	1,804,837	13,102	81,599	....	1,899,538	3,226,064	1.70	213	2,443
La Plata	108,612	15,442	912	7,521	132,487	231,631	1.75	217	164
Las Animas	3,844,200	41,687	97,642	725,169	4,708,698	5,864,060	1.25	262	4,895
Mesa	80,826	30,167	3,500	....	114,493	159,544	1.39	196	135
Routt	429,359	3,675	15,227	....	448,261	783,499	1.75	200	480
Weld	445,479	26,491	19,067	....	491,037	726,002	1.48	206	536
Other counties [b]	201,756	4,785	15,745	....	222,286	313,325	1.41	169	357
Small mines	....	14,182	....	....	14,182	26,310	1.86	....	....
Total	9,527,149	331,570	352,551	766,554	10,977,824	16,345,336	1.49	227	13,000

[a] Archuleta, Jefferson, Larimer, Montezuma, Pitkin, and Rio Blanco.
[b] Archuleta, Jackson, Jefferson, Montezuma, and Pitkin.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are given in the following table:

Coal production in Colorado, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (—) 1912.
Boulder	1,067,948	1,332,322	802,769	954,752	1,054,925	+ 100,173
Delta	37,689	55,031	63,590	71,399	75,043	+ 3,644
El Paso	317,763	312,233	336,780	332,155	334,904	+ 2,749
Fremont	669,274	611,980	722,142	661,240	738,833	+ 77,593
Garfield	220,099	257,796	189,755	165,908	185,452	+ 19,544
Gunnison	503,140	598,463	640,982	575,648	557,685	— 17,963
Huerfano	1,644,068	1,915,910	2,387,090	1,786,654	1,899,538	+ 112,884
Jefferson	163,624	195,809	227,744	1,187	94,534	+ 93,347
La Plata	166,090	139,858	147,755	96,749	132,487	+ 35,738
Las Animas	4,190,801	4,592,964	5,548,085	4,458,753	4,708,698	+ 249,945
Pitkin	228,828	159,753	183,068	101,773	74,683	— 27,090
Routt	13,005	92,439	258,452	317,791	448,261	+ 130,470
Weld	343,414	327,545	322,896	520,396	491,037	— 29,359
Other counties [a]	69,230	124,833	142,628	112,978	181,744	+ 68,766
Total	9,634,973	10,716,936	11,973,736	10,157,383	10,977,824	+ 820,441
Total value	$13,586,988	$14,296,012	$17,026,934	$14,747,764	$16,345,336	+$1,597,572

[a] Includes small mines.

Coal mining as an industry in Colorado began in 1864, a production of 500 short tons being recorded in that year. In 1876 the production reached for the first time a total exceeding 100,000 tons, and six years later, in 1882, it had reached the million-ton mark. Since that date the increase has been almost uninterrupted, there being only five times prior to 1911 (in 1884, 1892, 1894, 1904, and 1908) when the production showed a decrease of any importance, and only six times altogether in 38 years. The largest decrease was in the "hard-times" year, 1894. The coal production of the State exceeded 3,000,000 tons in 1890; 10 years later it had grown to over 5,000,000 tons; in 1910 it exceeded 11,000,000 tons; but in 1911 and 1912 it fell below the 11,000,000-ton mark.

The record, by years, since 1864 is shown in the following table:

Production of coal in Colorado from 1864 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1864	500	1877	160,000	1890	3,077,003	1903	7,423,602
1865	1,200	1878	200,630	1891	3,512,632	1904	6,658,355
1866	6,400	1879	322,732	1892	3,510,830	1905	8,826,429
1867	17,000	1880	462,747	1893	4,102,389	1906	10,111,218
1868	10,500	1881	706,744	1894	2,831,409	1907	10,790,236
1869	8,000	1882	1,061,479	1895	3,082,982	1908	9,634,973
1870	4,500	1883	1,229,593	1896	3,112,400	1909	10,716,936
1871	15,600	1884	1,130,024	1897	3,361,703	1910	11,973,736
1872	68,540	1885	1,356,062	1898	4,076,347	1911	10,157,383
1873	69,997	1886	1,368,338	1899	4,776,224	1912	10,977,824
1874	77,372	1887	1,791,735	1900	5,244,364		
1875	98,838	1888	2,185,477	1901	5,700,015	Total	166,129,188
1876	117,666	1889	2,597,181	1902	7,401,343		

GEORGIA.

Total production in 1912, 227,503 short tons; spot value, $338,426.

Portions of two counties in the extreme northwestern corner of Georgia are underlain by 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 coal area of any Appalachian State. Not all of the field is workable. Extensive operations have been carried on in both counties, however, but all of the production in 1912 was by two companies operating in Walker County. On account of its high percentage (80 per cent) of fixed carbon and its low sulphur content, the Lookout Mountain coal (Walker County) gives a large product of excellent coke which is sold to the furnaces of Chattanooga and of other points in Tennessee and in Georgia.

In 1912, for the first time in five years, the coal production of Georgia showed an increase over the preceding year. Since 1903 when the maximum output of 416,951 short tons was recorded, the production has shown a declining tendency, the single exception prior to 1912 to the annual decrease being in the boom year, 1907. The decreased production in the last few years has been attributed to the withdrawal by the State of the convicts with which the mines had been operated. Scarcity of free labor in the somewhat isolated district has prevented the mines being worked to their full capacity.

The influence of free labor is exhibited by a marked increase in the efficiency record. In 1908, 670 men were employed for an average of 261 days in the production of 264,822 short tons, whereas in 1912, 450 men working an average of 254 days produced 227,503 tons. In 1907 when the principal labor was done by the convicts leased from the State it required 808 men working an average of 262 days to produce 362,401 tons of coal. The average production per man in 1907 was 449 tons; in 1912 it was 505 tons. The average daily production per man was 1.7 tons in 1907 and 2 tons in 1912. No mining machines are used in the State. About two-thirds of the production is undercut by hand and one-third shot off the solid.

The production in 1912 exceeded that of 1911 by 62,293 tons, or 38 per cent. The value increased $92,218 in the same proportion as the production, the average price per ton being the same ($1.49) in both years. More than 60 per cent of the increased production in 1912 was in the quantity of coal made into coke, this item amounting to 111,923 tons in 1912, against 72,677 tons in 1911, a gain in the later year of 39,246 tons. At one of the establishments the slack coal used for making coke is washed before being charged into the ovens. In 1912 the total quantity of coal washed was 111,923 tons, yielding 87,300 tons of cleaned coal and 24,623 tons of refuse.

The statistics of production during the last five years, with the distribution of the product for consumption, is shown in the following table:

Coal production of Georgia, 1908–1912, 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.
1908	184,040	930	8,400	71,452	264,822	$364,279	$1.38	261	670
1909	119,806	1,000	4,100	86,290	211,196	298,792	1.41	....	460
1910	94,330	776	2,760	79,379	177,245	259,122	1.46	265	386
1911	86,141	957	5,435	72,677	165,210	246,208	1.49	278	510
1912	108,135	1,304	6,141	111,923	227,503	338,426	1.49	254	450

The Eighth United States Census contains the first authentic statement of production of coal in Georgia. This report, which is for 1860, gives the production in that year as 1,900 short tons. The census for 1870 does not mention any production in Georgia for that year. The Tenth Census (1880) reports an output of coal for the State of 154,644 short tons, since which time the production has been reported in Mineral Resources of the United States.

The annual production since 1860 is shown in the following table:

Annual production of coal in Georgia, 1860–1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	1,900	1874	60,000	1888	180,000	1902	414,083
1861	2,500	1875	80,000	1889	225,934	1903	416,951
1862	3,500	1876	110,000	1890	228,337	1904	383,191
1863	6,000	1877	120,000	1891	171,000	1905	351,991
1864	10,000	1878	128,000	1892	215,498	1906	332,107
1865	10,000	1879	140,000	1893	372,740	1907	362,401
1866	8,000	1880	154,644	1894	354,111	1908	264,822
1867	8,000	1881	168,000	1895	260,998	1909	211,196
1868	10,000	1882	160,000	1896	238,546	1910	177,245
1869	12,000	1883	155,000	1897	195,869	1911	165,210
1870	15,000	1884	150,000	1898	244,187	1912	227,503
1871	20,000	1885	150,000	1899	233,111		
1872	25,000	1886	223,000	1900	315,557	Total	9,169,672
1873	40,000	1887	313,715	1901	342,825		

IDAHO.

Total production in 1912, 2,319 short tons; spot value, $6,603.

The small production in Idaho is from a few scattered lignite beds and is used locally.

The production in Idaho during the last six years has been as follows:

Coal production in Idaho, 1907–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1907	6,508	$26,494	1910	4,448	$17,426
1908	5,429	21,832	1911	1,805	4,808
1909	4,553	19,459	1912	2,319	6,603

ILLINOIS.

Total production in 1912, 59,885,226 short tons; spot value, $70,294,338.

There are 102 counties in Illinois, and coal is mined in 50 of them. The coal formations underlie a number of other counties, the total productive territory occupying nearly three-fourths of the entire State. The total coal area is estimated at 35,600 square miles, the largest area in any State east of Mississippi River and exceeded only by those of Montana and North Dakota. The coal fields comprise the western part of a broad and relatively flat basin whose eastern border is in the western part of Indiana and whose southern extremity extends under Ohio River into Kentucky. The principal developments are in the northern, western, and southern borders from Grundy, La Salle, and Bureau counties on the north, to Williamson, and Saline counties on the south, with a somewhat isolated district in Vermilion County at the northeast. These developments are divided more into districts or regions from a commercial standpoint than into distinct fields determined by geologic conditions, though of course the accessibility of the beds at relatively shallow depths, or the thickness and quality of the coal, has influenced their exploitation. Among the principal mining districts are the Mazon Creek region of Grundy and Livingston counties; the Streator-Spring Valley district of Bureau and La Salle counties; the Peoria district; the Springfield-Belleville belt, including Sangamon, Christian, Macoupin, Montgomery, Madison, and St. Clair counties; the Southwestern district, including Washington, Perry, Franklin, Jackson, and Williamson counties; the Harrisburg district of Saline County; and the Danville district in Vermilion County. Of these districts, the Springfield-Belleville belt is the most important, contributing nearly 40 per cent of the State's total output of coal. The production in this district, which supplies St. Louis and other important manufacturing sections, amounted in 1912 to 23,112,703 tons. The Mazon Creek and Streator-Spring Valley districts, which are the closest to the Chicago market, produced together in 1912 only 3,821,469 tons. The counties in what has been termed the Southwestern district produced in 1912 a total of 13,951,295 tons, or a little over 23 per cent of the State's output.

As shown in the report for 1910, the coal production of Illinois is from six different beds, Nos. 1, 2, 3, 5, 6, and 7, but in some cases doubt exists as to the exact correlation of the beds, Nos. 6 and 7 being especially confused locally. It has been demonstrated that what is generally designated as No. 7, in southeastern Illinois, is identical with No. 6 in the southwestern part of the State. Bed No. 6 is by far the most important one in the State. It averages 6 feet in thickness over a wide extent of territory, and is mined at depths varying from 50 to 800 feet. Nearly 60 per cent of the total output of the State is from this bed, and if to the coal reported as from No. 6, is added that reported as from No. 7 (which ought to be No. 6), the percentage from this bed would probably exceed 60. The mines operated on No. 6 coal, about 275 in number, average over 100,000 tons each in production.

Bed No. 5, which is the one chiefly worked in the Danville district, and in the north-central and southeastern parts of the State, is second in importance and produces something over 25 per cent of the total, and bed No. 2, or "Big Muddy," produces a little over 10 per cent.

The biennial shutdown, which has now become a regular incident in the spring months of the even years in Illinois coal mining, occurred as usual on April 1, 1912, but in this case was in marked contrast to the preceding one of 1910. Trade conditions in 1912, while not all that might be desired, were better than in 1910 or 1911, and in order to take advantage of them and to prevent the further loss of markets through the intervention of West Virginia coal, the operators did not prolong the struggle. The miners were given an advance of 5 cents a ton and work was generally resumed after an idleness of from 30 to 60 days. In 1910 operations were suspended for nearly six months during which some markets were lost that have not been recovered. The statistics of production in 1912 show that the relatively short time lost, as compared with 1910, was made up partly through a greater intensity of labor before and after the suspension, and partly by increased production with machines. The production reached the highest record ever attained, nearly touching 60,000,000 tons. The actual figures were 59,885,226 short tons, exceeding the previous maximum, 53,679,118 tons, made in 1911, by 6,206,108 tons, or 11.6 per cent. The value increased $10,774,860, or 18.1 per cent, from $59,519,478 in 1911 to $70,294,338 in 1912.

The increased labor efficiency is exhibited by an average tonnage per man in 1912 of 767 against 701 in 1911 and 632 in 1910. The average daily production per man in 1912 was 3.95, against 3.7 tons in 1911. The average daily production in 1910, when the working days were much fewer, was the same as in 1912. The increase in the machine-mined production in 1912 over 1911 was 3,784,242 tons, or 61 per cent of the total increase. The average working time for the Illinois miners in 1912 was 194 days, a little less than two-thirds of the working days of the year, exclusive of Sundays and legal holidays, indicating that if full working time, say, 300 days, were made, the miners of Illinois with their present complement of labor are capable of producing about 90,000,000 tons of coal annually.

In spite of the increase of over 6,000,000 tons in 1912, Illinois still fell below West Virginia in tonnage and continued third in rank among the coal-producing States. With regard to the value of the output, however, Illinois has the better of West Virginia by more in dollars than it is surpassed by that State in tonnage. West Virginia's output in 1912 exceeded that of Illinois by 6,901,461 tons, whereas in value Illinois had the advantage by $7,502,104. The explanation lies in the fact that the operators of Illinois are favored with large consuming markets close at hand, while the producers in West Virginia have relatively none and must ship their output to distant points with the disadvantage of transportation expenses. On the other hand, natural conditions as well as lower labor cost are favorable to the West Virginia producers, and a great part of the advantage gained by Illinois in the one way is lost in the other. The average price per ton in Illinois in 1912 was $1.17 against $1.11 in 1911. The average price for West Virginia coal in the two years, respectively, was 94 and 90 cents. In fuel value West Virginia coal will average about 25 per cent higher than that of Illinois. The average selling price of Illinois coal is from 20 to 25 per cent higher than that of West Virginia.

There are more coal-producing counties in Illinois than in any other State in the Union, half of the 102 counties in the State being producers. Williamson County ranks first with an output in 1912 of 7,354,507 tons. Sangamon County, second in importance, produced 5,714,742 tons; and five others, Macoupin, St. Clair, Franklin, Saline, and Madison, in the order named, each produced over 4,000,000 tons. One other, Vermilion, produced over 3,000,000 tons, and two, Fulton and Montgomery, produced over 2,000,000. Seven other counties had productions exceeding 1,000,000 tons. The principal increases in 1912 were in Franklin County, 886,698 tons; Madison County, 873,173 tons; St. Clair, 803,361 tons; Williamson, 740,478; Saline, 597,464 tons; and Sangamon, 576,907 tons. All of these counties, with the exception of Sangamon, are in the southwestern part of the State and embraced within the seven counties which produce over 4,000,000 tons. Altogether there were 30 counties, whose production is reported separately which showed increases, and 19 in which the output decreased. The decreases were, with two exceptions, unimportant. The exceptions were Grundy County, whose output declined 236,013 tons, and Montgomery County, where the coal production declined 212,991 tons. There was no other county in which the output decreased as much as 100,000 tons.

The coal miners of Illinois are probably better organized than those of any other bituminous coal-mining State. One result of this has been the establishment throughout the coal-mining regions of the eight-hour day. But the biyearly shutdown has naturally resulted in long periods of idleness and loss of income both to operators and to employees. In 1906 practically all of the important mines were shut down, and 49,792 men out of a total of 61,988 were idle for an average of 58 days each. This was equivalent to an average of 48 days of idleness for each of the 61,988 employees, and was equal to 25 per cent of the total time made. In 1908 the suspension was not of such long duration nor were quite as many men affected, 47,456 men out of a total of 68,035 being idle for an average of 37 days, equivalent to an average idleness of 26 days for each of the 68,035 employees, and equal to 14 per cent of the total number of days worked by each man during the year. In 1910, 67,218 men out of a total of 72,645 were idle for an average of 136 days, and the total time lost was equivalent to 9,133,953 working days. The total time made by the 72,645 men employed was 11,612,966 days, or an average of 160 days each. The idle time in 1910 was nearly 80 per cent of the working time made. The total number of men employed in 1912 was 78,098 who worked an average of 194 days. Idleness due to strikes or suspensions affected a total of 60,505 men who lost an average of 33 days. The aggregate idle time due to labor troubles was 13 per cent of the total time made.

Of the total production of 59,885,226 short tons in 1912, 26,878,049 tons, or 44.9 per cent, were mined by machines; 7,675,805 tons, or 12.8 per cent, were pick-mined; and 24,136,940 tons, or 40.3 per cent, were shot off the solid. In 1911, 43.0 per cent of the total was machine-mined and 38.1 per cent was shot off the solid. These figures show that a comparatively small proportion of Illinois coal is hand-mined, and the relatively large amount "powder-mined" is discreditable and inexcusable. It bears unwholesome comparison with West Virginia, where less than 1 per cent of the production in 1912 was shot off the solid. The larger proportion of machine-mined tonnage in 1912 is gratifying and bears out the statement in the report for 1911 that the operators were determined to reduce as much as possible the pernicious practice of "making the powder do the work." The flat-lying character of the Illinois beds is favorable to machine mining, and there appears to be no good reason for permitting solid shooting to continue. The number of mining machines in use increased from 1,402 in 1911 to 1,654 in 1912. The latter included 847 punchers, 701 chain-breast, 22 long-wall, and 81 short-wall machines, and 3 radial-axe or post punchers.

Considerable quantities of the Illinois product are washed in preparation for the domestic trade, and washed Illinois egg and nut coals have a distinctive place in the market. This indicates that the coal is usually sized before being washed. The washed nut is the most popular domestic size.

During 1912 the quantity of Illinois coal which was washed before being marketed was 3,522,760 short tons, which yielded 3,070,523 tons of cleaned coal and 452,237 tons of refuse.

Illinois shared with the other States the credit of a lower death record in 1912, compared with the preceding year, not only in the actual number of men killed, but also in the death rate per thousand, and a corresponding increase in the quantity of coal mined for each life lost. According to the statistics compiled by the United States Bureau of Mines, the number of fatalities in and about the mines in 1912 was 159, against 172 in 1911. The decrease in 1912 was 13, or 8 per cent. Of the 159 men killed in 1912, 141 were underground, 11 were in shafts, and 7 on the surface. More than half of the total deaths were due to falls of roof and coal, 84 of the fatalities being due to that cause. Haulage-way accidents were responsible for 39 deaths, and premature blasts, etc., for 10. Only 3 deaths were due to explosions of gas or dust. The 11 shaft accidents included 6 which were due to the men falling down the shaft. The death rate per 1,000 men employed in 1912 was 2.04 against 2.25 in 1911. The number of tons mined for each life lost was 376,637, against 312,088.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Illinois in 1911 and 1912, by counties, in short tons.

1911.

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	1,503,394	66,226	59,068		1,628,688	$2,569,897	$1.58	219	3,873
Christian	1,061,568	98,891	61,800		1,222,259	1,211,196	.99	132	2,158
Clinton	867,177	11,465	42,583		921,225	896,667	.97	160	1,292
Franklin	3,425,108	28,922	101,556		3,555,586	3,781,363	1.07	206	4,064
Fulton	2,026,679	59,325	47,025		2,133,029	2,706,871	1.27	174	3,693
Gallatin	50,227	11,443	1,338		63,008	71,588	1.14	167	138
Grundy	709,403	28,505	38,892		776,800	1,254,323	1.61	220	1,865
Henry	52,118	35,962	2,642		90,722	156,560	1.73	193	183
Jackson	545,892	86,410	55,451		687,753	906,645	1.32	147	1,140
Knox		28,832	1,304		30,136	53,620	1.78	186	83
La Salle	1,251,017	286,668	72,785		1,610,470	2,676,710	1.66	223	3,547
Livingston	46,536	39,380	3,507		89,423	139,675	1.56	149	341
Logan	259,014	49,896	25,950		334,860	388,724	1.16	124	680
McDonough	1,939	6,056	32		8,027	17,822	2.22	189	37
Macon	118,084	110,334	7,785		236,203	369,591	1.56	200	610
Macoupin	4,490,380	67,382	130,450		4,688,212	4,436,723	.95	201	4,638
Madison	2,954,710	118,381	79,614		3,152,705	3,094,573	.98	154	4,109
Marion	998,215	187,324	38,787		1,224,326	1,237,569	1.01	184	1,664
Marshall	384,679	20,301	19,004		423,984	705,130	1.66	218	1,051
Menard	146,739	36,126	7,612		190,477	221,786	1.16	194	343
Mercer	267,845	17,417	12,290		297,552	421,922	1.42	168	599
Montgomery	2,295,420	37,622	62,772		2,395,814	2,395,461	1.00	191	2,740
Peoria	924,951	86,641	25,770		1,037,362	1,285,259	1.24	208	1,477
Perry	1,213,576	17,103	41,613		1,272,292	1,216,946	.96	139	2,122
Randolph	739,287	23,124	15,335		777,746	755,451	.97	160	1,238
Rock Island	22,074	39,848	4,061		65,983	123,474	1.88	166	106
St. Clair	3,634,322	187,960	109,197		3,931,479	3,566,857	.91	157	5,113
Saline	3,712,201	36,614	71,595		3,820,410	4,144,308	1.08	204	4,895
Sangamon	4,733,096	255,767	148,972		5,137,835	5,248,253	1.02	175	6,936
Shelby	54,939	21,902	4,774		81,615	139,983	1.72	202	197
Stark	8,460	27,033	1,800		37,293	63,007	1.69	235	54
Tazewell	146,000	67,274	7,509		220,783	293,182	1.33	228	336
Vermilion	3,159,386	172,018	53,796		3,385,200	3,694,799	1.09	248	3,942
Will	161,721	10,824	5,852		178,397	308,560	1.73	206	411
Williamson	6,137,410	195,013	195,831	85,775	6,614,029	6,888,812	1.04	170	8,527
Other counties[a] and small mines	1,060,260	232,208	64,967		1,357,435	2,076,171	1.53	239	2,398
Total	49,163,827	2,806,197	1,623,319	85,775	53,679,118	59,519,478	1.11	188	76,600

[a] Bond, Calhoun, Greene, Hancock, Jefferson, Johnson, McLean, Morgan, Moultrie, Putnam, Schuyler, Scott, Warren, Washington, White, and Woodford.

Coal production of Illinois in 1911 and 1912, by counties, in short tons—Continued.

1912.

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	1,560,490	48,706	68,121	....	1,677,317	$2,736,737	$1.63	224	3,808
Christian	1,250,722	152,163	64,961	....	1,467,846	1,687,823	1.15	167	2,075
Clinton	978,791	12,947	48,741	....	1,040,479	1,073,188	1.03	171	1,336
Franklin	4,282,721	39,878	119,685	....	4,442,284	5,389,076	1.21	204	4,499
Fulton	2,337,698	54,323	61,403	....	2,453,424	3,193,202	1.30	201	3,578
Gallatin	48,977	14,399	868	....	64,244	72,295	1.13	147	164
Grundy	480,549	30,690	29,548	....	540,787	963,365	1.78	162	1,595
Henry	17,000	39,863	1,750	....	58,613	104,602	1.78	174	126
Jackson	629,550	29,806	43,834	....	703,190	968,303	1.38	160	1,068
Knox	....	21,417	876	....	22,293	39,765	1.78	163	60
La Salle	1,156,290	307,696	73,605	....	1,537,591	2,706,718	1.76	224	3,275
Livingston	24,918	39,219	1,637	....	65,774	130,847	1.99	216	127
Logan	392,374	56,638	17,516	....	466,528	574,713	1.23	186	678
McDonough	3,178	10,954	314	....	14,446	31,820	2.20	178	48
Macon	148,443	136,047	7,100	....	291,590	413,179	1.42	163	581
Macoupin	4,791,107	80,155	115,312	....	4,986,574	4,894,191	.98	206	5,061
Madison	3,804,878	124,515	96,485	....	4,025,878	4,386,620	1.09	184	4,466
Marion	1,451,864	48,313	48,526	....	1,548,703	1,666,346	1.08	212	1,651
Marshall	361,335	66,443	21,882	....	449,660	812,020	1.81	240	1,065
Menard	116,431	53,797	7,350	....	177,578	240,850	1.36	169	335
Mercer	364,886	15,635	12,497	....	393,018	594,171	1.51	209	479
Montgomery	2,092,984	43,122	46,717	....	2,182,823	2,348,084	1.08	192	2,665
Peoria	1,097,830	101,958	25,786	....	1,225,574	1,580,021	1.29	213	1,721
Perry	1,361,180	31,128	51,806	....	1,444,114	1,518,746	1.05	146	1,968
Randolph	752,609	30,924	14,630	....	798,163	814,922	1.02	138	1,116
Rock Island	15,456	47,477	3,884	....	66,817	107,377	1.61	180	122
St. Clair	4,437,137	182,573	115,130	....	4,734,840	4,656,454	.98	162	5,799
Saline	4,293,635	34,699	89,540	....	4,417,874	4,924,839	1.11	204	5,204
Sangamon	5,260,048	298,353	156,341	....	5,714,742	6,335,965	1.11	178	7,030
Shelby	153,045	24,210	8,246	....	185,501	252,865	1.36	142	339
Stark	10,881	21,845	1,450	....	34,176	57,128	1.67	188	43
Tazewell	192,423	71,224	7,674	....	271,321	348,063	1.28	325	376
Vermilion	3,179,572	201,243	54,108	....	3,434,923	3,940,780	1.15	234	4,149
Will	111,833	14,063	4,910	....	130,806	242,805	1.86	201	408
Williamson	6,982,822	69,188	302,497	....	7,354,507	8,214,769	1.12	187	8,602
Other counties [a] and small mines	1,160,873	238,250	62,105	....	1,461,228	2,271,689	1.56	237	2,481
Total	55,304,530	2,793,861	1,786,835	....	59,885,226	70,294,338	1.17	194	78,098

[a] Bond, Calhoun, Edgar, Greene, Jefferson, McLean, Morgan, Moultrie, Putnam, Schuyler, Scott, Warren, Washington, White, and Woodford.

In the following table are shown the statistics of production of coal in Illinois, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911:

Coal production of Illinois, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (—), 1912.
Bond	60,129	89,861	139,398	119,250	232,571	+ 113,321
Bureau	1,512,971	1,612,452	973,346	1,628,688	1,677,317	+ 48,629
Calhoun	3,521	....	....	1,400	1,156	— 244
Christian	1,377,166	1,395,158	1,223,295	1,222,259	1,467,846	+ 245,587
Clinton	1,078,848	970,709	950,243	921,225	1,040,479	+ 119,254
Franklin	2,187,383	2,316,509	1,778,768	3,555,586	4,442,284	+ 886,698
Fulton	2,012,415	2,388,617	1,721,527	2,133,029	2,453,424	+ 320,395
Gallatin	59,667	64,713	70,091	63,008	64,244	+ 1,236
Greene	9,506	7,318	9,082	6,207	7,841	+ 1,634
Grundy	1,081,442	1,114,101	600,281	776,800	540,787	— 236,013
Hamilton	....	....	....	....	....	....
Hancock	1,406	1,085	640	230	....	— 230
Henry	141,624	137,060	124,243	90,722	58,613	— 32,109
Jackson	624,055	652,280	584,240	687,753	703,190	+ 15,437
Jefferson	18,675	4,800	10,000	9,500	21,032	+ 11,532
Jersey	1,496	1,000				
Kankakee	30,994	25,000	....	....	....	....
Knox	41,040	21,973	28,295	30,136	22,293	— 7,843
La Salle	1,557,173	1,686,391	1,178,885	1,610,470	1,537,591	— 72,879
Livingston	265,666	246,031	162,898	89,423	65,774	— 23,649
Logan	372,980	395,888	409,244	334,860	466,528	+ 131,668
McDonough	17,818	16,276	26,338	8,027	14,446	+ 6,419
McLean	95,854	116,412	83,982	96,517	89,781	— 6,736
Macon	235,237	238,607	235,361	236,203	291,590	+ 55,387
Macoupin	3,894,199	4,597,775	3,854,229	4,688,212	4,986,574	+ 298,362
Madison	3,367,820	3,373,798	4,102,773	3,152,705	4,025,878	+ 873,173
Marion	981,284	1,171,950	812,873	1,224,326	1,548,703	+ 324,377
Marshall	393,281	295,812	267,447	423,984	449,660	+ 25,676
Menard	355,309	303,948	332,557	190,477	177,578	— 12,899
Mercer	376,435	369,762	229,024	297,552	393,018	+ 95,466
Montgomery	1,410,978	1,780,668	1,799,720	2,395,814	2,182,823	— 212,991
Morgan	3,244	1,200	1,300	1,268	1,000	— 268
Peoria	921,929	914,961	810,595	1,037,362	1,225,574	+ 188,212
Perry	1,576,891	1,423,135	1,367,771	1,272,292	1,444,114	+ 171,822
Putnam	466,019	597,703	364,882	772,976	720,048	— 52,928
Randolph	751,605	799,893	1,025,557	777,746	798,163	+ 20,417
Rock Island	50,781	46,228	66,207	65,983	66,817	+ 834
St. Clair	3,696,017	3,471,630	5,788,567	3,931,479	4,734,840	+ 803,361
Saline	2,552,137	3,283,939	2,459,650	3,820,410	4,417,874	+ 597,464
Sangamon	5,015,608	5,616,357	4,449,634	5,137,835	5,714,742	+ 576,907
Schuyler	15,269	4,573	2,427	6,138	4,573	— 1,565
Scott	3,427	2,056	2,400	464	460	— 4
Shelby	181,373	124,087	135,672	81,615	185,501	+ 103,886
Stark	20,351	23,159	32,582	37,293	34,176	— 3,117
Tazewell	206,882	208,049	155,659	220,783	271,321	+ 50,538
Vermilion	2,452,485	1,919,955	2,515,250	3,385,200	3,434,923	+ 49,723
Warren	11,687	12,304	10,275	9,044	5,021	— 4,023
Washington	72,500	31,322	22,500	25,000	7,200	— 17,800
White	19,583	22,133	23,722	35,681	27,052	— 8,629
Will	162,239	162,307	124,652	178,397	130,806	— 47,591
Williamson	5,670,474	6,537,654	4,620,372	6,614,029	7,354,507	+ 740,478
Woodford	[a] 174,031	194,410	125,823	164,001	185,499	+ 21,498
Small mines	68,786	111,981	85,969	109,759	157,994	+ 48,235
Total	47,659,690	50,904,990	45,900,246	53,679,118	59,885,226	+6,206,108
Total value	$49,978,247	$53,522,014	$52,405,897	$59,519,478	$70,294,338	+$10,774,860

[a] Includes production of Edgar and Moultrie counties.

The production of coal in Illinois from 1833 to the close of 1912 is shown in the following table:

Production of coal in Illinois, 1833–1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1833	6,000	1854	385,000	1875	4,453,178	1896	19,786,626
1834	7,500	1855	400,000	1876	5,000,000	1897	20,072,758
1835	8,000	1856	410,000	1877	5,350,000	1898	18,599,299
1836	10,000	1857	450,000	1878	5,700,000	1899	24,439,019
1837	12,500	1858	490,000	1879	5,000,000	1900	25,767,981
1838	14,000	1859	530,000	1880	6,115,377	1901	27,331,552
1839	15,038	1860	728,400	1881	6,720,000	1902	32,939,373
1840	16,967	1861	670,000	1882	9,115,653	1903	36,957,104
1841	35,000	1862	780,000	1883	12,123,456	1904	36,475,060
1842	58,000	1863	890,000	1884	12,208,075	1905	38,434,363
1843	75,000	1864	1,000,000	1885	11,834,459	1906	41,480,104
1844	120,000	1865	1,260,000	1886	11,175,241	1907	51,317,146
1845	150,000	1866	1,580,000	1887	12,423,066	1908	47,659,690
1846	165,000	1867	1,800,000	1888	14,328,181	1909	50,904,990
1847	180,000	1868	2,000,000	1889	12,104,272	1910	45,900,246
1848	200,000	1869	1,854,000	1890	15,292,420	1911	53,679,118
1849	260,000	1870	2,624,163	1891	15,660,698	1912	59,885,226
1850	300,000	1871	3,000,000	1892	17,862,276		
1851	320,000	1872	3,360,000	1893	19,949,564	Total.	903,897,579
1852	340,000	1873	3,920,000	1894	17,113,576		
1853	375,000	1874	4,203,000	1895	17,735,864		

INDIANA.

Total production in 1912, 15,285,718 short tons; spot value, $17,480,546.

All of the coal productive area of Indiana is in the southwestern part of the State, which constitutes the eastern edge of the eastern interior coal region. The total area embraces about 6,500 square miles and includes 26 counties, from 19 of which coal is being produced at the present time. Coal of workable thickness has been found at eight different horizons. All of the coal is classed as bituminous. Along the eastern edge of the field is a series of basins, some of which are but a few acres in area, which produce a variety of coal known as block or semiblock, from the almost perfectly rectangular blocks into which it fractures. This is a very pure, dry, noncoking coal, suitable for use in its raw state as a blast-furnace fuel, though usually mixed with coke when so used. The rest of the coals, designated locally as "bituminous" are excellent steam fuels. Some of them possess coking qualities but not sufficiently to compete with those of the Eastern States. Cannel coal is mined at several places. The "bituminous" coals are much more regular and persistent over large areas, some of them being traced with certainty over several thousand square miles of territory. The beds range from 3 to 10 feet in thickness and most of the mines are working on 5 feet or more of coal. Some of the mines, most of which are operated by shaft, are working on three different beds.

The production of coal in Indiana increased from 14,201,355 short tons, valued at $15,326,808, in 1911, to 15,285,718 tons, valued at $17,480,546, in 1912. The increase was 1,084,363 tons, or 7.6 per cent in quantity, and $2,153,738, or 14 per cent, in value. Neither in quantity nor in value, however, did the production of 1912 attain the record made in 1910, when, because of the long-continued labor troubles in Illinois, an abnormal demand was created for Indiana coal and the production rose to 18,389,815 tons, or over 3,000,000 tons more than that of 1912. Except for the time lost by the suspension in the spring the production in 1912 would have approximated the high record made in 1910. The principal increase in 1912 (over 70 per cent of the total increase) was made in Vigo County, which showed a gain of 770,694 tons, or 27.6 per cent. Knox County, in which extensive developments have been made during the last five years, increased its production 333,273 tons and reached its maximum output. The only other increase of over 100,000 tons was in Warrick County. Six counties fell short of their production in 1911, the principal decreases being in Sullivan County, 170,419 tons, and Vermilion County, 126,495 tons.

The number of men employed in the coal mines of Indiana in 1912 was 21,651, who worked an average of 182 days, against 21,182 for the same number of days in 1911. The average production per man in 1912 was 706 tons for the year and 3.88 tons per day, against 670 tons and 3.68 tons, respectively, in 1911.

Of the total production of 15,285,718 tons in 1912, 8,363,759 tons, or 54.7 per cent, were mined by the use of machines, against 7,049,758 tons, or 49.6 per cent, in 1911. The number of machines in use increased from 667 in 1911 to 687 in 1912. Chain-breast machines are in the majority, 348 of those in use in 1912 being of that type. Of the remainder, 198 were punchers, 99 long-wall, and 42 short-wall or continuous cutters. The quantity of coal shot off the solid in 1912 was 4,615,580 tons, or 30.2 per cent of the total, and the quantity hand mined was 2,094,397 tons, or 13.7 per cent of the total. Mines producing 211,918 tons, or 1.4 per cent of the total, did not report the method employed in mining.

Strikes and suspensions in 1912 resulted in the idleness of 15,400 men for an average of 52 days. The total time lost was equivalent to 20 per cent of the time made.

The United States Bureau of Mines reports 40 lives lost by accidents in the coal mines of Indiana in 1912, 39 underground and 1 on the surface. One-half of the deaths were due to falls of roof, 7 were due to haulage-way accidents, 3 to gas and dust explosions, and 2 to explosions of powder, premature blasts, etc. The death rate per 1,000 employees was 1.85, and 382,143 tons of coal were mined for each life lost.

The statistics of coal production in Indiana in 1911 and 1912, by counties, with the distribution of the product for consumption, are shown in the following table:

Coal production of Indiana in 1911 and 1912, by counties, in short tons.

1911.

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	721,263	26,533	31,576	779,372	$986,457	$1.28	173	1,573
Daviess	57,600	17,506	4,360	79,466	104,381	1.31	187	240
Dubois and Martin	....	4,119	....	4,119	5,686	1.38	143	14
Fountain and Warren	....	5,625	....	5,625	11,660	2.11	240	16
Gibson	223,618	18,560	4,950	247,128	270,008	1.09	201	321
Greene	2,457,831	45,143	60,392	2,563,366	2,739,788	1.06	200	3,191
Knox	826,853	25,830	26,640	879,323	872,714	1.00	171	835
Owen	20,474	2,219	....	22,693	40,216	1.77	154	90
Parke	471,939	19,569	30,059	521,567	641,293	1.23	164	1,116
Perry	....	16,378	305	16,683	22,253	1.33	226	51
Pike	428,815	29,964	8,844	467,623	513,954	1.10	153	842
Spencer	2,455	7,084	12	9,551	13,167	1.38	198	31
Sullivan	3,147,202	41,280	73,305	3,261,787	3,430,587	1.05	187	4,505
Vanderburg	78,630	190,602	9,877	279,109	357,963	1.25	223	488
Vermilion	1,588,121	24,647	60,853	1,673,621	1,691,166	1.00	177	2,162
Vigo	2,608,681	101,522	83,149	2,793,352	2,990,086	1.07	179	4,833
Warrick	501,472	29,559	14,101	545,132	559,179	1.03	166	874
Small mines	....	51,838	....	51,838	76,250	1.47	....	....
Total	13,134,954	657,978	408,423	14,201,355	15,326,808	1.08	182	21,182

1912.

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	636,236	37,331	26,756	700,323	$949,270	$1.36	164	1,365
Daviess	83,395	19,056	2,628	105,079	150,931	1.44	205	215
Dubois and Martin	....	16,500	....	16,500	21,675	1.31	278	18
Fountain and Warren	....	5,066	....	5,066	10,480	2.07	195	19
Gibson	189,763	33,075	5,719	228,557	267,632	1.17	195	255
Greene	2,537,194	42,182	57,133	2,636,509	3,080,437	1.17	199	2,984
Knox	1,160,560	24,866	27,170	1,212,596	1,256,293	1.04	196	1,258
Owen	26,787	3,000	920	30,707	47,585	1.55	186	53
Parke	475,972	26,461	20,717	523,150	684,087	1.31	184	865
Perry	....	15,904	....	15,904	19,344	1.22	239	30
Pike	521,123	23,147	15,067	559,337	638,826	1.14	190	860
Spencer	2,597	7,703	6	10,306	15,152	1.47	210	20
Sullivan	2,968,371	43,233	79,764	3,091,368	3,428,248	1.11	179	4,419
Vanderburg	103,630	188,254	10,190	302,074	403,250	1.33	183	499
Vermilion	1,479,182	21,046	46,898	1,547,126	1,653,789	1.07	165	2,370
Vigo	3,363,229	106,053	94,764	3,564,046	4,055,879	1.14	183	5,511
Warrick	631,647	45,757	14,071	691,475	732,630	1.06	166	910
Small mines	....	45,595	....	45,595	65,038	1.43	....	....
Total	14,179,686	704,229	401,803	15,285,718	17,480,546	1.14	182	21,651

In the following table are shown the statistics of the production of coal in Indiana, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911:

Coal production of Indiana, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Clay	863,649	958,732	980,016	779,372	700,323	− 79,049
Daviess	77,034	73,877	87,374	79,466	105,079	+ 25,613
Dubois	*a* 12,320	*a* 35,404	*a* 8,290	*a* 4,119	*a* 16,500	+ 12,381
Fountain	....	5,520	3,300	1,700	1,100	− 600
Gibson	188,500	232,599	296,753	247,128	228,557	− 18,571
Greene	2,361,404	2,612,686	3,439,002	2,563,366	2,636,509	+ 73,143
Knox	428,821	642,727	1,003,909	879,323	1,212,596	+ 333,273
Owen	....	15,904	10,690	22,693	30,707	+ 8,014
Parke	644,062	730,082	764,115	521,567	523,150	+ 1,583
Perry	10,601	15,603	26,317	16,683	15,904	− 779
Pike	460,180	447,122	697,385	467,623	559,337	+ 91,714
Spencer	13,206	11,118	9,096	9,551	10,306	+ 755
Sullivan	2,602,543	3,227,515	4,035,934	3,261,787	3,091,368	− 170,419
Vanderburg	263,171	271,644	398,293	279,109	302,074	+ 22,965
Vermilion	1,142,802	1,443,099	1,635,623	1,673,621	1,547,126	− 126,495
Vigo	2,735,399	3,562,534	4,181,799	2,793,352	3,564,046	+ 770,694
Warren	4,800	7,130	5,122	3,925	3,966	+ 41
Warrick	482,613	488,194	768,706	545,132	691,475	+ 146,343
Small mines	23,785	52,769	38,091	51,838	45,595	− 6,243
Total	12,314,890	14,834,259	18,389,815	14,201,355	15,285,718	+ 1,084,363
Total value	$13,084,297	$15,154,681	$20,813,659	$15,326,808	$17,480,546	+$2,153,738

a Includes Martin County.

The statistics of coal production in Indiana from 1840 to the close of 1912 are given in the following table, the years for which no official statistics are available having been estimated from the best information obtainable:

Production of coal in Indiana from 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	9,682	1859	95,000	1878	1,000,000	1897	4,151,169
1841	10,000	1860	101,280	1879	1,196,490	1898	4,920,743
1842	18,000	1861	128,000	1880	1,454,327	1899	6,006,523
1843	25,000	1862	150,000	1881	1,984,120	1900	6,484,086
1844	30,000	1863	200,000	1882	1,976,470	1901	6,918,225
1845	35,000	1864	250,000	1883	2,560,000	1902	9,446,424
1846	40,000	1865	280,000	1884	2,260,000	1903	10,794,692
1847	45,000	1866	320,000	1885	2,375,000	1904	10,842,189
1848	50,000	1867	350,000	1886	3,000,000	1905	11,895,252
1849	56,000	1868	375,000	1887	3,217,711	1906	12,092,560
1850	60,000	1869	400,000	1888	3,140,979	1907	13,985,713
1851	60,000	1870	437,870	1889	2,845,057	1908	12,314,890
1852	75,000	1871	600,000	1890	3,305,737	1909	14,834,259
1853	75,000	1872	896,000	1891	2,973,474	1910	18,389,815
1854	80,000	1873	1,000,000	1892	3,345,174	1911	14,201,355
1855	80,000	1874	812,000	1893	3,791,851	1912	15,285,718
1856	85,000	1875	800,000	1894	3,423,921		
1857	85,000	1876	950,000	1895	3,995,892	Total.	234,466,427
1858	87,000	1877	1,000,000	1896	3,905,779		

IOWA.

Total production in 1912, 7,289,529 short tons; spot value, $13,152,088.

The coal fields of Iowa constitute the northern limits of the western interior region and occupy the central and southern portions of the State. They have a total area of approximately 20,000 square miles, of which about 13,000 square miles are considered as workable under present conditions, and most of the remainder possess possibilities for the future. The coal beds as a usual thing are not thick, the thickest, in the Des Moines section, averaging about 5 feet, and these are somewhat irregular and faulted. The coal is of noncoking bituminous grade, somewhat high in sulphur (iron pyrite), but is a fair steaming fuel. In the vicinity of Centerville the coal is regular and persistent, but is thin, being not over 30 inches in thickness. It has, however, a strong roof that furnishes ideal conditions for longwall mining.

The more important producing areas are: (1) The northern, including Webster, Boone, and neighboring counties, and yielding 4 per cent of the total output; (2) the north central, including Polk, Jasper, and Dallas counties, and producing 29 per cent of the output, chiefly from Polk County; (3) the south central, including Marion, Mahaska, Monroe, and adjacent counties, and producing 43 per cent of the total output; (4) the southeastern, including Wapello, Van Buren, and adjacent counties, and yielding 4 per cent of the total (in all of these areas practically all of the coal mined comes from the lower part of the Des Moines group); (5) the south central, including Appanoose and Wayne counties, produces 19 per cent of the State's total (the coal mined is from the Mystic or Centerville bed); (6) the southwestern, including Adams, Taylor, and Page counties, yields one-half of 1 per cent of the total. This product is from the Nodaway bed of the Missouri group.

The market for Iowa coal is largely confined within the borders of the State. Considerable coal is shipped to Nebraska, Minnesota, and other States, but an equal amount comes into Iowa from Illinois and eastern fields.

Iowa was a conspicuous exception to the general increase in production during 1912, although the amount of decrease, as compared with 1911, was small. Most of the mines were shut down during April and the greater part of May pending the adjustment of the wage scale, and when operations were resumed it was found that many of the miners had left the State and that railroad cars usually serving the Iowa coal mines had been diverted to other lines of traffic. Some of the mines did not reach their normal capacity for three or four months after work was resumed, and the car shortage continued to the close of the year. The coal mines of Iowa suffered more from car shortage in the latter part of 1912 than at any time in their history. Except for these conditions the production in 1912 would have showed a substantial increase over 1911. Iowa is primarily an agricultural State, and, although manufacturing industries have been developed to some extent, it is not one of the more important States in this regard. There are no cities of more than 100,000 inhabitants, and only one, Des Moines, had a population exceeding 50,000 when the census of 1910 was taken. The markets for the coal of Iowa, outside of that taken by the railroads, are chiefly in rural communities and cities of moderate size dependent upon agricultural trade.

The production of coal in Iowa in 1912 was 7,289,529 short tons, valued at $13,152,088, against 7,331,648 tons, valued at $12,663,507, in 1911. The decrease in 1912 was 42,119 short tons, but evidence that the smaller tonnage was due to the labor and car shortage and not to any falling off in demand is presented in the fact that the value increased $488,581. The average price per ton advanced from $1.73 in 1911 to $1.80 in 1912.

Coal was mined in 22 counties in 1912, one more than in 1911, and the same number as in 1910. Production in 1912 increased and decreased in exactly the same number of counties, 11 each. Appanoose County, which declined about 300,000 tons from 1910 to 1911, recovered nearly half the loss, or 147,943 tons in 1912. Monroe County, which has shown steady gains since 1908, added 134,173 tons to its output in 1911. Dallas County continued an uninterrupted sequence of increases since 1906 by a further gain of 50,618 tons in 1912. Mahaska County's production, on the other hand, has decreased each year since 1909 and that of 1912 was 198,346 tons short of 1911. The production of Wapello County decreased 106,230 tons, or about one-third. The changes in other counties were relatively small.

The number of men employed in the coal mines of Iowa in 1912 was 16,370, who worked an average of 188 days, against 16,599 men for an average of 203 days in 1911. The average production by each man employed was 445 tons for the year and 2.37 tons per day in 1912, against 442 tons and 2.18 tons, respectively, in 1911. During the suspension in the spring of 1912, 8,455 men were idle for an average of 44 days.

"Shooting off the solid" is practiced to a greater extent in the States of the interior province than in any other part of the country, and Iowa is no exception. In 1912 mines producing 707,785 tons, or 9.7 per cent of the total, did not report the method employed in winning the coal, and specific requests for this information brought no replies. The replies from the operators who did report their mining methods show that 5,034,729 tons, or 69.1 per cent of the toal production of the State, were "powder-mined;" 1,451,673 tons, or 19.9 per cent, were hand-mined, and 95,342 tons, or 1.3 per cent, were mined by machines. The mining machines reported consisted of 16 punchers, 3 chain-breast, 3 long-wall, 1 short-wall, and 1 radialaxe, a total of 24.

There were fewer deaths by over 50 per cent in 1912 than in 1911, the United States Bureau of Mines reporting 19 men killed in the coal mines of Iowa against 40 the preceding year. All of the 19 fatalities in 1912 occurred underground, and 11 of them were due to falls of roof and coal. Mine cars and locomotives killed 3, dust explosions 2, and powder explosions, premature blasts, etc., 3. The death rate per thousand decreased from 2.41 to 1.16, and the number of tons mined for each life lost increased from 183,291 to 383,659.

The statistics of coal production in Iowa in 1911 and 1912, by counties, with the distribution of the product for consumption, are shown in the following table:

Coal production of Iowa in 1911 and 1912, by counties, in short tons.

1911.

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	160	7,272	40	7,472	$18,779	$2.51	120	52
Appanoose	1,023,405	55,051	26,267	1,104,723	2,102,485	1.90	163	4,066
Boone	174,932	26,388	13,120	214,440	413,548	1.93	206	653
Dallas	371,794	7,204	6,590	385,588	731,805	1.90	257	707
Greene	800	11,000	....	11,800	30,400	2.58	160	43
Guthrie	....	10,390	....	10,390	29,570	2.84	142	59
Jasper	277,795	14,587	45	292,427	672,532	2.30	219	648
Keokuk	....	11,697	815	12,512	23,978	1.92	188	29
Mahaska	733,178	22,152	21,859	777,189	1,200,117	1.54	213	1,425
Marion	149,803	15,446	6,080	171,329	265,303	1.55	225	327
Monroe	2,140,265	55,181	63,793	2,259,239	3,402,743	1.51	217	4,266
Polk	1,302,029	173,288	56,693	1,532,010	2,729,625	1.78	217	2,995
Taylor	4,565	5,385	....	9,950	22,979	2.32	135	58
Van Buren	6,000	2,651	5	8,656	20,340	2.35	208	15
Wapello	268,784	38,690	4,858	312,332	523,535	1.68	226	572
Wayne	103,640	11,442	1,300	116,382	234,761	2.00	203	379
Webster	37,749	6,425	1,852	46,026	101,949	2.13	173	169
Other counties [a] and small mines	....	58,270	913	59,183	139,058	2.35	151	136
Total	6,594,899	532,519	204,230	7,331,648	12,663,507	1.73	203	16,599

1912.

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	....	9,868	....	9,868	$24,690	$2.50	124	55
Appanoose	1,168,776	65,969	17,921	1,252,666	2,506,844	2.00	161	4,166
Boone	172,585	35,683	3,900	212,168	454,731	2.14	161	776
Dallas	420,990	8,969	6,247	436,206	810,532	1.86	225	957
Greene	90	9,500	....	9,590	24,250	2.53	158	32
Guthrie	....	5,870	....	5,870	16,191	2.76	201	28
Jasper	237,221	19,530	14,550	271,301	669,936	2.47	212	584
Jefferson	....	4,248	....	4,248	9,170	2.16	170	16
Keokuk	....	14,240	50	14,290	26,733	1.87	153	31
Mahaska	546,100	20,669	12,074	578,843	944,156	1.63	211	983
Marion	161,655	16,434	3,979	182,068	315,260	1.73	191	428
Monroe	2,272,658	48,297	72,457	2,393,412	3,757,856	1.57	206	4,281
Polk	1,226,294	221,240	38,519	1,486,053	2,761,723	1.86	187	2,912
Taylor	2,600	2,520	....	5,120	12,700	2.48	155	31
Van Buren	5,600	3,529	25	9,154	18,785	2.05	221	14
Wapello	175,031	25,877	5,194	206,102	345,324	1.68	203	488
Wayne	87,387	10,631	1,150	99,168	205,182	2.47	159	377
Webster	42,320	3,054	2,700	48,074	107,088	2.23	196	151
Other counties [b] and small mines	....	64,078	1,250	65,328	140,937	2.16	180	60
Total	6,519,307	590,206	180,016	7,289,529	13,152,088	1.80	188	16,370

[a] Jefferson, Lucas, Page, and Warren.

[b] Lucas, Page, Scott, and Warren.

The production, by counties, during the last five years, with increase and decrease in 1912, as compared with 1911, is shown in the following table:

Coal production of Iowa, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Adams	17,492	13,194	12,745	7,472	9,868	+ 2,396
Appanoose	1,144,405	1,236,009	1,413,896	1,104,723	1,252,666	+147,943
Boone	237,498	275,711	275,882	214,440	212,168	− 2,272
Dallas	174,585	244,219	255,085	385,588	436,206	+ 50,618
Davis	3,700	....	....	....	....	....
Greene	15,431	9,700	10,150	11,800	9,590	− 2,210
Guthrie	....	6,730	17,324	10,390	5,870	− 4,520
Jasper	393,516	323,092	349,063	292,427	271,301	− 21,126
Jefferson	3,500	6,255	7,530	5,129	4,248	− 881
Keokuk	18,301	14,430	13,141	12,512	14,290	+ 1,778
Lucas	8,739	9,326	11,233	13,337	15,459	+ 2,122
Mahaska	807,515	925,438	848,199	777,189	578,843	−198,346
Marion	294,607	329,353	215,281	171,329	182,068	+ 10,739
Monroe	1,967,337	2,025,559	2,184,030	2,259,239	2,393,412	+134,173
Page	11,364	16,134	10,550	12,396	5,050	− 7,346
Polk	1,616,895	1,788,129	1,778,264	1,532,010	1,486,053	− 45,957
Scott	1,248	8,400	400	....	300	+ 300
Taylor	18,003	13,536	9,749	9,950	5,120	− 4,830
Van Buren	15,362	15,955	10,284	8,656	9,154	+ 498
Wapello	189,506	261,520	283,500	312,332	206,102	−106,230
Warren	6,820	16,201	1,992	1,500	3,595	+ 2,095
Wayne	127,409	128,004	135,439	116,382	99,168	− 17,214
Webster	62,768	66,584	49,973	46,026	48,074	+ 2,048
Other counties and small mines	25,309	24,283	34,410	a 26,821	a 40,924	+ 14,103
Total	7,161,310	7,757,762	7,928,120	7,331,648	7,289,529	− 42,119
Total value	$11,706,402	$12,793,628	$13,903,913	$12,663,507	$13,152,088	+$488,581

a Small mines only.

Iowa probably ranks second among the States west of 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 Mississippi in which any coal production was reported. Missouri, however, was credited with an output of nearly 10,000 tons, and 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 following table, estimates being given for years for which no official figures are available:

Production of coal in Iowa, 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	400	1859	42,000	1878	1,350,000	1897	4,611,865
1841	500	1860	41,920	1879	1,400,000	1898	4,618,842
1842	750	1861	50,000	1880	1,461,116	1899	5,177,479
1843	1,000	1862	53,000	1881	1,960,000	1900	5,202,939
1844	2,500	1863	57,000	1882	3,920,000	1901	5,617,499
1845	5,000	1864	63,000	1883	4,457,540	1902	5,904,766
1846	6,500	1865	69,574	1884	4,370,566	1903	6,419,811
1847	8,000	1866	99,320	1885	4,012,575	1904	6,519,933
1848	10,000	1867	150,000	1886	4,315,779	1905	6,798,609
1849	12,500	1868	241,453	1887	4,473,828	1906	7,266,224
1850	15,000	1869	295,105	1888	4,952,440	1907	7,574,322
1851	18,000	1870	263,487	1889	4,095,358	1908	7,161,310
1852	20,000	1871	300,000	1890	4,021,739	1909	7,757,762
1853	23,000	1872	336,000	1891	3,825,495	1910	7,928,120
1854	25,000	1873	392,000	1892	3,918,491	1911	7,331,648
1855	28,000	1874	799,936	1893	3,972,229	1912	7,289,529
1856	30,000	1875	1,231,547	1894	3,967,253		
1857	33,000	1876	1,250,000	1895	4,156,074	Total	179,077,161
1858	37,500	1877	1,300,000	1896	3,954,028		

KANSAS.

Total production in 1912, 6,986,182 short tons; spot value, $11,324,130.

The coal-productive area of Kansas lies entirely in the eastern part of the State. The coal measures underlie approximately 20,000 square miles, of which about three-fourths may be considered as probably productive. Three fields or districts have been fairly well developed. The most important of them is the Cherokee and Crawford County field in the southeast corner of the State. Over 90 per cent of the total production of the Kansas mines is from these two counties. The principal coal bed in the district, the Cherokee, varies from 3 to 10 feet in thickness, though the average is only about 3½ feet. The coal is bituminous, of good quality, and roof and floor conditions are excellent. Some of the coal beds lie near the surface and mining operations are carried on by removing the overburden and "stripping" the coal. Some of this coal because of its absolute freedom from coking tendency is known locally as "dead" coal and is used raw by the zinc smelters in and near Pittsburg.

The second district in importance is that adjacent to Leavenworth and Atchison, in the northeast corner of the State, where at a depth of from 700 to 1,500 feet a thin bed is found and is mined "longwall." It is the only district in which deep mining is carried on in the Western Interior coal field. A considerable portion of the production from the shaft at Leavenworth is mined on the Missouri side of the river. In previous reports of this series it has been customary to credit all of the production to Kansas, as the opening is in that State. For the present report the tonnage taken from the Missouri side in both 1911 and 1912 has been obtained and credited to that State, the proper corrections in the 1911 figures being made.

The third district is in the eastern central part of the State, chiefly in Osage County. The bed mined in this district is only 22 inches thick, but lies at comparatively shallow depth. There are more mines in Osage County than in the other two districts combined, but they are relatively small and are worked chiefly for comparatively local consumption.

The production of coal in Kansas increased from 6,178,728 short tons, valued at $9,473,572, in 1911 to 6,986,182 tons, valued at $11,324,130, in 1912, the gain amounting to 807,454 tons, or 13 per cent, in quantity and $1,850,558, or 19.5 per cent, in value. The average price per ton advanced from $1.53 to $1.62. The principal increase in 1912 was in the two leading counties of Cherokee and Crawford, the former showing a gain of 296,892 tons and the latter of 477,173 tons. The increased production in Kansas, as in the other Southwestern States, in 1912, may be attributed to the diminished supply of fuel oil and natural gas from the Mid-Continent field. These fuels, especially fuel oil (on account largely of the increased demand for gasoline), have been virtually removed from the steam trade and steam users have returned to coal. During the first three months of 1912 the demand was heavier than usual because the railroads, industrial plants, and dealers were laying up supplies in anticipation of a suspension on April 1. Later in the year bountiful crops in the neighborhood tributary to the southwestern region made 1912 one of the best in a number of years, and enabled producers to secure the advance in price necessitated by the advance in wages granted the miners in the spring.

In 1912 a total of 11,646 men, who worked an average of 202 days, were employed in the coal mines of Kansas, against 11,357 men for an average of 190 days in 1911. The average production per man in 1912 was 600 short tons for the year, and 2.97 tons for each working day. In 1911 the corresponding figures were 544 tons and 2.86 tons.

Kansas, like the other States of the Mississippi Valley region, is open to criticism because of its nonprohibition of solid shooting in the coal mines. In 1912, out of a total production of 6,986,182 short tons, 5,864,226 tons, or 83.9 per cent, were "powder-mined." In 1911 that method was employed in mining 4,857,714, tons, or 78.6 per cent of the total. The production by machines in 1912 was 75,816 short tons, against 100,444 tons in 1911. Most of the miners in Kansas are organized and the eight-hour working day prevails.

The fatality record in Kansas exhibits the same improvement in 1912 that was evident in most of the coal-mining States. The number of fatal accidents decreased from 42 to 28, a diminution of exactly one-third. Of the 28 men killed, 26 met death underground, and of that number 11 were killed by falls of roof or coal, 9 by explosions of dust and gas, and 2 by mine cars or locomotives. The death rate per thousand was 2.4 and the quantity of coal mined for each life lost was 249,507 tons, a decrease in the death rate from 3.61 in 1911 and an increase in tonnage per death from 148,910 tons in 1911.

The threatened suspension of operations on April 1 was averted by the granting of an advance in wages of 5½ per cent over those prevailing in 1911, and the time lost through labor disaffections was not sufficient to influence the production. Altogether there were 2,088 men idle at one time or another, the average idleness amounting to 65 days.

The statistics of the production of coal in Kansas in 1911 and 1912, with the distribution of the production for consumption, are shown in the following table:

Coal production of Kansas in 1911 and 1912, 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.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
1911.									
Cherokee	1,951,284	34,099	50,669		2,036,052	$2,956,171	$1.45	182	3,510
Crawford	3,651,806	33,301	93,135		3,778,242	5,670,934	1.50	194	6,464
Leavenworth	166,349	9,816	29,309	575	206,049	478,017	2.32	212	668
Linn	18,367	7,879	1,120		27,366	48,704	1.78	177	82
Osage	82,211	22,064	204		104,479	261,901	2.51	174	610
Other counties [a] and small mines	2,400	24,140			26,540	57,845	2.18	113	23
Total	5,872,417	131,299	174,437	575	6,178,728	9,473,572	1.53	190	11,357
1912.									
Cherokee	2,256,917	23,635	52,392		2,332,944	$3,821,196	$1.64	207	3,436
Crawford	4,114,461	41,025	99,929		4,255,415	6,569,751	1.54	202	6,759
Leavenworth	145,442	19,145	39,161	775	204,523	445,597	2.18	221	682
Linn	23,978	8,760	850		33,588	65,205	1.94	198	94
Osage	121,476	14,062	258		135,796	367,176	2.70	171	660
Other counties [b] and small mines	560	23,351	5		23,916	55,205	2.31	129	15
Total	6,662,834	129,978	192,595	775	6,986,182	11,324,130	1.62	202	11,646

[a] Atchison, Franklin, and Neosho. [b] Franklin and Neosho.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production of Kansas, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Atchison	....	(a)	....	(a)	....	....
Cherokee	1,826,081	2,201,947	1,477,525	2,036,052	2,332,944	+ 296,892
Cloud	4,500	800	800	....	....	....
Crawford	3,917,818	4,328,012	2,986,411	3,778,242	4,255,415	+ 477,173
Franklin	1,604	3,160	2,000	2,400	725	− 1,675
Leavenworth	348,117	321,132	275,377	206,049	204,523	− 1,526
Linn	11,581	8,544	24,298	27,366	33,588	+ 6,222
Osage	126,448	100,197	116,769	104,479	135,796	+ 31,317
Other counties and small mines	9,359	22,686	38,271	24,140	23,191	− 949
Total	6,245,508	6,986,478	4,921,451	6,178,728	6,986,182	+ 807,454
Total value	$9,292,222	$10,083,384	$7,914,709	$9,473,572	$11,324,130	+$1,850,558

a Included in other counties.

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 following table, giving the annual production of coal in Kansas from 1869 to 1912, inclusive:

Production of coal in Kansas, 1869 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1869	36,891	1881	840,000	1893	2,652,546	1905	6,423,979
1870	32,938	1882	750,000	1894	3,388,251	1906	6,024,775
1871	41,000	1883	900,000	1895	2,926,870	1907	7,322,449
1872	44,800	1884	1,100,000	1896	2,884,801	1908	6,245,508
1873	56,000	1885	1,212,057	1897	3,054,012	1909	6,986,478
1874	85,000	1886	1,400,000	1898	3,406,555	1910	4,921,451
1875	150,000	1887	1,596,879	1899	3,852,267	1911	6,178,728
1876	225,000	1888	1,850,000	1900	4,467,870	1912	6,986,182
1877	300,000	1889	2,221,043	1901	4,900,528		
1878	375,000	1890	2,259,922	1902	5,266,065	Total	122,494,551
1879	460,000	1891	2,716,705	1903	5,839,976		
1880	771,442	1892	3,007,276	1904	6,333,307		

KENTUCKY.

Total production in 1912, 16,490,521 short tons; spot value, $16,854,207.

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 Mountain 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 10,270 square miles, and the coal-bearing areas in the western part of the State are estimated to contain 6,400 square miles, or somewhat more than one-half of that of the eastern part. Up to the close of 1911 the larger part of the production of the State had been from the western district, but as a result of extensive developments in Harlan, Johnson, Letcher, and Pike counties the larger part of the coal production in 1912 was from the eastern part of the State. There is little probability of the western district again getting the ascendancy.

Generally speaking, the eastern coal field of Kentucky is a unit, unless the Middlesboro-Harlan portion of it, cut off by the Pine Mountain fault, be excepted. Until 1912 a large part of the field was without railroad facilities, but the extension of the Big Sandy & Elkhorn branch of the Chesapeake & Ohio Railway into Pike and Letcher counties, and of the Lexington & Eastern branch of the Louisville & Nashville system into Harlan and Letcher counties, has resulted in the development in eastern Kentucky during 1910, 1911, and 1912, of probably more absolutely new coal territory than has been opened in the same time in all the rest of the United States. Other railroad construction is in contemplation. Some impression of the effect of this development may be formed from the statement that in 1908 Pike County had a production of 560,000 tons of coal, and in 1912 it produced over 1,400,000 tons; Johnson County produced less than 160,000 tons in 1908 and over 930,000 tons in 1912; Harlan and Letcher counties produced no coal prior to 1910, except from country banks, and in 1912 they had a combined production of over 525,000 tons.

The coals of this field belong to the Allegheny formation ("Lower Productive Coal Measures") and to the Pottsville group. The Pottsville, which at Ohio River has a thickness of only a few hundred feet and carries five coals, is in the southeast corner of the State 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 beds are both thin, the latter being successfully mined where averaging only 22 inches. On the other hand, some of the beds show 8 and 9 feet or more of workable coal.

The workable coal of the western district of Kentucky is confined for the most part to two beds, designated as No. 9 and No. 11 by the Geological Survey of Kentucky. Of these, No. 9 (equivalent to No. 5 of the Illinois field) is the more persistent and furnishes probably 75 per cent or more of the total production of the western counties of the State. It underlies the whole or portions of eight counties, including all of the field except its eastern portion and the southern or southwestern edge and a few other places, where it has been cut out by irregularities in the structure, which near the west and south borders of the field is seriously affected by faults. 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. Over a broad zone it lies within 300 feet below the surface, and the mining is done by shaft. Bed 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 bed 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 beds besides these three are mined at several localities in the district, notably what is supposed to be No. 6 and also No. 5.

The production of coal in Kentucky established a new record in 1912 with a total of 16,490,521 short tons, an increase of 2,440,818 tons, or 17.4 per cent over 1911[1], and of 1,867,202 tons over the former maximum output of 1910. The value increased $2,845,749, or 20.3 per cent, from $14,008,458 in 1911 to $16,854,207 in 1912. Kentucky participated in the general advance in prices, the average value per ton being $1.02 in 1912 against 99 cents in 1911. The increased production in 1912 was due chiefly to the new developments in eastern Kentucky, for although the western counties exhibited a gain of 712,787 tons, and the largest gain in any one county was in the western field, the total gain in the eastern part of the State was 1,728,031 tons or over 1,000,000 tons more than the gain in the western counties. Moreover, the western district did not reach by over 450,000 tons the record made in 1910, while in the eastern counties the gain over 1910 was nearly 2,340,000 tons.

The principal increases in 1912 were in Harlan County (314,532 tons), Pike (269,465 tons), Bell (197,569 tons), Floyd (195,891 tons), and Johnson County (130,766 tons), in the eastern district, and in Hopkins (393,092 tons), Webster (294,018 tons), and Muhlenberg County (124,844 tons), in the western district. McCreary County in the eastern district showed a gain of 543,307 tons, its entire production in 1912, but this is a new county carved out of Pulaski, Wayne, and Whitley counties, all of the production of Wayne and considerable portions of the output credited to the other two counties in 1911 being from the new county in 1912.

The number of men employed in the coal mines of Kentucky in 1912 was 24,304, who worked an average of 201 days, against 21,921 men for the same number of days in 1911. The average production per man in 1912 was 679 tons for the year, and 3.38 tons for each working day, against 640 tons and 3.18 tons, respectively, in 1911.

Kentucky ranks second among the States in the percentage of coal produced by machines, Ohio holding first place. In 1912, out of a total production of 16,490,521 tons, 10,954,648 tons, or 66.4 per cent, were machine mined. The total number of machines reported in use was 1,168, of which 611 were punchers, 361 chain breast, 54 longwall, and 136 short wall and continuous cutters. Six machines of the radialaxe or post-puncher type were installed in 1912. The quantity of coal shot off the solid was 2,727,399 tons, or 16.5 per cent of the total, and the quantity mined by hand was 2,306,222 tons, or 14 per cent of the total.

Labor troubles were not of enough significance to affect the production, the total number of men reported on strike being 2,759 for an average of 29 days.

According to the United States Bureau of Mines, there were 51 fatalities in and about the coal mines of Kentucky in 1912, 41 under-

[1] The production reported to the Survey in 1911 was about 340,000 tons short of the actual output, owing to the fact that in two or three instances where large properties were consolidated only the production after the change of management took place was reported. The corrections have been made in the present report.

ground, 2 in shafts, and 8 on the surface. Of the deaths underground, 20 were due to falls of roof and coal, 10 to explosions of gas and dust, 5 to electricity, 3 to haulage-way accidents, and 3 to other causes.

The statistics of production in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Kentucky, 1911 and 1912, by counties, in short tons.

1911.

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	1,960,572	23,311	18,625	....	2,002,508	2,200,365	$1.10	266	3,880
Boyd	107,932	163	1,160	....	109,255	92,447	.85	191	168
Carter	29,160	9,450	396	....	39,006	34,565	.89	163	105
Christian	30,568	450	1,400	....	32,418	36,072	1.11	141	128
Daviess	10,640	65,136	2,359	....	78,135	77,671	.99	252	133
Floyd	244,430	2,040	4,413	....	250,883	249,532	.99	159	422
Harlan	15,230	2,180	250	200	17,860	20,731	1.16	110	169
Henderson	145,501	71,173	7,283	....	223,957	244,490	1.09	183	393
Hopkins	1,915,283	68,531	92,701	79,506	2,156,021	1,742,676	.81	183	2,652
Johnson	779,645	5,798	16,021	....	801,464	1,003,357	1.25	226	1,080
Knox	732,179	16,429	15,993	....	764,601	855,765	1.12	213	1,277
Laurel	234,133	2,426	6,169	....	242,728	254,594	1.05	209	532
Lawrence	48,473	2,344	1,329	....	52,146	45,432	.87	107	194
Lee	44,176	596	1,085	....	45,857	61,279	1.34	232	165
McLean	111,178	9,534	1,670	....	122,382	104,524	.85	121	236
Morgan	67,899	7,419	263	....	75,581	165,177	2.19	233	248
Muhlenberg	2,158,092	28,457	56,644	....	2,243,193	1,944,883	.87	157	3,485
Ohio	724,331	22,357	23,197	....	769,885	709,928	.92	163	1,192
Pike	1,076,943	12,985	13,716	33,353	1,136,997	1,038,660	.91	210	1,348
Union	394,312	42,603	23,329	2,439	462,683	462,132	1.00	201	611
Webster	827,546	24,379	26,541	....	878,466	743,884	.85	188	1,064
Whitley	1,148,676	19,297	14,335	....	1,182,308	1,472,777	1.25	207	2,082
Other counties [a]	181,165	6,973	2,325	....	190,463	204,847	1.08	190	357
Small mines	....	170,906	....	....	170,906	242,670	1.42	......	......
Total	12,988,064	614,937	331,204	115,498	14,049,703	14,008,458	.99	201	21,921

1912.

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	2,120,053	29,302	43,222	7,500	2,200,077	$2,382,862	$1.08	209	3,476
Boyd	92,874	6,909	975	....	100,758	90,829	.90	185	214
Carter	60,237	26,731	365	....	87,333	78,526	.90	198	189
Christian	54,749	2,225	3,165	....	60,139	50,517	.84	184	122
Daviess	14,286	73,522	2,217	....	90,025	101,309	1.13	253	132
Floyd	433,803	5,796	7,175	....	446,774	504,243	1.13	207	531
Hancock	....	3,800	....	....	3,800	5,700	1.50	134	15
Harlan	184,797	3,979	5,933	137,683	332,392	361,934	1.09	197	483
Henderson	164,296	63,336	8,527	....	236,159	259,754	1.10	164	438
Hopkins	2,264,891	77,750	126,302	80,170	2,549,113	2,130,462	.84	222	2,983
Johnson	901,977	9,295	20,958	....	932,230	1,299,033	1.39	217	1,045
Knox	815,463	7,809	17,600	....	840,872	892,180	1.06	219	1,520
Laurel	210,940	11,562	4,488	....	226,990	238,493	1.05	197	420
Lawrence	63,145	1,476	2,613	....	67,234	61,624	.92	171	202
Lee	46,485	679	580	....	47,744	62,366	1.31	193	124
McCreary	530,248	9,044	4,015	....	543,307	572,178	1.05	208	1,126
McLean	116,667	3,446	2,218	....	122,331	110,854	.91	137	251
Morgan	76,312	12,448	1,198	....	89,958	203,087	2.26	260	267
Muhlenberg	2,278,470	34,515	55,052	....	2,368,037	2,189,013	.92	160	3,627
Ohio	616,109	22,054	23,223	....	661,386	586,722	.89	165	1,122
Pike	1,330,815	13,918	27,614	34,115	1,406,462	1,355,596	.96	216	1,582
Union	472,908	48,067	28,915	531	550,421	541,603	.98	181	814
Webster	1,118,956	24,572	28,956	....	1,172,484	1,046,807	.89	229	1,189
Whitley	971,116	11,533	17,336	....	999,985	1,287,670	1.29	219	1,986
Other counties [b]	219,918	9,995	5,731	....	235,644	280,024	1.19	161	446
Small mines	....	118,866	....	....	118,866	160,821	1.35	......	......
Total	15,159,515	632,629	438,378	259,999	16,490,521	16,854,207	1.02	201	24,304

[a] Breathitt, Butler, Clay, Crittenden, Greenup, Hancock, Knott, Magoffin, Pulaski, and Wayne.
[b] Breathitt, Clay, Greenup, Letcher, Magoffin, Perry, Pulaski, and Rockcastle.

In the following table is presented a statement of the production of coal in Kentucky for the last five years, by counties, with increase and decrease in each county in 1912 compared with 1911:

Coal production of Kentucky, 1908 to 1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Bell	1,557,924	1,538,568	2,051,106	2,002,508	2,200,077	+ 197,569
Boyd	61,319	86,904	103,051	109,255	100,758	− 8,497
Breathitt and Lee	181,551	105,091	92,125	57,102	84,180	+ 27,078
Butler	6,858	7,228	1,756	1,580	....	− 1,580
Carter	83,546	81,404	67,400	39,006	87,333	+ 48,327
Christian, Daviess, and Hancock	128,195	121,738	117,286	111,203	153,964	+ 42,761
Floyd	....	....	137,330	250,883	446,774	+ 195,891
Greenup	1,474	....	290	513	241	− 272
Harlan	....	....	1,440	17,860	332,392	+ 314,532
Henderson	196,023	163,782	241,281	223,957	236,159	+ 12,202
Hopkins	1,864,346	1,864,453	2,554,620	2,156,021	2,549,113	+ 393,092
Johnson	158,270	222,746	468,609	801,464	932,230	+ 130,766
Knox	515,210	610,705	654,478	764,601	840,872	+ 76,271
Laurel	207,084	214,251	275,224	242,728	226,990	− 15,738
Lawrence	22,975	96,440	100,895	52,146	67,234	+ 15,088
McCreary	....	....	....	....	543,307	+ 543,307
McLean	105,469	128,015	206,001	122,382	122,331	− 51
Morgan	....	....	70,061	75,581	89,958	+ 14,377
Muhlenberg	1,784,285	2,009,549	2,738,427	2,243,193	2,368,037	+ 124,844
Ohio	601,138	626,158	819,397	769,885	661,386	− 108,499
Pike	561,735	684,450	953,605	1,136,997	1,406,462	+ 269,465
Pulaski	99,505	61,723	85,218	69,437	1,000	− 68,437
Rockcastle	....	....	5,000	....	190	+ 190
Union	499,729	444,457	590,378	462,683	550,421	+ 87,738
Webster	559,247	449,508	1,026,188	878,466	1,172,484	+ 294,018
Whitley	239,556	933,154	1,167,937	1,182,308	999,985	− 182,323
Other counties and small mines	801,291	247,060	94,216	277,944	316,643	+ 38,699
Total	10,246,553	10,697,384	14,623,319	14,049,703	16,490,521	+ 2,440,818
Total value	$10,317,162	$10,079,917	$14,405,887	$14,008,458	$16,854,207	+$2,845,749

In the following table the statistics of Kentucky's coal production during the last five years are divided according to the counties in the eastern and western parts of the State. The coal areas in the eastern part of Kentucky belong to the Appalachian region; those in the western district belong to the eastern interior region and form the southern extremity of the Illinois-Indiana field:

Coal production of the eastern district of Kentucky, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Bell	1,557,924	1,538,568	2,051,106	2,002,508	2,200,077	+ 197,569
Boyd	61,319	86,904	103,051	109,255	100,758	− 8,497
Breathitt	23,100	20,982	24,432	11,245	36,436	+ 25,191
Carter	83,546	81,404	67,400	39,006	87,333	+ 48,327
Floyd	....	....	137,330	250,883	446,774	+ 195,891
Greenup	1,474	....	290	513	241	− 272
Harlan	....	....	1,440	17,860	332,392	+ 314,532
Johnson	158,270	222,746	468,609	801,464	932,230	+ 130,766
Knox	515,210	610,705	654,478	764,601	840,872	+ 76,271
Laurel	207,084	214,251	275,224	242,728	226,990	− 15,738
Lawrence	22,975	96,440	100,895	52,146	67,234	+ 15,088
Lee	158,451	84,109	67,693	45,857	47,744	+ 1,887
McCreary	....	....	....	....	543,307	+ 543,307
Morgan	....	....	70,061	75,581	89,958	+ 14,377
Pike	561,735	684,450	953,605	1,136,997	1,406,462	+ 269,465
Pulaski	99,505	61,723	85,218	69,437	1,000	− 68,437
Rockcastle	....	....	5,000	....	190	+ 190
Whitley	811,114	933,154	1,167,937	1,182,308	999,985	− 182,323
Other counties and small mines	184,726	190,663	45,255	86,773	257,210	+ 170,437
Total	4,446,433	4,826,099	6,279,024	6,889,162	8,617,193	+1,728,031

Coal production of the western district of Kentucky, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Butler	6,858	7,228	1,756	1,580	....	− 1,580
Christian	67,040	45,453	37,136	32,418	60,139	+ 27,721
Daviess	51,155	61,175	73,786	78,135	90,025	+ 11,890
Hancock	10,000	15,110	6,364	650	3,800	+ 3,150
Henderson	196,023	163,782	241,281	223,957	236,159	+ 12,202
Hopkins	1,864,346	1,864,453	2,554,620	2,156,021	2,549,113	+ 393,092
McLean	105,469	128,015	206,001	122,382	122,331	− 51
Muhlenberg	1,784,285	2,009,549	2,738,427	2,243,193	2,368,037	+ 124,844
Ohio	601,138	626,158	819,397	769,885	661,386	− 108,499
Union	499,729	444,457	590,378	462,683	550,421	+ 87,738
Webster	559,247	449,508	1,026,188	878,466	1,172,484	+ 294,018
Other counties and small mines	54,830	56,397	48,961	191,171	[a] 59,433	− 131,738
Total	5,800,120	5,871,285	8,344,295	7,160,541	7,873,328	+ 712,787

[a] Small mines only.

For the first time in the history of coal mining in the State the eastern district had the larger production. The lead will be maintained and widened by the continued increase of production in the recently developed virgin areas already referred to.

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 five boatloads of coal from these mines arrived at Nashville, and that from 1829 to 1834 probably from 25 to 35 boatloads were sent out each year. The boatloads averaged about 1,750 bushels, or 66 tons each. From 1834 to 1837 the shipments were from 75 to 100 boatloads, or about 3,500 bushels annually. 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 a year. The United States census for 1840 gives the total production in the State as 23,527 short tons. By 1860, according to the census for that year, the production amounted to 285,760 short tons. Operations were necessarily somewhat interrupted during the Civil War, but since 1870, after the State had begun to recover from the effects of the war, the production increased rapidly, as shown in the following table, giving the annual and total production from 1828 to the close of 1912:

Production of coal in Kentucky from 1828 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1828	328	1850	150,000	1872	380,800	1894	3,111,192
1829	2,000	1851	160,000	1873	400,000	1895	3,357,770
1830	2,000	1852	175,000	1874	360,000	1896	3,333,478
1831	2,100	1853	180,000	1875	500,000	1897	3,602,097
1832	2,500	1854	190,000	1876	650,000	1898	3,887,908
1833	2,750	1855	200,000	1877	850,000	1899	4,607,255
1834	5,000	1856	215,000	1878	900,000	1900	5,328,964
1835	6,000	1857	240,000	1879	1,000,000	1901	5,469,986
1836	8,000	1858	250,000	1880	946,288	1902	6,766,984
1837	10,000	1859	275,000	1881	1,232,000	1903	7,538,032
1838	11,500	1860	285,760	1882	1,300,000	1904	7,576,482
1839	16,000	1861	280,000	1883	1,650,000	1905	8,432,523
1840	23,527	1862	275,000	1884	1,550,000	1906	9,653,647
1841	35,000	1863	250,000	1885	1,600,000	1907	10,753,124
1842	50,000	1864	250,000	1886	1,550,000	1908	10,246,553
1843	60,000	1865	200,000	1887	1,933,185	1909	10,697,384
1844	75,000	1866	180,000	1888	2,570,000	1910	14,623,319
1845	100,000	1867	175,000	1889	2,399,755	1911	14,049,703
1846	115,000	1868	160,000	1890	2,701,496	1912	16,490,521
1847	120,000	1869	160,000	1891	2,916,069		
1848	125,000	1870	150,582	1892	3,025,313	Total	188,512,054
1849	140,000	1871	250,000	1893	3,007,179		

MARYLAND.

Total production in 1912, 4,964,038 short tons; spot value, $5,839,079.

The coal deposits of Maryland are confined to a limited area in the two western counties of the State, Allegany and Garrett. There are five basins known, respectively, as Georges Creek, Upper Potomac, Castleman, Lower Youghiogheny, and Upper Youghiogheny. Most of the production in the past has been in the Georges Creek basin, which, in Allegany County, contains a detached portion of the Pittsburgh bed known generally in this region as the "Maryland Big Vein." This bed has been worked for nearly a hundred years and is now approaching exhaustion. The greater prominence of the Georges

Creek basin as the source of Maryland's coal production has given the name "Georges Creek" to most of the coal shipped from the State. Georges Creek coal has a high reputation as a steam and blacksmith fuel. It does not, however, possess strong coking qualities, and none of it is used for that purpose. The development of the upper Potomac basin in Garrett County began about 1895 and that area is now extensively worked. The other three basins are practically untouched. The gradual exhaustion of the "Big Vein" has led to the exploitation of some of the smaller beds in the Georges Creek basin, and many companies that formerly worked the "Big Vein" alone are now mining the thinner beds either independently or in conjunction with the big bed. The total amount of coal recoverable from the numerous small beds far exceeds the original contents of the "Big Vein," but they can not be so cheaply worked, and it appears doubtful if, in the annual production, they will do more than make up the deficiency caused by the exhaustion of the big bed.

Maryland's coal production has been fairly constant for the last 15 years, and during that period it has averaged about 4,860,000 short tons. The smallest annual output in those 15 years was 4,023,241 short tons. The maximum output was 5,532,628 tons (in 1907). The production in 1912 was about 100,000 tons over the average for the period, and more than 550,000 tons less than the maximum. Compared with 1911 the production in 1912 was a gain of 278,243 short tons, or 5.94 per cent, in quantity and of $642,013, or 12.35 per cent, in value. In sympathy with the generally higher values in 1912, the average price per ton for Maryland coal advanced from $1.11 in 1911 to $1.18 in 1912.

Mechanical methods of mining coal have manifested little progress in the mines of Maryland, although as the output from the Big Vein grows proportionately less and that from the thinner beds increases, the more extended use of mining machines will probably follow. At the present time practically 95 per cent of the total production is mined by hand, the remainder being nearly evenly divided between powder-mined and machine-mined coal. Out of a total output of 4,964,038 short tons, 4,668,104 tons were hand-mined, 125,625 tons were machine-mined, and 121,130 tons were shot off the solid. The method employed in mining 49,179 tons was not reported.

The effect of the gradual depletion of Maryland's Big Vein is exhibited in the fewer tons produced per man employed. In 1912 there were 6,162 men employed in the coal mines of Maryland, against 5,881 in 1911, and 5,809 in 1910. In 1910 the average production per man was 898 tons, and the average working time 270 days; in 1911 the average working time was 248 days, and the average number of tons mined per man was 797; in 1912 the men averaged 259 days in working time and 806 tons of coal. The average daily tonnage per man was 3.33 in 1910, 3.21 in 1911, and 3.11 in 1912.

The United States Bureau of Mines reports a total of only 13 men killed in the coal mines of Maryland in 1912, a decrease of 2 from 1911, when there were fewer men employed and fewer tons mined. Nine of the fatalities in 1912 were due to falls of roof. The death rate per 1,000 was 2.11, and the number of tons mined for each life lost was 381,849, exceptionally good records. Maryland also presents an excellent record in regard to labor troubles, of which there were only three minor instances in 1912, the largest one lasting but 12 days.

No strike of any kind was reported in either 1910 or 1911. Most of the mines are operated 10 hours a day.

The statistics of the production of coal in Maryland in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Maryland in 1911 and 1912, 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.
1911.								
Allegany	3,752,185	48,655	63,355	3,864,195	$4,554,978	$1.18	247	4,923
Garrett	795,415	7,381	2,790	805,586	623,313	.78	226	958
Small mines	....	16,014	....	16,014	18,775	1.17	....	....
Total	4,547,600	72,050	66,145	4,685,795	5,197,066	1.11	248	5,881
1912.								
Allegany	4,036,128	37,787	62,895	4,136,810	$5,129,153	$1.24	265	5,242
Garrett	800,263	6,811	3,245	810,319	690,566	.85	228	920
Small mines	....	16,909	....	16,909	19,360	1.14	....	....
Total	4,836,391	61,507	66,140	4,964,038	5,839,079	1.18	259	6,162

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, 1908–1912, 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.
1908	4,288,306	38,054	50,733	4,377,093	$5,116,753	$1.17	220	6,079
1909	3,917,803	55,882	49,556	4,023,241	4,471,731	1.11	....	8,004
1910	5,097,347	62,760	57,018	5,217,125	5,835,058	1.12	270	5,809
1911	4,547,600	72,050	66,145	4,685,795	5,197,066	1.11	248	5,881
1912	4,836,391	61,507	66,140	4,964,038	5,839,079	1.18	259	6,162

Comparisons of the total production, by counties, in 1911 and 1912, are shown in the following table:

Coal production of Maryland, 1911 and 1912, by counties, in short tons.

County.	1911	1912	Increase (+) or decrease (−), 1912.
Allegany	3,864,195	4,136,810	+ 272,615
Garrett	805,586	810,319	+ 4,733
Small mines	16,014	16,909	+ 895
Total	4,685,795	4,964,038	+ 278,243
Total value	$5,197,066	$5,839,079	+$642,013

Although coal was discovered in the Georges Creek basin as early as 1782, the first eastern shipments from the Maryland coal district were not made until 1830, when small quantities were transported by barges down the Potomac River. The first company was incorporated in 1836. After the construction of the Baltimore & Ohio Railroad, in 1842, and of the Chesapeake & Ohio Canal, in 1850, the output from the Maryland mines increased rapidly.

The attempt to ship coal from the Maryland mines by barges, prior to the advent of the Baltimore & Ohio Railroad, was not long continued. The method 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 & 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 earliest years. These districts have been commonly known as the Georges Creek or Cumberland and the Piedmont regions. The Cumberland region was opened in 1842. The Piedmont region began shipping in 1853. The records of shipment have been carefully preserved and are published annually in the reports of the Cumberland coal trade.

The annual production from the coal mines of Maryland from 1820 to the close of 1912 has been as follows:

Production of coal in Maryland from 1820 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1820	3,000	1858	722,686	1877	1,939,575	1896	4,143,936
1832	12,000	1859	833,349	1878	2,068,925	1897	4,442,128
1840	8,880	1860	438,000	1879	2,132,233	1898	4,674,884
1842	2,104	1861	287,073	1880	2,228,917	1899	4,807,396
1843	12,421	1862	346,201	1881	2,533,348	1900	4,024,688
1844	18,345	1863	877,313	1882	1,555,445	1901	5,113,127
1845	30,372	1864	755,764	1883	2,476,075	1902	5,271,609
1846	36,707	1865	1,025,208	1884	2,765,617	1903	4,846,165
1847	65,222	1866	1,217,668	1885	2,833,337	1904	4,813,622
1848	98,032	1867	1,381,429	1886	2,517,577	1905	5,108,539
1849	175,497	1868	1,529,879	1887	3,278,023	1906	5,435,453
1850	242,517	1869	2,216,300	1888	3,479,470	1907	5,532,628
1851	317,460	1870	1,819,824	1889	2,939,715	1908	4,377,093
1852	411,707	1871	2,670,338	1890	3,357,813	1909	4,023,241
1853	657,862	1872	2,647,156	1891	3,820,239	1910	5,217,125
1854	812,727	1873	3,198,911	1892	3,419,962	1911	4,685,795
1855	735,137	1874	2,899,392	1893	3,716,041	1912	4,964,038
1856	817,659	1875	2,808,018	1894	3,501,428		
1857	654,017	1876	2,126,873	1895	3,915,585	Total	170,873,840

MICHIGAN.

Total production in 1912, 1,206,230 short tons; spot value, $2,399,451.

The coal fields of Michigan occupy an isolated basin in the Lower Peninsula. They have an area of approximately 11,000 square miles in almost the exact center of the Peninsula. The fields are estimated to have originally contained 12,000,000,000 tons of coal, from which the exhaustion to the close of 1912 has amounted to about 30,000,000 tons. It is only within the last 12 years that the coal fields of Michigan have been worked to any considerable extent, and their development has followed in some degree the depletion of the forest resources. The lumber industry of Michigan has materially declined. Formerly the refuse from the lumber mills furnished fuel not only for their own operations but for salt-evaporating plants which were operated as a by-industry of the lumber mills. The exhaustion of the forests and the decline of the lumber industry have created a demand for coal to supply the salt works and other manufacturing establishments of the State. The decline in the lumber industry in Michigan is exhibited by the statistics compiled by the Twelfth and Thirteenth Censuses in cooperation with the United States Forest Service. In 1900 the lumber cut amounted to 3,462,152,000 board feet. The State was second in rank of quantity of lumber cut. In 1905 the lumber cut of Michigan had declined to 2,006,670,000 board feet and the State to third in rank. In 1910 Michigan's lumber cut had fallen to 1,681,081,000 board feet and the State to ninth in rank.

The principal coal-mining operations are in Bay and Saginaw counties, with a smaller production (chiefly from local mines) in Clinton, Ingham, and Tuscola counties.

The production of coal in Michigan in 1912 amounted to 1,206,230 short tons, valued at $2,399,451, as compared with 1,476,074 tons, valued at $2,791,461, in 1911. The decrease of 269,844 tons, or 18.3 per cent, in 1912 was in close proportion to the time lost at most of the larger mines by reason of the suspension from April 1 to May 31, pending the renewal of the wage agreements. In some places the idleness was extended to the 10th or 15th of June. The time lost by the suspension was equal to 17.9 per cent of the time made. The decreased production was, however, partly compensated for by a gain in price from an average of $1.89 per ton in 1911 to $1.99 in 1912, so that whereas the decrease in tonnage was 18.3 per cent that of the total value was $392,010, or 14 per cent. Michigan's production has decreased each year since 1907. In the opinion of one of the larger operators the decline has been due to competition of West Virginia coal and to the small demand for lump coal in the manufacturing plants in the State. Every modern plant is equipped with mechanical stokers, which equipment creates a demand for slack coal, obtained cheaply and of better quality from West Virginia, and decreases the demand for lump coal. The coal mines of Michigan depend almost exclusively on the domestic trade for lump orders. In winter this demand exceeds the supply; in summer the conditions are reversed.

Of the total production of 1,206,230 tons in 1912, 635,560 tons, or something over one-half, were mined by machines, of which there were 126 in use—48 punchers, 37 chain-breast, and 41 "short-wall" or continuous cutters. Of the remainder, 443,222 tons were reported as shot off the solid, 120,637 tons were mined by hand, and the methods employed in mining 6,811 tons were not reported.

The number of men employed in the coal mines of Michigan in 1912 was 3,113, a decrease from 3,323 men in 1911. The average number of working days decreased from 218 to 183. The average production per man decreased from 444 in 1911 to 388 tons in 1912, but the average daily output mined by each employee increased from 2.04 to 2.11 tons.

Reports to the United States Bureau of Mines show that there were 8 men killed in the Michigan coal mines in 1912, against 7 fatalities in

1911. The death rate in 1912 was 2.57, against 2.1 in 1911, and the number of tons mined for each life lost was 150,779, against 210,868 tons in 1911.

The statistics of the production of coal in Michigan, by counties, during 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Michigan in 1911 and 1912, 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.
1911.								
Bay	676,787	7,399	32,898	717,084	$1,320,484	$1.84	211	1,586
Saginaw	595,663	52,406	19,885	667,954	1,267,652	1.90	225	1,451
Other counties [a] and small mines	74,694	10,322	6,020	91,036	203,325	2.23	222	286
Total	1,347,144	70,127	58,803	1,476,074	2,791,461	1.89	218	3,323
1912.								
Bay	584,005	7,828	39,098	630,931	$1,237,449	$1.96	173	1,664
Saginaw	440,032	46,838	17,742	504,612	1,025,959	2.03	193	1,302
Other counties [b] and small mines	56,282	7,745	6,660	70,687	136,043	1.92	203	147
Total	1,080,319	62,411	63,500	1,206,230	2,399,451	1.99	183	3,113

[a] Clinton, Eaton, Genesee, Ingham, Shiawassee, and Tuscola.
[b] Clinton, Ingham, and Tuscola.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production of Michigan, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (—), 1912.
Bay	782,503	822,577	766,470	717,084	630,931	— 86,153
Eaton	2,286	558	100	1,000	....	— 1,000
Jackson	5,539	1,500	....	....	....	....
Saginaw	999,338	859,434	667,282	667,954	504,612	— 163,342
Shiawassee	[a] 45,353	[b] 100,623	[c] 101,115	[c] 90,036	[b] 70,687	— 19,349
Total	1,835,019	1,784,692	1,534,967	1,476,074	1,206,230	— 269,844
Total value	$3,322,904	$3,199,351	$2,930,771	$2,791,461	$2,399,451	—$392,010

[a] Includes Clinton and Tuscola counties and small mines.
[b] Includes Clinton, Ingham, and Tuscola counties and small mines.
[c] Includes Clinton, Genesee, Ingham, and Tuscola counties and small mines.

Coal was known to exist in Michigan early in the last century, and some mining is said to have been done in the Jackson field as early as 1835. Other mines were opened at Grand Ledge, in Clinton County, in 1838. It is known that some coal was produced at that place in those early years, but there is no record of the output prior to the census report of 1860, in which year Michigan was credited with a production of 2,320 tons. It was only in the closing decade of the last century that serious attention began to be paid to the coal resources of the State, and prior to 1896 the production had exceeded 100,000 tons in four years only. In 1897 it exceeded 200,000 tons, in 1899 it exceeded 600,000 tons, and in the first year of the present century it reached a total exceeding 1,200,000 tons. The maximum output of 2,035,858 tons was reached in 1907.

The record, by years, from 1860 to 1912, inclusive, is shown in the following table:

Production of coal in Michigan, 1860 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	2,320	1874	58,000	1888	81,407	1902	964,718
1861	3,000	1875	62,500	1889	67,431	1903	1,367,619
1862	5,000	1876	66,000	1890	74,977	1904	1,342,840
1863	8,000	1877	69,197	1891	80,307	1905	1,473,211
1864	12,000	1878	85,322	1892	77,990	1906	1,346,338
1865	15,000	1879	82,015	1893	45,979	1907	2,035,858
1866	20,000	1880	100,800	1894	70,022	1908	1,835,019
1867	25,000	1881	112,000	1895	112,322	1909	1,784,692
1868	28,000	1882	135,339	1896	92,882	1910	1,534,967
1869	29,980	1883	71,296	1897	223,592	1911	1,476,074
1870	28,150	1884	36,712	1898	315,722	1912	1,206,230
1871	32,000	1885	45,178	1899	624,708		
1872	33,600	1886	60,434	1900	849,475	Total	21,679,925
1873	56,000	1887	71,461	1901	1,241,241		

MISSOURI.

Total production in 1912, 4,339,856 short tons; spot value, $7,633,864.

The coal fields of Missouri occupy the greater part of that portion of the State lying north and west of a line drawn from the northeast to the southwest corner. About 25,000 square miles contain coal-bearing formations of which about 60 per cent are potentially productive under present conditions and more will become available in the future. The supplies eventually recoverable are large and less than 1 per cent has been exhausted up to the present time. The coal is all of bituminous variety of rather medium quality, but is a fair steam producer. Developments have not kept pace with progress in some of the other States, largely because the markets that can be reached are restricted by the fuels, some of them of higher grade, from the States to the north, east, south, and west of Missouri. St. Louis secures its fuel from the more accessible fields of southwestern Illinois, and Kansas City depends to a large extent upon Arkansas, Kansas, and Oklahoma for coal. But a more potential factor in limiting the demand for Missouri coal in the last few years, or at least until 1912, has been the notable increase in the production of petroleum and natural gas in the Mid-Continent field of Kansas and Oklahoma. Natural gas from eastern Kansas is now piped to Kansas City, St. Joseph, and Joplin, Mo., and to Atchison, Leavenworth, and other cities in Kansas. Oil from the same district and from northern Oklahoma is being extensively used for fuel by manufacturers in Kansas City and other cities contiguous to the Missouri coal fields, and as long as these more desirable fuels are available the demand for Missouri coal is not likely to increase materially. Smaller supplies of gas and of fuel oil in 1912 have caused an increase in the production of coal in the Southwestern States, which increase was shared by Missouri. The interruptions to their regular supplies of fuel caused by the biyearly conflicts between coal operators and their miners has created a tendency on the part of manufacturers to substitute oil and gas for coal. The chief producing fields of the State are: (1) The Bevier, occupying parts of Macon, Randolph, Chariton, Howard, and Boone counties, and producing 27 per cent of the State's output from a bed that ranges from 3 to 6 feet in thickness. (2) The Lexington, including Lafayette, Ray, and Clay counties. The bed mined is only 14 to 26 inches thick and belongs in the Des Moines group. Because it is ideally adapted to the long-wall system of mining and is situated near large consuming centers, this bed, in spite of its thinness, produces 27 per cent of the total for the State. (3) The Southwestern, including various districts in Henry, Barton, Bates, and adjacent counties, where several beds are mined, chiefly in the lower part of the Des Moines group. About 20 per cent of the output comes from this part of the State. (4) The Novinger, in Adair County, which produces 15 per cent of the total output. The bed mined lies at the same stratigraphic horizon as the one in the Bevier field and averages $3\frac{1}{2}$ feet in thickness. (5) The Marceline, in Linn County, where 4 per cent of the State's total production is taken from a bed 29 inches thick. (6) The Mendota, in Putnam, Schuyler, and northwestern Adair counties. The coal of this field lies stratigraphically about 100 feet above that in the Novinger field and probably at the same horizon as that of the Lexington field. It is the southern extension of the Mystic or Centerville bed of Iowa, but is not extensively mined in Missouri and produces only 2 per cent of the total for the State.

The coal production of Missouri reached the highest point in the history of the State in 1912, amounting to 4,339,856 short tons, valued at $7,633,864. This was an increase of 503,749 tons, or 13.13 per cent, in quantity and of $1,030,798, or 15.61 per cent, in value over 1911, when the production amounted to 3,836,107 short tons, valued at $6,603,066. Prior to 1912 the largest production of coal in Missouri was made in 1903, when it amounted to 4,238,586 tons, about 100,000 less than that of 1912.

An apparent increase in the production of Missouri in 1911 is shown in the figures of the present report as compared with the one for that year. The difference is due to the adding to Missouri's production for 1911, as for 1912, of the part of the product from the mines at Leavenworth which is mined from the Missouri side of the State line. Prior to 1911 and in the report for that year all of this production was credited to Leavenworth County, Kans., where the tipple is located.

Coal mining in Missouri in 1912 gave employment to 9,704 men, who worked an average of 206 days, compared with 10,259 men and 182 days in 1911. The rate of production per man is low, being 447 tons for the year and 2.17 tons for each day in 1912, and 374 tons for the year and 2.05 tons per day in 1911. Mining machines are used chiefly in the thin beds where long-wall mining is practiced. In consequence the long-wall type of machine is in the majority. There were 86 machines employed in the coal mines of Missouri in 1912, a decrease of 6 as compared with 1911. The machine-mined production, however, increased from 753,614 tons to 898,852 tons. The 86 machines in 1912 included 78 long-wall, 4 short-wall, 2 punchers, and 2 chain-breast.

Nearly one-half (48 per cent in 1912) of Missouri's coal is "powder-mined," and the pick-mined coal is about half as much as that shot off the solid. In 1912, 2,083,656 short tons were shot off the solid and 1,036,994 tons mined by hand.

A total of 55,022 working days was lost by strike or suspension in 1912, 952 men being idle for an average of 58 days.

The statistics collected by the United States Bureau of Mines show that in 1912 there were 20 men killed in the coal mines of Missouri against a death roll of 8 in 1911, when the Missouri mines had the lowest death rate in the entire country. Of the 20 men killed in and about the mines in 1912, 16 were underground, 1 in the shaft, and 3 on the surface. Of the 16 fatalities underground, 9, or more than 50 per cent, were due to falls of roof and coal. Dust explosions killed 2 men. The other deaths from miscellaneous causes all occurred singly. The death rate per thousand employees in 1912 was 2.06; in 1911 it was 0.8. The quantity of coal mined for each life lost in 1912 was 216,993 short tons; in 1911 it was 470,076 tons.

The statistics of coal production in Missouri in 1911 and 1912, by counties, with the distribution of the product for consumption, are shown in the following table:

Coal production of Missouri in 1911 and 1912, by counties, in short tons.

1911.

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	320,126	21,015	7,418	348,559	$546,876	$1.57	148	1,032
Audrain	9,636	17,742	2,295	29,673	69,372	2.34	161	158
Barton	270,242	20,901	4,093	295,236	425,029	1.44	196	550
Bates	72,822	13,543	2,255	88,620	152,347	1.72	153	251
Boone	3,237	18,633	161	22,031	46,093	2.09	212	79
Callaway	....	36,211	200	36,411	86,309	2.37	231	116
Henry	217,785	19,621	3,165	240,571	422,773	1.76	217	412
Lafayette	697,973	49,694	18,212	765,879	1,391,279	1.82	205	2,201
Linn	102,351	18,058	2,760	123,169	281,581	2.29	217	378
Macon	647,373	19,230	9,330	675,933	1,009,953	1.49	139	1,916
Putnam	24,377	5,129	770	30,276	54,279	1.79	99	191
Ralls	15,459	699	....	16,158	30,413	1.88	245	44
Randolph	448,977	22,563	12,260	483,800	742,578	1.53	222	1,085
Ray	283,234	28,317	5,583	317,134	619,303	1.95	180	1,077
Other counties [a]	176,527	67,169	9,845	253,541	499,353	1.97	187	769
Small mines	....	109,116	....	109,116	225,528	2.07	....	....
Total	3,290,119	467,641	78,347	3,836,107	6,603,066	1.72	182	10,259

1912.

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	563,015	20,014	10,638	593,667	$965,880	$1.63	231	931
Audrain	6,356	16,752	2,404	25,512	56,683	2.22	234	103
Barton	361,606	8,689	11,787	382,082	598,399	1.57	194	619
Bates	140,303	14,805	4,121	159,229	277,225	1.74	190	282
Boone	....	19,556	140	19,696	39,016	1.98	148	78
Callaway	11,900	11,052	10	22,962	56,504	2.46	233	83
Dade	200	5,820	80	6,100	11,825	1.94	146	12
Henry	107,160	33,549	2,875	143,584	260,396	1.81	161	428
Lafayette	683,283	47,358	18,957	749,598	1,454,965	1.94	227	2,018
Linn	100,450	22,174	3,025	125,649	287,504	2.29	219	410
Macon	779,358	23,687	15,125	818,170	1,251,755	1.53	179	1,629
Putnam	25,198	5,737	775	31,710	54,828	1.73	118	163
Randolph	448,450	27,297	8,156	483,903	781,919	1.62	239	1,039
Ray	340,793	28,339	6,032	375,164	723,981	1.93	191	1,182
Other counties [b]	240,260	48,407	15,348	304,015	607,601	2.00	206	727
Small mines	....	98,815	....	98,815	205,383	2.08	....	....
Total	3,808,332	432,051	99,473	4,339,856	7,633,864	1.76	206	9,704

[a] Caldwell, Cass, Clay, Cole, Dade, Grundy, Harrison, Howard, Johnson, Moniteau, Montgomery, Platte, Schuyler, Sullivan, and Vernon.

[b] Caldwell, Cass, Clay, Cole, Grundy, Harrison, Howard, Johnson, Livingston, Moniteau, Montgomery, Platte, Ralls, Schuyler, Sullivan, and Vernon.

The statistics of production during the last five years, by counties, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production in Missouri, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Adair	600,352	576,485	408,007	348,559	593,667	+ 245,108
Audrain	37,479	41,207	40,662	29,673	25,512	− 4,161
Barton	129,632	259,766	222,595	295,236	382,082	+ 86,846
Bates	133,700	147,322	95,451	88,620	159,229	+ 70,609
Boone	25,868	18,000	19,885	22,031	19,696	− 2,335
Caldwell	10,600	7,815	7,300	3,181	2,015	− 1,166
Callaway	22,534	25,179	28,954	36,411	22,962	− 13,449
Grundy	10,821	9,818	9,640	8,000	10,000	+ 2,000
Henry	219,974	263,352	145,644	240,571	143,584	− 96,987
Johnson	13,571	8,128	2,532	1,500	3,411	+ 1,911
Lafayette	595,678	715,223	553,832	765,879	749,598	− 16,281
Linn	103,104	134,260	89,311	123,169	125,649	+ 2,480
Livingston	1,010	400	200	....	500	+ 500
Macon	833,060	790,083	613,949	675,933	818,170	+ 142,237
Montgomery and Morgan	2,783	2,420	*a* 1,500	*a* 1,000	*a* 1,200	+ 200
Putnam	50,775	48,120	61,968	30,276	31,710	+ 1,434
Ralls	11,802	16,009	12,761	16,158	13,799	− 2,359
Randolph	66,391	186,573	193,482	483,800	483,903	+ 103
Ray	263,288	277,075	292,442	317,134	375,164	+ 58,030
Vernon	47,281	20,278	7,208	2,658	2,340	− 318
Other counties and small mines	137,612	209,017	175,110	346,318	375,665	+ 29,347
Total	3,317,315	3,756,530	2,982,433	3,836,107	4,339,856	+ 503,749
Total value	$5,444,907	$6,183,626	$5,328,285	$6,603,066	$7,633,864	+$1,030,798

a Montgomery County only.

As far as any records are obtainable, coal mining began in Missouri in 1840, the United States Census for that year recording a production of 9,972 tons. The annual production since 1840 is shown in the following table, the output of the years 1841 to 1869, inclusive, being estimated from the best information available:

Production of coal in Missouri from 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	9,972	1859	260,000	1878	1,008,000	1897	2,665,626
1841	12,000	1860	280,000	1879	1,008,000	1898	2,688,321
1842	15,000	1861	300,000	1880	844,304	1899	3,025,814
1843	25,000	1862	320,000	1881	1,960,000	1900	3,540,103
1844	35,000	1863	360,000	1882	2,240,000	1901	3,802,088
1845	50,000	1864	375,000	1883	2,520,000	1902	3,890,154
1846	68,000	1865	420,000	1884	2,800,000	1903	4,238,586
1847	80,000	1866	450,000	1885	3,080,000	1904	4,168,308
1848	85,000	1867	500,000	1886	1,800,000	1905	3,983,378
1849	90,000	1868	541,000	1887	3,209,916	1906	3,758,008
1850	100,000	1869	550,000	1888	3,909,967	1907	3,997,936
1851	125,000	1870	621,930	1889	2,557,823	1908	3,317,315
1852	140,000	1871	725,000	1890	2,735,221	1909	3,756,530
1853	160,000	1872	784,000	1891	2,674,606	1910	2,982,433
1854	175,000	1873	784,000	1892	2,733,949	1911	3,836,107
1855	185,000	1874	789,680	1893	2,897,442	1912	4,339,856
1856	200,000	1875	840,000	1894	2,245,039		
1857	220,000	1876	1,008,000	1895	2,372,393	Total.	115,850,347
1858	240,000	1877	1,008,000	1896	2,331,542		

MONTANA.

Total production in 1912, 3,048,495 short tons; spot value, $5,558,195.

The coal fields of Montana are widely scattered and range in the quality of their output from lignite to a fair grade of bituminous coal. Nearly all of the eastern third, or Great Plains section, of the State is underlain by lignite and low-grade subbituminous coal. As the mountainous district is approached the coals pass into high-grade subbituminous and true bituminous coals. These occur for the most part in relatively small and much scattered areas. In the valley region of the western part of the State the coals grade again into lignite, but, like those of the eastern part, they are also widely scattered and at present are not of economic importance. In point of production the most important field at the present time is what is known as the Red Lodge field, in Carbon County. Extensive mining operations are carried on in the vicinity of Red Lodge and Bear Creek, the production amounting to approximately 1,200,000 short tons annually. The coal is so nearly on the line between subbituminous and bituminous coal that classification is difficult. Second in importance in 1912, and the district that is now attracting the most attention, is the Bull Mountain field, in Musselshell County. It was opened in 1908, following the completion of the Chicago, Milwaukee & Puget Sound Railway, and from a production of less than 100,000 tons in that year has increased to over 900,000 tons in 1912. This coal is a good grade of subbituminous.

Until superseded in 1912 by the Bull Mountain field, the Great Falls field, in Cascade County, was second in point of production, and still is in its future potentiality as important as any, if not the most important, in the State. Mining is extensively carried on at Cottonwood, Stockett, and Belt, and, up to 1907, Cascade County was credited with more than half the production of the State. This coal is bituminous in grade, but somewhat dirty.

An extensive area of subbituminous coal underlies a large part of Chouteau County in the north-central part of the State, but the mining operations are comparatively small. Coal mining, principally for local consumption, is also carried on in Fergus, Gallatin, Hill, Missoula, Park, Rosebud, and Valley counties.

The total production of coal in Montana in 1912 was 3,048,495 short tons, valued at $5,558,195, against 2,976,358 tons, valued at $5,342,168, in 1911. This indicates an increase in 1912 over 1911 of 72,137 short tons, or 2.42 per cent, in quantity, and of $216,027, or 4.04 per cent, in value. The principal increase was in Musselshell County, which showed a gain of 207,540 tons. Small increases were also made in Chouteau and Carbon counties, but in all other counties the production decreased. Cascade County showed the largest decrease—138,467 short tons. The average price per ton advanced from $1.79 in 1911 to $1.82 in 1912.

In the statistics of production in 1912, as reported to the Survey, two features deserve special mention. These are a decreased tonnage from the use of machines and an increase in the quantity of coal shot from the solid. In 1911 there were 87 machines reported in use, 12 fewer than in 1910. In 1912 the number of machines reported dropped to 69 (30 less than in 1910), and the quantity of machine-mined coal decreased from 1,172,582 tons to 984,905 tons. The quantity of coal shot from the solid, on the other hand, increased from 1,008,465 tons to 1,123,571 tons. In 1911, 34 per cent of the total production was shot from the solid and in 1912, 37 per cent.

Of the 69 machines in use in 1912, 38 were puncher, 21 were chain breast, 8 were short wall, and 2 were radialaxe.

Fewer men were employed in the coal mines of Montana in 1912 than in 1911, the number decreasing from 3,866 to 3,440. The average days worked were the same in both years. The average production per man was 886 for the year and 4.03 for each day in 1912, against 770 tons and 3.5 tons, respectively, in 1911.

Labor strikes were reported at 5 mines, but they were all of short duration and did not affect the production. A total of 869 men were idle for an average of 10 days.

According to the statistics of accidents reported to the United States Bureau of Mines, there was a decrease of practically 50 per cent in the fatalities in the mines of Montana in 1912, compared with 1911. In 1912 the total number of men killed—all of them inside the mines—was 7, as against 13 in 1911. The death rate per 1,000 employees in 1912 was 2.03, as compared with 3.36 in 1911. The quantity of coal mined for each fatality was 228,951 tons in 1911 and 435,499 tons in 1912. Of the 7 fatalities, 2 each were due to falls of roof, to tramway accidents, and to explosions of powder. One death was caused by a fall of coal. There were no gas or dust explosions attended by fatal results.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Montana in 1911 and 1912, by counties, in short tons.

1911.

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.
Carbon	1,080,301	19,801	85,087	1,185,189	$2,350,580	$1.98	214	1,721
Cascade	932,625	23,388	38,030	994,043	1,577,869	1.59	242	1,149
Chouteau	....	9,527	200	9,727	26,640	2.74	205	30
Fergus	3,702	12,076	933	16,711	51,499	3.08	166	36
Musselshell	677,627	5,923	22,814	706,364	1,193,363	1.69	201	801
Other counties[a]	45,274	5,251	8,780	59,305	131,049	2.21	236	129
Small mines	....	5,019	....	5,019	11,168	2.23	....	....
Total	2,739,529	80,985	155,844	2,976,358	5,342,168	1.79	220	3,866

1912.

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.
Carbon	1,095,207	20,439	71,624	1,187,270	$2,472,534	$2.08	221	1,527
Cascade	794,766	16,419	44,391	855,576	1,340,392	1.57	210	1,054
Chouteau	7,638	13,352	600	21,590	53,924	2.50	292	41
Fergus	....	6,251	....	6,251	15,881	2.54	150	9
Hill	....	9,674	325	9,999	16,352	1.64	242	19
Musselshell	878,452	7,745	27,707	913,904	1,532,629	1.68	232	656
Other counties[b]	42,440	5,365	3,293	51,098	119,572	2.34	203	134
Small mines	....	2,807	....	2,807	6,911	2.46	....	....
Total	2,818,503	82,052	147,940	3,048,495	5,558,195	1.82	220	3,440

[a] Gallatin, Missoula, Park, and Valley.
[b] Gallatin, Missoula, Park, Rosebud, and Valley.

In the following table is presented a statement of the coal production of Montana, by counties, during the last five years. with increase and decrease in 1912 as compared with 1911:

Production of coal in Montana, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Carbon	868,112	989,664	1,211,028	1,185,189	1,187,270	+ 2,081
Cascade	811,245	954,657	928,306	994,043	855,576	− 138,467
Chouteau	19,770	31,432	17,327	9,727	21,590	+ 11,863
Fergus	90,318	221,663	287,614	16,711	6,251	− 10,460
Gallatin	15,973	16,771	22,465	8,515	1,406	− 7,109
Hill					9,999	+ 9,999
Musselshell				706,364	913,904	+ 207,540
Park	106,942	139,464	98,434	46,333	44,626	− 1,707
Other counties and small mines	7,830	200,289	355,796	9,476	7,873	− 1,603
Total	1,920,190	2,553,940	2,920,970	2,976,358	3,048,495	+ 72,137
Total value	$3,771,248	$5,036,942	$5,329,322	$5,342,168	$5,558,195	+$216,027

The first record of coal production in Montana was 32 years ago, in 1880, when the output amounted to only 224 tons. Up to 1888 the development had been rather slow, amounting to 41,467 tons in that year. In 1889 it rose to 363,301 tons and increased rapidly until 1895, when it reached a total of about 1,500,000 tons, and averaged approximately that quantity each year until 1904. Since 1904 it has shown an increasing tendency, reaching the maximum of 3,048,495 tons in 1912.

Production of coal in Montana from 1880 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	224	1889	363,301	1898	1,479,803	1907	2,016,857
1881	5,000	1890	517,477	1899	1,496,451	1908	1,920,190
1882	10,000	1891	541,861	1900	1,661,775	1909	2,553,940
1883	19,795	1892	564,648	1901	1,396,081	1910	2,920,970
1884	80,376	1893	892,309	1902	1,560,823	1911	2,976,358
1885	86,440	1894	927,395	1903	1,488,810	1912	3,048,495
1886	49,846	1895	1,504,193	1904	1,358,919		
1887	10,202	1896	1,543,445	1905	1,643,832	Total.	38,159,086
1888	41,467	1897	1,647,882	1906	1,829,921		

NEW MEXICO.

Total production in 1912, 3,536,824 short tons; spot value, $5,037,051.

As in Montana, the coal-bearing areas of New Mexico are in somewhat widely separated localities, as follows: (1) The Raton field of Colfax County, which is the southern extension of the Trinidad field of Colorado; (2) the San Juan River region, which extends from Durango, Colo., southward through Rio Arriba, San Juan, and McKinley counties to Gallup and Mount Taylor, and which embraces the producing districts of Gallup and Monero; (3) a large area farther south and east than the one noted above, in Valencia, Bernalillo, and Sandoval counties, of which very little is known; (4) the Los Cerrillos field in Santa Fe County, including the little known areas east, south, and west of the Ortiz Mountains; and (5) the White Oaks field in Lincoln County. There are several other areas of little economic importance.

From the standpoint of production the most important field at the present time is the Raton field of Colfax County, about 75 per cent of the production in 1912 being from this region. The product is a true coking coal and most of the operations are on an extensive scale. In 1912 there were 11 mines that produced over 100,000 tons, and two of these produced over 400,000 tons. Nearly 840,000 tons, chiefly washed slack, were made into coke. There are five known coal beds of workable thickness, but most of the mining operations are on the lowest bed of the series.

In point of area the San Juan River field in the northwestern part of the State is the most important. It has in New Mexico an area of about 13,000 square miles, and like the Raton field crosses the northern boundary into Colorado. In the southern part of this field the coal is subbituminous in quality but grades into bituminous coal at the north in Colorado and at the northeast in New Mexico. The principal mining operations in the San Juan River field are in McKinley (formerly a part of Bernalillo) County. Three mines in this county produce over 100,000 tons each, and one of them over 200,000 tons.

The Los Cerrillos field in Santa Fe County and the White Oaks field in Lincoln County are relatively small in area, but contain true bituminous coal. In the former some of the coal has been locally altered into anthracite, of which 32,411 tons were mined in 1912. Operations in Lincoln County are small and the production is limited to local consumption. Mining on a small scale is also carried on in Socorro County from an isolated area containing bituminous coking coal.

The production of coal in New Mexico increased from 3,148,158 short tons in 1911, valued at $4,525,925, to 3,536,824 tons in 1912, valued at $5,037,051, a gain of 388,666 tons, or 12.4 per cent in quantity and of $511,126, or 11.3 per cent, in value. These figures indicate an apparent decline in value per ton, from $1.44 in 1911 to $1.42 in 1912, but as explained in the report for 1911, small fluctuations in the price of New Mexico coal are not to be taken as an indication of changing values, for in Colfax County, which produces 75 per cent of the total output of the State, the largest coal mining operations are carried on by companies affiliated with or subordinate to railroad and smelting interests which consume the greater part of the product, and the fixing of values is simply a matter of accounting. Colfax County produced 2,691,306 short tons in 1912, valued at $1.31 per ton, against 2,297,611 tons, valued at $1.33 per ton, in 1911. In McKinley County, which produced 735,544 tons in 1912 (4,179 tons more than in 1911) the average price advanced from $1.53 to $1.65 per ton.

The output of coal in New Mexico in 1912 was the largest ever made, exceeding that of 1910, the previous record of production, by a small margin, 28,503 tons.

Notwithstanding the larger production in 1912, there were fewer men employed in the coal mines than in 1911, but the average working time was increased 20 per cent, from 230 days in 1911 to 274 days in 1912. The average yearly production per man increased from 788 tons to 900 tons, with a reduction in the average daily production from 3.41 tons to 3.28 tons. There were 4,007 men employed in 1911 and 3,928 in 1912, the fewer number in the latter year being attributed to the migration of miners to the scene of conflict in the Balkan States. This increase in efficiency was due in small part at least to the larger production by machines, of which there were 25 reported in use, against 10 in 1911 and 3 in 1910. The machine-mined production was 285,362 tons, against 93,722 tons in 1911. Short-wall machines appear to be the favorites, 13 of the 25 machines in use in 1912 being of this type. In addition to these there were 7 punchers, 4 chain-breast machines, and 1 post machine. Most of the coal produced in New Mexico is mined by hand, 2,642,137 short tons having been reported as hand-mined in 1912. Two mines, each producing over 450,000 tons, reported half their output shot off the solid, and altogether about 600,000 tons were so reported. Prior to 1912 New Mexico was practically free from this practice.

The United States Bureau of Mines reports 15 fatal accidents in the coal mines of New Mexico in 1912, a decrease of 6 from 1911 when 21 men were killed. All of the fatalities occurred underground, 8 being due to falls of roof, 1 to a fall of coal, and 6 to haulage-way accidents. The death rate per thousand was 3.82 and the quantity of coal mined for each life lost was 235,788 tons. The corresponding figures for 1911 were 5.24 and 149,912.

There were no strikes reported among the coal miners of New Mexico in 1912.

The statistics of production, by counties, during 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of New Mexico in 1911 and 1912, by counties, in short tons.

1911.

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	1,504,323	11,523	14,657	767,108	2,297,611	$3,066,686	$1.33	221	2,848
McKinley	700,675	7,124	23,566		731,365	1,121,621	1.53	262	844
Other counties[a]	103,464	7,843	7,101		118,408	335,955	2.84	226	315
Small mines		774			774	1,663	2.15		
Total	2,308,462	27,264	45,324	767,108	3,148,158	4,525,925	1.44	230	4,007

1912.

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	1,816,057	13,230	22,755	839,264	2,691,306	$3,514,360	$1.31	280	2,692
McKinley	709,015	6,662	19,867		735,544	1,213,590	1.65	263	1,013
Other counties[b]	95,860	4,471	8,706		109,037	307,032	2.82	246	223
Small mines		937			937	2,069	2.21		
Total	2,620,932	25,300	51,328	839,264	3,536,824	5,037,051	1.42	274	3,928

[a] Lincoln, Rio Arriba, Sandoval, San Juan, Santa Fe, and Socorro.
[b] Lincoln, San Juan, Santa Fe, and Socorro.

In the following table are presented the statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911:

Coal production of New Mexico, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Colfax	1,781,635	2,013,318	2,651,585	2,297,611	2,691,306	+ 393,695
Lincoln	1,245	1,466	2,476	1,658	435	− 1,223
McKinley	539,050	665,423	698,730	731,365	735,544	+ 4,179
Rio Arriba	20,000	12,266	10,200	2,625	....	− 2,625
Santa Fe	54,740	46,495	73,106	58,726	57,239	− 1,487
Other counties and small mines	71,267	62,160	72,224	56,173	52,300	− 3,873
Total	2,467,937	2,801,128	3,508,321	3,148,158	3,536,824	+ 388,666
Total value	$3,368,753	$3,619,744	$4,877,151	$4,525,925	$5,037,051	+$511,126

The first record of coal production in New Mexico is that contained in the first volume of Mineral Resources of the United States, published in 1882. In that year the production amounted to 157,092 tons, about 4 per cent of what it is at the present time. The maximum was reached in 1912, when the production of coal in New Mexico was 3,536,824 short tons.

Production of coal in New Mexico from 1882 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1882	157,092	1891	462,328	1900	1,299,299	1909	2,801,128
1883	211,347	1892	661,330	1901	1,086,546	1910	3,508,321
1884	220,557	1893	665,094	1902	1,048,763	1911	3,148,158
1885	306,202	1894	597,196	1903	1,541,781	1912	3,536,824
1886	271,285	1895	720,654	1904	1,452,325		
1887	508,034	1896	622,626	1905	1,649,933	Total	37,787,800
1888	626,665	1897	716,981	1906	1,964,713		
1889	486 943	1898	992,288	1907	2,628,959		
1890	375,777	1899	1,050,714	1908	2,467,937		

NORTH DAKOTA.

Total production in 1912, 499,480 short tons; spot value, $765,105.

All of the present mineral-fuel production of North Dakota is brown coal or lignite, though considerable areas of subbituminous coal of workable quality and thickness are believed to exist along the southeastern border of the fields and in the extreme southwest corner of the State. The subbituminous coals lie below the lignite and may extend to considerable distances under them. The lignite areas occupy nearly all of the western half of the State and are estimated to contain about 35,000 square miles. According to the reports of the North Dakota Geological Survey, there are 97 townships which contain at least one bed of lignite 7 feet or more in thickness, in some places as much as 30 feet. At least 100 other townships contain beds from 4 to 7 feet in thickness. The lignite is well exposed along Missouri, Little Missouri, Knife, Heart, and Mouse rivers. Mining is carried on to some extent along the Northern Pacific Railway west of Mandan; on the Milwaukee, St. Paul & Sault Ste. Marie Railway in the Mouse River valley and north of Bismarck; to less extent along the Great Northern Railway in the northwestern part of the State, and along the Chicago, Milwaukee & Puget Sound Railway in the southwestern part. The principal mining operations are in the vicinity of Wilton, in Burleigh County, where the proximity to Bismarck and the markets provided by the State institutions, compelled by law to use North Dakota lignite for fuel, have encouraged development. The production of Ward County, the second county of importance as a lignite producer, decreased nearly 50,000 tons, owing principally to one of the larger mines being shut down nearly half of the year. Except for this, the output of the State in 1912 would have shown a substantial increase over the high record of 1911.

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 that 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 supply the towns of the State with fuel for domestic purposes and for use under steam boilers. On account of the large percentage of moisture contained in the lignite, however, it has difficulty in meeting competition with Pennsylvania and West Virginia coals, which find their way into this country via the Great Lakes. But although lignite is not a fuel of high calorific value, it has been found well adapted for certain purposes and is used satisfactorily for burning brick because of its smokeless and sootless qualities and relative low cost. It is used in considerable quantities for that purpose at Dickinson, Scranton, and Kenmare, and experience has shown that 1 ton of lignite is equal in efficiency to 1 cord of such wood as is available in the localities.

Lignite is also an excellent fuel for the generation of producer gas, and with the development of manufacturing industries in the State, the extensive deposits of lignite in North Dakota will receive more attention as a source of power. It has been found that 1 ton of lignite in the gas producer will yield as much horsepower in internal-combustion engines as will 1 ton of the best bituminous coal under boilers.

The University of North Dakota has been conducting some interesting experiments on the utilization of lignite for gas making and in the manufacture of briquets. A plant operated by the school of mines of the university has been located at the mining substation at Hebron. Details regarding that plant were published in the chapter on "Fuel briquetting in 1911" in Mineral Resources for 1911.

As the gas producer and internal-combustion engines in large units come into more general use in the West, as they are rapidly doing in the East, the lignites of North Dakota will be found to possess great potentialities in the settlement and economic development of the State.

The production of lignite in North Dakota in 1912 amounted to 499,480 short tons, valued at $765,105, against 502,628 short tons, valued at $720,489, in 1911, the latter being the maximum output in the history of the State. The decrease of 3,148 short tons in 1912 was so small as to possess no significance, while the increase of $44,616 in the value of the product indicates a satisfactory condition of trade.

The number of men employed in the lignite mines of North Dakota in 1912 was 622 and they worked an average of 232 days, against 640 men for an average of 229 days in 1911. The average production per man in 1912 was 803 tons for the year and 3.5 tons for each working day, against 785 tons and 3.43 tons, respectively, in 1911.

Of the total production of 499,480 tons in 1911, 168,904, or 33.8 per cent, were undercut by the use of chain-breast machines, of which 11 were reported in use; 71,103 tons were mined by hand; and 181,798 tons, or 36.4 per cent of the total, were shot off the solid. The mines were practically free from labor troubles, a strike of 10 men for 2 days being the only one reported. The mines were also free from accidents of a fatal character, no casualties from which death resulted being reported to the United States Bureau of Mines.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of North Dakota in 1911 and 1912, 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.
1911.								
Adams	4,027	7,821	12	11,860	$13,873	$1.17	193	18
Burke	7,200	9,160	225	16,585	20,226	1.22	205	18
McLean	1,451	5,182	530	7,163	11,013	1.54	183	7
Morton	3,800	16,224	10	20,034	24,139	1.20	171	35
Stark	52,245	3,542	2,590	58,377	66,067	1.13	270	61
Ward	103,059	33,635	1,411	138,105	241,757	1.75	230	201
Williams	14,200	6,374	342	20,916	27,203	1.30	250	37
Other counties [a]	173,093	24,155	7,778	205,026	279,839	1.36	229	263
Small mines		24,562		24,562	36,372	1.48		
Total	359,075	130,655	12,898	502,628	720,489	1.43	229	640
1912.								
Adams	3,390	6,150	28	9,568	$11,630	$1.22	212	12
Burke	5,500	6,350	100	11,950	15,482	1.30	168	29
Burleigh	169,302	9,812	7,894	187,008	286,177	1.53	261	165
Hettinger		11,005	24	11,029	12,921	1.17	265	16
Morton	18,190	17,806	330	36,326	51,276	1.41	186	45
Stark	55,308	2,800	1,677	59,785	78,546	1.31	240	55
Ward	63,380	25,384	510	89,274	160,995	1.80	211	190
Williams	12,495	9,527	931	22,953	35,821	1.56	227	37
Other counties [b]	27,330	13,691	140	41,161	65,859	1.60	263	73
Small mines		30,426		30,426	46,398	1.52		
Total	354,895	132,951	11,634	499,480	765,105	1.53	232	622

[a] Burleigh, Divide, Hettinger, Mercer, and Oliver.
[b] Bowman, Divide, Dunn, McLean, Mercer, and Oliver.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912, as compared with 1911, are shown in the following table:

Coal production of North Dakota, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Burke				16,585	11,950	− 4,635
Burleigh	116,957	122,422	142,597	173,214	187,008	+ 13,794
McLean	7,452	9,325	4,090	7,163	4,145	− 3,018
Morton	20,850	18,634	23,250	20,034	36,326	+ 16,292
Stark	38,467	72,550	56,700	58,377	59,785	+ 1,408
Ward	115,780	139,996	117,382	138,105	89,274	− 48,831
Williams	13,969	18,722	17,380	20,916	22,953	+ 2,037
Other counties and small mines	7,267	40,398	37,642	68,234	88,039	+ 19,805
Total	320,742	422,047	399,041	502,628	499,480	− 3,148
Total value	$522,116	$645,142	$595,139	$720,489	$765,105	+$44,616

Lignite has doubtless been mined and used in North Dakota by ranchmen and others since the time when the State was a Territory, but it was not until 1884 that any record of production was obtained. This was published in the volume of Mineral Resources of the United States covering that year. The production since 1884 is given in the following table:

Production of coal in North Dakota from 1884 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	35,000	1892	40,725	1900	129,883	1908	320,742
1885	25,000	1893	49,630	1901	166,601	1909	422,047
1886	25,955	1894	42,015	1902	226,511	1910	399,041
1887	21,470	1895	38,997	1903	278,645	1911	502,628
1888	34,000	1896	78,050	1904	271,928	1912	499,480
1889	28,907	1897	77,246	1905	317,542		
1890	30,000	1898	83,895	1906	305,689	Total	4,928,196
1891	30,000	1899	98,809	1907	347,760		

OHIO.

Total production in 1912, 34,528,727 short tons; spot value, $37,083,363.

The coal fields of Ohio belong to the Appalachian Province and lie entirely within the eastern part of the State. The areas formerly underlain by coal are estimated at 12,600 square miles, or about one-third of the entire State. There are 16 different beds, of which the more important are No. 1, or Sharon (block) coal; No. 2, or Wellston; No. 5, or Lower Kittanning; No. 6, or Middle Kittanning; No. 7, or Upper Freeport; No. 8, or Pittsburgh; Pomeroy; and Meigs Creek. All of these beds have been developed on a large scale. The other eight beds have been developed chiefly by small mines for local trade.

Coal No. 1, the block coal, is mined in the northeastern part of the State, principally in Mahoning, Stark, and Summit counties. It is a dry, free-burning, noncoking coal, very pure, and consumed largely raw, in blast furnaces. This coal was the first mineral fuel to supplant charcoal in the blast furnaces of the State. As a domestic fuel it is known as Massillon coal and is highly prized for household use in Cleveland and other Lake cities. The annual production from this bed at the present time is about 600,000 tons. Twenty years ago, in 1892, the production exceeded 1,200,000 tons, indicating that this coal in that particular area is being worked out.

The No. 2, or Wellston coal, lies above the block (or No. 1) and has its highest development in the southwestern part of the Ohio field. The principal mining operations are at Jackson and Wellston, in Jackson County, whose production in 1912 was 737,284 short tons. This coal also appears to be approaching exhaustion, as in 1892 the production of Jackson County was 1,833,910 tons, and as late as 1906 it amounted to 1,370,000 tons.

Bed No. 5 (Lower Kittanning) is extensive, having been traced from Mahoning County, in the northeastern part of the State, to Lawrence County, at the southwestern extremity of the Ohio field. It is not extensively mined, however, being of workable thickness and quality in but few places. The principal mining operations are in Lawrence County, which had a total production of 66,158 tons in 1912, and part of this was probably from the No. 7 bed.

No. 6 (or Middle Kittanning) yields the justly celebrated Hocking Valley coal mined extensively in Athens, Hocking, and Perry counties. Like the block, it is a free-burning, noncoking coal, chiefly popular as a blast-furnace fuel, for which purpose it is used raw, but it is also highly regarded as a steam and domestic coal. The production of the three counties mentioned was 8,728,867 tons in 1912. In 1892 the same counties produced 4,640,647 tons. A small part of the Athens County production may be credited to the Pittsburgh (No. 8) bed, which is present in the county, and some little of Perry County's output may be from No. 7.

Bed No. 7, the Upper Freeport, mined in Gallia, Guernsey, Lawrence, and Muskingum counties and in portions of Perry County, is a high-grade steam fuel, and except for its content of sulphur, would make an excellent coke. No coke is made from this bed in Ohio, however. The production of the three counties (Gallia, Guernsey, and Muskingum) from this bed in 1912 was 4,804,159 short tons.

No. 8, the Pittsburgh bed, is the most extensive and valuable in North America, underlying considerable portions of Pennsylvania, Maryland, West Virginia, and Ohio. Its area in Ohio probably amounts to over 1,000 square miles and it is extensively mined in Belmont, Jefferson, Harrison, and Noble counties, and to less extent in Athens, Gallia, Guernsey, Meigs, Monroe, and Morgan counties. The production of the first four counties, mostly Pittsburgh coal, in 1912, was 15,678,216 short tons. To this may be added about 500,000 tons mined in the other counties. How the development of this coal has progressed in 20 years is shown by the fact that the four counties which produced over 15,600,000 tons in 1912 produced only 1,973,697 tons in 1892.

The Pomeroy bed, correlated with the Redstone of Pennsylvania, lies a short distance above the Pittsburgh and is worked in Gallia, Lawrence, and Meigs counties, the most of the production of Meigs County being from this bed.

The Meigs Creek coal, 80 to 100 feet above the Pittsburgh bed, is correlated with the Sewickley bed of western Pennsylvania. It is workable in portions of Morgan, Noble, Washington, Muskingum, Harrison, Belmont, and Monroe counties, and will ultimately prove a most valuable reserve, though its variable thickness and lower grade subordinate it to the Pittsburgh, and its exploitation is at present local and generally on a small scale.

The total production of coal in Ohio in 1912, as reported to the Survey[1] was 34,528,727 short tons, valued at $37,083,363, against 30,759,986 tons, valued at $31,810,123, in 1911. The increase in 1912 was 3,768,741 short tons, or 12.25 per cent, in quantity and $5,273,240, or 16.58 per cent, in value. The production in 1912, although notably less than the tonnage estimated for the preliminary statement issued in January, makes the highest record in the history of the State. The largest output previously reported was in 1910, when, on account of the labor troubles in Illinois and Indiana, Ohio coal was in big demand and production increased over 6,250,000 tons, to 34,209,668 tons. This figure was exceeded in 1912 by 319,059 tons, and as the industry in 1912 was not influenced by the abnormal conditions that existed in 1910 and as the increased production over 1911 was attended also by advances in price, coal mining in Ohio may be said to have been fairly satisfactory. Following the suspension of mining, on April 1, the employees secured an advance in wages amounting to between 5¼ and 5½ per cent, which partly accounts for and partly offsets the advance in the price of coal. The agreement on which the wage advance was granted is to be in effect from April 1, 1912, to March 31, 1914.

Of the 27 counties in which commercial coal was produced in 1912, the output increased in 17 and decreased in 10. Belmont County showed the largest gain, with 1,290,203 tons added to the production of 1911. Tuscarawas County showed the greatest percentage of increase and nearly regained its old-time importance; the output increased 647,264 tons, nearly 100 per cent, from 677,330 tons in 1911 to 1,324,594 tons in 1912. Athens County increased its production 527,247 tons; Guernsey County gained 351,273 tons; and Harrison County, 253,686 tons. Four other counties showed an increase of over 100,000 tons each. The decreases, with the exception of a loss of 211,418 tons in Columbiana County, were relatively unimportant.

The chief factors in stimulating Ohio coal production in 1912 were (1) big farm crops and the resultant prosperity in agricultural districts; (2) a general increase in manufacturing, particularly in iron and steel, in which Ohio ranks second among the States; and (3) the labor troubles in the Cabin Creek and Paint Creek districts of West Virginia, which reduced competition with and stimulated the demand for Ohio coals in the Lake trade.

Fewer men were employed in the coal mines of Ohio in 1912 than in 1911, but there was a marked increase in the number of days worked. This, too, in spite of the increased production on the one hand and of the suspension on April 1 on the other. The suspension in Ohio, however, was not so general nor so prolonged as in Illinois and Indiana. Strikes and suspensions resulted altogether in the loss of a total of 895,777 working days, or an average of 32 days for the 27,200 men affected. The number of men employed in the Ohio mines in 1912 was 45,527, who worked an average of 201 days against 46,035 men, for an average of 179 days in 1911. The average production per

[1] The production reported to the State mine inspector was 34,424,951 short tons, or about 100,000 tons less than that reported to the Survey. The difference is probably due to the inclusion in the Survey figures of the output from numerous country banks that hardly rise to the importance of local mines.

employee was 758.4 tons in 1912 against 668 tons in 1911, and the average daily tonnage for each employee was 3.77 tons against 3.73 tons. In 1910 the average daily production per man was 3.61 tons and in 1908 it was 3.44 tons.

Ohio continues to lead in the percentage of coal mined by the use of machines. In 1912, according to the reports to the Survey, out of a total of 34,528,727 short tons, 30,048,831 tons, or 87 per cent, were machine mined, the percentage being about the same as in 1911, when 26,556,630 tons out of a total of 30,759,986 were machine mined. The number of machines reported in use in 1912 was 1,547. Electrically driven chain-breast machines far outnumber all other types of machines in the Ohio mines, 1,362, or nearly 90 per cent of the total number, being chain cutters. The others consisted of 106 short-wall, 2 long-wall, and 77 puncher machines.

Comparatively little of the coal product of Ohio is washed. In 1912 the quantity of coal washed was 336,639 tons, less than 1 per cent of the total. This yielded 305,629 tons of cleaned coal and 31,010 tons of refuse.

According to the United States Bureau of Mines, the fatalities in the coal mines of Ohio numbered 133 in 1912, of which 125 were underground, 4 in shafts, and 4 on the surface. Seventy-two per cent, or 90 in all, of the deaths were due to falls of roof; 6 deaths were due to falls of coal; 18 to haulageway accidents; 6 to premature blasts, etc.; 2 to electric shock; and 3 to other causes. Only 1 death was due to an explosion of gas.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Ohio in 1911 and 1912, by counties, in short tons.

1911.

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	4,137,664	33,074	121,789		4,292,527	$4,655,451	$1.09	144	7,523
Belmont	7,715,763	283,233	93,131		8,092,127	7,441,402	.92	201	9,842
Carroll	223,490	42,577	3,100		269,167	296,331	1.09	205	452
Columbiana	609,865	37,408	12,923		660,196	760,835	1.15	234	1,013
Coshocton	343,092	43,226	4,494		390,812	469,328	1.20	198	725
Guernsey	3,801,642	30,081	63,959		3,895,682	3,579,661	.92	182	4,988
Harrison	534,072	17,830	7,365		559,267	512,187	.92	190	838
Hocking	1,514,973	26,175	34,971		1,576,119	1,664,214	1.06	171	2,343
Holmes	200	10,550	180		10,930	15,346	1.40	227	32
Jackson	560,690	75,317	33,584		669,591	1,185,007	1.77	141	2,043
Jefferson	4,099,181	412,736	175,278	536	4,687,731	4,670,321	.99	194	6,231
Lawrence	26,891	32,011	290		59,192	66,270	1.12	159	168
Mahoning	33,525	17,503	1,720		52,748	81,966	1.55	182	163
Medina	6,225	7,478	484		14,187	23,460	1.65	177	27
Meigs	465,289	42,142	9,414		516,845	582,572	1.13	177	1,134
Muskingum	290,712	84,692	1,042		376,446	391,133	1.04	196	619
Noble	464,041	5,277	2,685		472,003	462,800	.98	210	388
Perry	1,999,356	47,091	40,352		2,086,799	2,168,544	1.04	173	3,117
Stark	291,125	137,770	21,361		450,256	735,156	1.63	209	885
Summit	72,255	5,985	7,339		85,579	148,407	1.73	163	188
Tuscarawas	434,957	227,987	14,386		677,330	701,907	1.04	136	1,904
Vinton	34,675	66,313	3,350		104,338	113,810	1.09	169	264
Wayne	176,041	15,888	17,130		209,059	366,960	1.76	165	480
Other counties [a]	279,010	8,876	12,450		300,336	392,719	1.31	165	668
Small mines		250,719			250,719	324,336	1.29		
Total	28,114,734	1,961,939	682,777	536	30,759,986	31,810,123	1.03	179	46,035

[a] Gallia, Morgan, Portage, and Scioto.

Coal production of Ohio in 1911 and 1912, by counties, in short tons—Continued.

1912.

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	4,660,471	32,183	117,920	9,200	4,819,774	$5,279,234	$1.10	186	6,711
Belmont	8,844,252	444,171	93,907		9,382,330	9,063,554	.97	222	10,253
Carroll	272,377	44,675	5,917		322,969	364,922	1.13	208	495
Columbiana	406,706	34,343	7,729		448,778	538,314	1.20	163	854
Coshocton	315,635	52,277	3,487		371,399	462,454	1.25	198	634
Guernsey	4,140,058	30,412	76,485		4,246,955	4,153,222	.98	203	5,029
Harrison	773,130	28,223	11,600		812,953	801,111	.99	248	871
Hocking	1,688,889	34,409	39,879		1,763,177	2,003,839	1.14	207	2,600
Holmes	530	9,599	128		10,257	13,523	1.32	158	33
Jackson	560,763	145,868	30,653		737,284	1,236,512	1.68	153	1,843
Jefferson	4,341,988	430,958	84,918	665	4,858,529	5,016,305	1.03	216	5,772
Lawrence	24,890	41,268			66,158	74,610	1.13	131	243
Mahoning	18,270	14,482	442		33,194	55,144	1.66	144	149
Medina		6,457	222		6,679	12,013	1.71	186	18
Meigs	597,920	37,225	9,318		644,463	787,322	1.22	181	1,161
Muskingum	395,210	68,830	1,589		465,629	498,643	1.07	198	656
Noble	615,253	6,209	2,942		624,404	585,631	.94	211	635
Perry	2,052,737	45,317	47,862		2,145,916	2,402,799	1.12	177	3,341
Stark	267,547	130,014	16,891		414,452	722,457	1.74	190	836
Summit	69,685	4,391	5,386		79,462	145,152	1.83	185	153
Tuscarawas	1,058,072	238,123	28,399		1,324,594	1,516,645	1.14	213	1,863
Vinton	76,626	17,355	3,957		97,938	111,852	1.14	135	277
Wayne	165,294	14,737	14,005		194,036	372,202	1.92	133	429
Other counties [a]	364,625	9,243	6,930		380,798	520,509	1.37	183	671
Small mines		276,599			276,599	345,394	1.25		
Total	31,710,928	2,197,368	610,566	9,865	34,528,727	37,083,363	1.07	201	45,527

[a] Gallia, Morgan, Portage, Scioto, and Trumbull.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production of Ohio, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Athens	3,967,318	4,131,270	5,593,560	4,292,527	4,819,774	+ 527,247
Belmont	5,593,777	6,061,573	8,265,019	8,092,127	9,382,330	+1,290,203
Carroll	366,748	390,273	313,517	269,167	322,969	+ 53,802
Columbiana	509,045	657,285	715,252	660,196	448,778	− 211,418
Coshocton	364,028	373,981	427,341	390,812	371,399	− 19,413
Gallia	11,450	7,700	9,187	10,805	91,575	+ 80,770
Guernsey	2,939,550	3,085,377	4,686,994	3,895,682	4,246,955	+ 351,273
Harrison	464,676	576,963	560,937	559,267	812,953	+ 253,686
Hocking	1,434,036	1,194,895	1,635,575	1,576,119	1,763,177	+ 187,058
Holmes	15,009	12,886	10,157	10,930	10,257	− 673
Jackson	836,328	784,463	878,656	669,591	737,284	+ 67,693
Jefferson	3,591,016	3,908,118	5,241,681	4,687,731	4,858,529	+ 170,798
Lawrence	171,307	184,940	148,568	59,192	66,158	+ 6,966
Mahoning	67,312	40,904	60,434	52,748	33,194	− 19,554
Medina	11,407	13,017	24,148	14,187	6,679	− 7,508
Meigs	449,969	564,904	599,492	516,845	644,463	+ 127,618
Morgan	268,106	191,391	124,336	174,513	193,745	+ 19,232
Muskingum	430,653	487,179	238,795	376,446	465,629	+ 89,183
Perry	2,146,995	2,133,266	2,283,257	2,086,799	2,145,916	+ 59,117
Portage	89,906	100,497	101,826	109,727	84,903	− 24,824
Stark	501,920	486,272	496,509	450,256	414,452	− 35,804
Summit	98,641	84,872	101,243	85,579	79,462	− 6,117
Trumbull	1,000	620	700		1,035	+ 1,035
Tuscarawas	1,358,129	1,577,303	816,189	677,330	1,324,594	+ 647,264
Vinton	138,545	151,954	86,801	104,338	97,938	− 6,400
Wayne	96,431	101,050	159,138	209,059	194,036	− 15,023
Noble Scioto	208,899	381,327	438,398	477,294	633,944	+ 156,650
Small mines	138,438	255,361	191,958	250,719	276,599	+ 25,880
Total	26,270,639	27,939,641	34,209,668	30,759,986	34,528,727	+3,768,741
Total value	$27,897,704	$27,789,010	$35,932,288	$31,810,123	$37,083,363	+$5.273,240

One of the early reports published by Ohio states that in 1838 there were 119,952 short tons produced in the coal mines of the State. It is probable that some coal was mined in Ohio prior to that date, but there is no record of such production. The United States census of 1840 credited Ohio with an output of 140,536 tons of coal. The census of 1850 did not consider the coal-mining industry, and the next report of coal production in the State was that of the census of 1860, which recorded an output of 1,265,600 short tons.

A statement of the annual production of coal in Ohio from 1838 to the close of 1912 will be found in the following table:

Production of coal in Ohio from 1838 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1838	119,952	1858	1,000,000	1877	5,250,000	1896	12,875,202
1839	125,000	1859	1,060,000	1878	5,500,000	1897	12,196,942
1840	140,536	1860	1,265,600	1879	6,000,000	1898	14,516,867
1841	160,000	1861	1,150,000	1880	6,008,595	1899	16,500,270
1842	225,000	1862	1,200,000	1881	9,240,000	1900	18,988,150
1843	280,000	1863	1,204,581	1882	9,450,000	1901	20,943,807
1844	340,000	1864	1,815,622	1883	8,229,429	1902	23,519,894
1845	390,000	1865	1,536,218	1884	7,640,062	1903	24,838,103
1846	420,000	1866	1,887,424	1885	7,816,179	1904	24,400,220
1847	480,000	1867	2,092,334	1886	8,435,211	1905	25,552,950
1848	540,000	1868	2,475,844	1887	10,300,708	1906	27,731,640
1849	600,000	1869	2,461,986	1888	10,910,951	1907	32,142,419
1850	640,000	1870	2,527,285	1889	9,976,787	1908	26,270,639
1851	670,000	1871	4,000,000	1890	11,494,506	1909	27,939,641
1852	700,000	1872	5,315,294	1891	12,868,683	1910	34,209,668
1853	760,000	1873	4,550,028	1892	13,562,927	1911	30,759,986
1854	800,000	1874	3,267,585	1893	13,253,646	1912	34,528,727
1855	890,000	1875	4,864,259	1894	11,909,856		
1856	930,000	1876	3,500,000	1895	13,355,806	Total.	646,478,019
1857	975,000						

OKLAHOMA.

Total production in 1912, 3,675,418 short tons; spot value, $7,867,331.

The coal areas of Oklahoma belong to the western interior coal field. They lie entirely in the eastern and northeastern part of the State, forming the connection between the Kansas fields on the north and the Arkansas fields on the east. The principal developments are in the southern portion of the field in what was formerly the Choctaw Nation of the Indian Territory and is now included within the counties of Coal, Haskell, Latimer, and Pittsburg. The total area underlain by workable coal is estimated at about 10,000 square miles. The coals, of which there are 10 or more beds, range from a medium-grade to a high-grade bituminous, some of the latter approaching semianthracite. Coking qualities are present in some of the higher grades, but efforts to make coke in the several hundred beehive ovens constructed for that purpose have not been conspicuously successful. Transportation and a considerable portion of the markets for the coals of Oklahoma are furnished by the Missouri, Kansas & Texas, the St. Louis & San Francisco, the Kansas City Southern, and the Rock Island Railway systems.

Diminished production of petroleum and natural gas in the Mid-Continent field is reflected in increased production of coal in Oklahoma in 1912, and by a substantial advance in values. The quantity of coal produced increased from 3,074,242 short tons, valued at $6,291,494, in 1911 to 3,675,418 tons, valued at $7,867,331, in 1912. The record of 1912 exceeded that of the previous maximum output (in 1907) by nearly 33,000 tons. Compared with 1911, it showed a gain of 601,176 short tons, or 19.6 per cent, in quantity and of $1,575,837, or 25 per cent, in value. The average price per ton advanced from $2.05 to $2.14. The year 1912 was the first in a decade to encourage the coal-mine operators of Oklahoma and the other Southwestern States. For 10 years the industry in those States had been kept practically at a standstill, the output of 1911 being just about the average for the decade ended in that year. The production in 1912 exceeded that average by nearly 20 per cent. The only assignable reason for the increased activity in 1912 appears to be, as already stated, the diminution in the supply of natural gas and fuel oil in the markets tributary to Oklahoma coal. Competition with coal from other States, particularly Colorado and New Mexico, continues keen.

The law in Oklahoma which compels the payment for mining on the mine-run basis continues in force, notwithstanding all that has been said against it and despite the efforts of the operators to have it repealed. It encourages the practice of solid shooting and the use of inordinate charges of powder, and produces disproportionate quantities of slack coal, for which it is difficult to find a market. It also increases the hazard of an occupation which is hazardous enough even when every possible precaution is taken to insure safety. Complaints of the high mining rates in Oklahoma as compared with those in competitive States, which have been referred to in previous reports of this series, have not been lessened by the further advance in wages of 5.5 per cent granted after the suspension of mining operations on April 1, 1912. The advance in price in 1912 over 1911 was little, if any, more than the additional cost. Operators claim that the restriction put on production by the high cost of mining reduces the time the miners are able to work, and that their yearly earnings are cut down accordingly. The average working time in Oklahoma and in Arkansas, where conditions are much the same, is much less than the general average in the other coal-mining States. In 1912 the average number of days worked in Oklahoma was 174, the largest number in recent years, except during the boom period in 1907. The general average of working time among the bituminous mines in 1912 was 223 days. The number of men employed in the coal mines of Oklahoma in 1912 was 8,785. In 1911 there were 8,790 men employed for an average of 156 days. The average production per man in 1912 was 418 tons for the year and 2.4 tons for each working day, against 350 tons and 2.24 tons, respectively, in 1911.

The effect of the law previously referred to, which provides that all coal mined in the State shall be paid for on the mine-run basis, is shown in the large proportion of coal shot off the solid, that is, without being previously "mined" either by hand or machine. In 1912, out of a total of 3,675,418 tons produced, 3,175,455 tons, or 86.4 per cent, were shot off the solid. The quantity mined by machines is relatively small, amounting to 259,719 tons, or 7.1 per cent of the total, in 1912.

The death rate in Oklahoma in 1912 was unusually high, due principally to an explosion of gas in the San Bois mine at McCutcheon on March 23, which resulted in the loss of 73 lives. According to the United States Bureau of Mines the total number of fatal accidents was 99, all of them underground. Seventy-seven were due to gas and dust explosions, 11 to mine fires, and 7 to falls of roof and coal. The death rate per thousand was 11.27, and there were 37,125 tons of coal mined for each life lost.

The number of men made idle by strikes and suspensions in 1912 was 860 for an average of 14 days. The total idle time from these causes was equivalent to 0.8 per cent of the time worked.

The statistics of production in 1911 and 1912, by counties, are shown in the following table:

Coal production of Oklahoma in 1911 and 1912, by counties, in short tons.

1911.

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.
Coal	739,586	7,899	31,061	778,546	$1,604,611	$2.06	201	1,706
Haskell and Latimer	642,008	4,504	54,862	701,374	1,290,196	1.84	155	1,755
Le Flore	112,835	2,774	6,859	122,468	182,342	1.49	111	375
Okmulgee	391,811	6,461	9,930	408,202	693,938	1.70	157	1,166
Pittsburg	915,635	19,153	83,954	1,018,742	2,424,763	2.38	140	3,660
Tulsa	20,893	404	125	21,422	46,324	2.16	131	75
Other counties [a]	17,234	2,207	175	19,616	38,729	1.97	172	53
Small mines	....	3,872	....	3,872	10,591	2.74	....	....
Total	2,840,002	47,274	186,966	3,074,242	6,291,494	2.05	156	8,790

1912.

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.
Coal	766,099	13,611	36,445	816,155	$1,805,804	$2.21	222	1,929
Haskell and Latimer	711,596	3,269	51,933	766,798	1,550,562	2.02	152	1,753
Le Flore	138,333	4,445	7,733	150,511	238,360	1.58	163	256
Okmulgee	605,532	12,493	11,964	629,989	1,123,473	1.78	158	1,120
Pittsburg	1,143,969	13,109	77,256	1,234,334	2,992,830	2.42	165	3,524
Tulsa	22,184	17,710	70	39,964	75,934	1.90	179	75
Other counties [b]	28,245	2,511	....	30,756	63,061	2.05	178	128
Small mines	....	6,911	....	6,911	17,307	2.50	....	....
Total	3,415,958	74,059	185,401	3,675,418	7,867,331	2.14	174	8,785

[a] Atoka, Johnston, Rogers, and Wagoner [b] Atoka, Rogers, and Wagoner.

The year 1908 was the first for which it was possible to give the production of Oklahoma (formerly Indian Territory) by counties, it having been organized as a State and admitted into the Union in 1906. The production of coal, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, is shown in the following table:

Coal production of Oklahoma in 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Coal	576,746	658,159	498,658	778,546	816,155	+ 37,609
Haskell and Latimer	674,636	738,806	675,953	701,374	766,798	+ 65,424
Le Flore	187,624	128,376	87,628	122,468	150,511	+ 28,043
Okmulgee	172,934	262,310	227,107	408,202	629,989	+ 221,787
Pittsburg	1,294,936	1,271,109	1,083,243	1,018,742	1,234,334	+ 215,592
Rogers and Wagoner	....	14,556	27,618	18,784	30,126	+ 11,342
Tulsa	39,848	39,834	40,007	21,422	39,964	+ 18,542
Small mines	1,392	6,227	6,012	a 4,704	b 7,541	+ 2,837
Total	2,948,116	3,119,377	2,646,226	3,074,242	3,675,418	+ 601,176
Total value	$5,976,504	$6,253,367	$5,867,947	$6,291,494	$7,867,331	+$1,575,837

a Includes Atoka and Johnston counties. b Includes Atoka County.

The Tenth United States Census (1880) contains the first published record of coal production in Oklahoma (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 (3,675,418 short tons) was mined in 1912, although, as shown in the following table, the industry during the last 10 years has been practically stationary, and has not shown the development and progress exhibited in other States:

Production of coal in Oklahoma from 1880 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	120,947	1889	752,832	1898	1,381,466	1907	3,642,658
1881	150,000	1890	869,229	1899	1,537,427	1908	2,948,116
1882	200,000	1891	1,091,032	1900	1,922,298	1909	3,119,377
1883	350,000	1892	1,192,721	1901	2,421,781	1910	2,646,226
1884	425,000	1893	1,252,110	1902	2,820,666	1911	3,074,242
1885	500,000	1894	969,606	1903	3,517,388	1912	3,675,418
1886	534,580	1895	1,211,185	1904	3,046,539		
1887	685,911	1896	1,366,646	1905	2,924,427	Total	55,308,394
1888	761,986	1897	1,336,380	1906	2,860,200		

OREGON.

Total production in 1912, 41,637 short tons; spot value, $108,276.

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 230 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. Among them are the upper Nehalem field, in Columbia County; the lower Nehalem, in Clatsop and Tillamook counties; the Yaquima field, in Lincoln County; the Eckley and Shasta Costa fields, in Curry County; the Eden field, in Coos County; and the Rogue River Valley field, in Jackson 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 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 small 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, except the best coals of Coos Bay, which are properly regarded as subbituminous. Transportation is confined exclusively to Coos Bay and the Pacific Ocean, and San Francisco is the principal market.

The production of coal in Oregon, never of great importance, has during recent years been materially reduced on account of the large increase in the use of oil for fuel. The quantity of coal mined in 1912 (41, 637 short tons) was less than half that of 1909. Compared with 1911, it showed a decrease of 5,024 short tons, or 10.8 per cent. The value of the output in 1912, however, was a little more than that of 1911, the reason for this being, doubtless, the considerably larger proportion of coal sold locally, for which a better price was obtained than for that shipped to distant points.

The statistics of production in Oregon, with the distribution of the product for consumption during the last five years, are shown in the following table:

Distribution of coal production of Oregon, 1908–1912, 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.
1908	45,375	22,518	18,366	86,259	$236,021	$2.74	249	214
1909	44,236	25,700	17,340	87,276	235,085	2.69	....	235
1910	40,497	13,583	13,453	67,533	235,229	3.48	257	153
1911	22,407	10,216	14,038	46,661	108,033	2.32	179	189
1912	14,361	19,646	7,630	41,637	108,276	2.60	239	222

Coal was first noted in the Coos Bay region about 60 years ago, Prof. J. S. Newberry having reported in 1855 that the coal deposits of Coos Bay had begun to attract attention.

The first cargo was shipped from the Empire Basin, but the discovery of coal near the head of Coos Bay soon transferred the point of production to Newport, which remained the principal mine until within the last decade, since the Beaver Hill mine has been more successfully managed and become the chief producer. The first record of coal production is contained in the census report of 1880, when 43,205 short tons were mined. The production has exceeded 100,000 tons in four years only—1896, 1897, 1904, and 1905—the maximum being obtained in 1904, when it reached 111,540 tons.

The total production to the close of 1912 has amounted to 2,119,758 short tons, as is shown in the following table:

Production of coal in Oregon, 1880–1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	43,205	1889	64,359	1898	58,184	1907	70,981
1881	33,600	1890	61,514	1899	86,888	1908	86,259
1882	35,000	1891	51,826	1900	58,864	1909	87,276
1883	40,000	1892	34,661	1901	69,011	1910	67,533
1884	45,000	1893	41,683	1902	65,648	1911	46,661
1885	50,000	1894	47,521	1903	91,144	1912	41,637
1886	45,000	1895	73,685	1904	111,540		
1887	37,696	1896	101,721	1905	109,641	Total	2,119,758
1888	75,000	1897	107,289	1906	79,731		

PENNSYLVANIA.

Total production in 1912, 246,227,086 short tons; spot value, $346,993,123.

Anthracite.—Total production in 1912, 75,322,855 long tons (equivalent to 84,361,598 short tons); spot value, $177,622,626.

Bituminous.—Total production in 1912, 161,865,488 short tons; spot value, $169,370,497.

The anthracite fields of Pennsylvania lie in the east-central part of the State and constitute the only anthracite areas of any importance in the United States, though small quantities of that grade are mined from locally metamorphosed beds in Colorado and New Mexico and some anthracite is reported as occurring on the slopes of Mount Baker in the State of Washington. The areas in Pennsylvania are in four distinct fields or basins known as the Northern, the Eastern Middle, the Western Middle, and the Southern. They are also divided into three well-known trade regions, the Wyoming, the Lehigh, and the Schuylkill, which in turn are subdivided into 18 local districts (see table in the anthracite section of this chapter). A separate field lying west of the Northern basin and known as the Bernice field, in Sullivan County, yields a semianthracite product which on account of its high percentage of fixed carbon is classed as anthracite by the Second Pennsylvania Geological Survey, and this is included with the anthracite production. The anthracite fields proper comprise an area of 480 square miles in the counties of Carbon, Columbia, Lackawanna, Luzerne, Northumberland, Schuylkill, and Susquehanna. Mining operations are conducted on a large scale in the anthracite region, nearly 90 per cent of the production being from mines that have an annual output of over 200,000 tons. More than half of all the mines have an average production of over 400,000 long tons, and the average production of all the mines in the region is more than 250,000 long tons a year. Only about 1 per cent of the production is from mines producing less than 50,000 tons.

The first anthracite mined in the United States was in the Wyoming region in the last decade of the eighteenth century. In 1807 the first shipment of 55 tons was made to Columbia, and in 1814 22 tons were shipped from Carbondale to Philadelphia. The first shipment from the Lehigh region was in 1820; and systematic production may be said to have had its beginning in that year, when 365 tons (one ton for each day of the year) were sent out of the region. From this small beginning and from this small area in less than 100 years the total production has amounted to over 2,000,000,000 long tons. It is believed by many that in the present yearly production of from 75,000,000 to 80,000,000 long tons, the maximum tonnage is about attained.

The bituminous fields of Pennsylvania underlie the greater part of the western half of the State and comprise a total area of about 14,200 square miles. Coal is, or has been mined in about 30 different counties, but the principal mining activities are confined to 10 counties which contribute about 95 per cent of the total output of the State and about one-third the total production of the United States. The larger developments may be divided into three principal mining districts: (1) The Pittsburgh, embracing Allegheny and Washington counties, in which the Pittsburgh bed furnishes the most of the steam and gas coals for which the district is celebrated (it produced about 35,000,000 tons in 1912); (2) the Connellsville (including the Lower Connellsville, or Klondike), lying in Fayette and Westmoreland counties, in which district the Pittsburgh bed yields the renowned Connellsville coking coal, of which in the two counties alone, nearly 63,000,000 short tons, or approximately 15 per cent of the country's total, were produced in 1912; (3) the Cambria-Clearfield, including the areas in Cambria, Clearfield, Indiana, and Jefferson counties, where the production is chiefly from the Lower Freeport "D" bed, which has a fine development in these counties, but which is worthless over most of the rest of the State. Geologically, the principal bituminous-producing formations are the Allegheny and the Monongahela, formerly known as the "Lower" and the "Upper Productive Coal Measures." The Allegheny has at least seven beds, all of which are workable at some point. They are the Brookville, Clarion, Lower, Middle, and Upper Kittanning, and Lower and Upper Freeport. The Lower Kittanning and the two Freeport beds are the principal producers. The Monongahela formation contains, in addition to the Pittsburgh, four other beds, the Redstone, Sewickley, Uniontown, and Waynesburg, all of which are workable locally. The Pittsburgh bed, on account of its nearly uniform thickness over enormous territory (several thousand square miles), its high grade, its adaptability to the production of coke and gas, and its use as a steam fuel, is the most famous coal bed in America and is probably unequaled in the world.

The combined production of anthracite and bituminous coal in Pennsylvania amounted in 1912 to 246,227,086 short tons, valued at $346,993,123, against 235,025,324 tons, valued at $321,344,344, in 1911. The increase in quantity was 11,201,762 short tons, or 4.8 per cent, and the gain in value, $25,648,779, or 8 per cent. In 1911 the larger percentage of increase in value was due to an increase in the production of anthracite and a decrease in the output of the lower-priced soft coal. In 1912 both anthracite and bituminous values were increased in larger ratio than the increase in tonnage. On account of the suspension of operations on April 1 the production of anthracite in 1912 was less than in 1911 by 5,448,633 long tons in quantity, but the value showed an increase of $2,433,234. The production of bituminous coal, on the other hand, increased 17,304,231 short tons in quantity and $23,215,545 in value. The average value per ton increased for both grades—anthracite from $2.17 to $2.36 per long ton and bituminous coal from $1.01 to $1.05 per short ton. The production of bituminous coal in Pennsylvania in 1912 exceeded that of anthracite by 77,503,890 short tons, or 93 per cent, but the value of the latter exceeded that of the former by $8,252,129.

Pennsylvania's coal production, anthracite and bituminous combined, exceeds that of any other country of the world except Great Britain and Germany, and is closely rivalling the latter. Pennsylvania's production of coal is more than four times that of Austria-Hungary, the fourth coal-producing country of the world; more than five times that of France; more than eight times that of Belgium; and is equal to nearly one-fifth of the total world's production. From 1829 to and including the first year of the present century Pennsylvania contributed over 50 per cent of the total coal production of the United States and still produces between 45 and 50 per cent of the total, but the relative importance of Pennsylvania as a coal producer has steadily declined in recent years. Whereas in 1880 Pennsylvania produced 66 per cent of the total; in 1890 its percentage was 56; in 1900 it was 51; in 1910 it was 46.9; in 1911 it was 47.4; and in 1912 it was 46.1. The smaller percentage in the later years, as compared with the earlier, must not be taken as an indication of any decline in the coal-mining industry of Pennsylvania, for that industry has, particularly in the bituminous districts, kept pace with the manufacturing industries and has increased in considerably larger ratio than the population of the State and of the United States as a whole. The falling off in the relative importance of Pennsylvania has been due to the more rapid increase in the production of other States, notably of West Virginia, Illinois, Alabama, and the Rocky Mountain States.

The following table shows the total production of the United States and of Pennsylvania since 1880, with the percentage of the total tonnage produced by Pennsylvania in each year:

Production of Pennsylvania coal compared with total production of the United States, 1880–1912, 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	1897	200,223,665	107,029,654	53
1881	85,881,030	54,320,018	63	1898	219,976,267	118,547,777	54
1882	103,285,789	57,254,507	55	1899	253,741,192	134,568,180	53
1883	115,212,125	62,488,190	54	1900	269,684,027	137,210,241	51
1884	119,735,051	62,404,488	52	1901	293,299,816	149,777,613	51
1885	110,957,522	62,137,271	56	1902	301,590,439	139,947,962	46
1886	112,743,403	62,857,210	56	1903	357,356,416	177,724,246	49.7
1887	129,975,557	70,372,857	54	1904	351,816,398	171,094,996	49
1888	148,659,402	77,719,624	52	1905	392,722,635	196,073,487	49.9
1889	141,229,514	81,719,059	58	1906	414,157,278	200,575,617	48.4
1890	157,770,963	88,770,814	56	1907	480,363,424	235,747,489	49.1
1891	168,566,668	93,453,921	55	1908	415,842,698	200,448,281	48.2
1892	179,329,071	99,167,080	55	1909	460,814,616	219,037,150	47.5
1893	182,352,774	98,038,267	54	1910	501,596,378	235,006,762	46.9
1894	170,741,526	91,833,584	54	1911	496,371,126	235,025,324	47.4
1895	193,117,530	108,216,565	56	1912	534,466,580	246,227,086	46.1
1896	191,986,357	103,903,534	54				

A somewhat unusual comparison is presented in the statistics covering the labor employed in the anthracite and the bituminous coal mines of Pennsylvania in 1912. Notwithstanding the decrease in the production of anthracite, more men were employed in the anthracite mines in 1912 than in 1911, whereas in the bituminous mines the production showed a material increase with fewer employees. The number of men employed in the anthracite mines in 1912 was 174,030, against 172,585 in 1911. The production decreased from 80,771,488 long tons in 1911 to 75,322,855 tons in 1912. The bituminous workers numbered 165,144 in 1912 and 168,199 in 1911, and the production increased from 144,561,257 tons in 1911 to 161,865,488 tons in 1912. The average number of working days in the anthracite region, however, decreased from 246 in 1911 to 231 in 1912, and in the bituminous mines the average working time increased from 233 days in 1911 to 252 days in 1912. The number of men employed and the average number of days worked both being considered, the total amount of working time in the anthracite and the bituminous regions of Pennsylvania did not materially vary. The working time in the bituminous mines was about 3 per cent more than it was in the anthracite fields, and the production of bituminous coal in the State was nearly double that of anthracite. The average yearly production per man in the anthracite region in 1912 was 485 short tons, and in the bituminous fields, 980 tons. The total number of men employed in the coal mines of Pennsylvania in 1912 was 339,174, against 340,784 in 1911.

In previous reports of this series reference has been made to the rapid increase in the production of bituminous coal, compared with that of anthracite. The increase in the production of anthracite bears an approximate relation to the increase in population. This has been particularly marked during the last two decades, or since the use of anthracite for iron making and in other branches of manufacture has practically disappeared.

Its use is now confined principally to domestic consumption and to the heating of hotels, apartment houses, and large office buildings. The natural sequence is that its increase in production should be regulated by the increase in population. Bituminous production, on the other hand, has owed its gain to the rapid development of the United States as a manufacturing country, and the record of bituminous coal production may be taken as indicating the progress made in manufactures.

The following table shows the average production of Pennsylvania anthracite and of bituminous coal in the United States, by five-year periods, from 1876 to 1910, and for the two years, 1911 and 1912, with the percentage that each bears to the total. It will be observed from this table that the average annual production of anthracite during the last five years of this period (1906 to 1910) was 3.1 times the average yearly production from 1876 to 1880. The production of anthracite in 1911 was something more than double that of the average production from 1886 to 1890. The average annual bituminous tonnage in the five years from 1906 to 1910 was 10.2 times that of the first five years, and the production in 1912 was almost five times that of the average from 1886 to 1890. From 1876 to 1880 anthracite production represented 41.44 per cent of the total, and bituminous coal 58.56 per cent. From 1906 to 1910 the anthracite production averaged 17.85 per cent of the total, and bituminous coal 82.15 per cent. On account of the decreased production of bituminous coal in 1911 and the increase in the output of anthracite, the percentage to the total of the latter showed a slight gain to 18.2 per cent for that year, while the percentage of bituminous production declined to 81.8 per cent of the total. The smaller production of anthracite and the larger output of bituminous coal in 1912 reversed the conditions of the previous year, and the percentage of anthracite to the total production decreased to 15.8 and that of bituminous coal increased to 84.2.

Production of anthracite and bituminous coal since 1876, by averages of five-year periods, in short tons.

Period.	Anthracite.		Bituminous.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.
1876–1880	25,800,169	41.44	36,460,776	58.56
1881–1885	36,198,188	33.74	71,092,930	66.26
1886–1890	43,951,763	31.76	94,446,451	68.24
1891–1895	53,405,187	29.87	125,416,327	70.13
1896–1900	55,625,265	24.49	171,498,143	75.51
1901–1905	66,853,778	19.70	272,503,363	80.30
1906–1910	81,142,214	17.85	373,412,644	82.15
1911	90,464,067	18.2	405,907,059	81.8
1912	84,361,598	15.8	450,104,982	84.2

Anthracite mining began between 1790 and 1800, when a small quantity was produced for local consumption. The year 1820 is, however, usually considered to mark the beginning of the anthracite industry, as in that year 365 long tons were shipped from the anthracite region. To the close of 1912 the total production of anthracite had amounted to 2,102,821,728 long tons, or 2,355,160,335 short tons.

The first records of bituminous-coal production in Pennsylvania are for the year 1840, when 464,826 short tons were mined. The total output of bituminous coal from 1840 to the close of 1912 has amounted to 2,558,163,842 short tons, from which it appears that the total production of anthracite and of bituminous coal in Pennsylvania has been nearly equal. At the close of 1908 the total production of anthracite from the earliest times to the close of that year had exceeded the total bituminous production by approximately 51,000,000 tons. As, however, the production of bituminous coal in the last four years has exceeded that of anthracite by more than 254,500,000 short tons the total production of bituminous coal in Pennsylvania now exceeds that of anthracite by over 200,000,000 tons.

PENNSYLVANIA ANTHRACITE.

The production of anthracite in Pennsylvania in 1912 amounted to 75,322,855 long tons, valued at $177,622,626, a decrease in quantity, as compared with 1911, of 5,448,633 long tons, or 6.7 per cent. Notwithstanding the smaller production, the value exhibited an increase of $2,433,234, or 1.4 per cent. The smaller production in 1912 was due entirely to the suspension of mining operations on April 1, pending the settlement of certain demands by the miners for changes in the agreement under which work had been carried on during the three previous years. The suspension was practically complete during the entire month of April and most of May. The modified agreement was signed on May 20, and operations were resumed at once. The total production for the month was only about 1,500,000 tons, or approximately one-fourth the normal output. A part of the shortage created by the suspension was partly made up by increased activity in March, in anticipation of the shutdown, and also after operations were resumed, particularly in July, August, and October. In three of these months, namely, March, August, and October, "record" outputs were made, the railroad shipments for each of the three months exceeding 6,500,000 tons. The previous high record was in March, 1909, when the shipments amounted to 6,333,000 tons. Notwithstanding the loss of time due to the suspension the average working time was only 15 days less than that of 1911.

Since the settlement by the awards of the Anthracite Coal Strike Commission of the notable strike in the anthracite mines in 1902, comparative peace and prosperity have prevailed throughout the region. The original awards were to continue in force for a period of three years from April 1, 1903, to March 31, 1906. At the expiration of the initial period and after a suspension of work for 45 days, the awards were extended by agreement between the operators and their employees for a second period of three years, or until March 31, 1909; and when this term had expired the awards were again extended, with slight modifications, for a third period of the same length and terminating March 31, 1912. On April 1, 1912, mining operations were suspended until a new agreement was signed on May 20. This agreement provided for an extension of four years, or until March 31, 1916, and granted an advance of 10 per cent in wages and some other changes.

The report of the Anthracite Strike Commission is out of print, and as its findings and the voluntary agreements that followed it are still matters of interest they are reprinted here.

The awards of the Anthracite Commission in settling the strike of 1902 were 11 in number and were as follows:

I. That an increase of 10 per cent over and above the rates paid in the month of April, 1902, be paid to all contract miners for cutting coal, yardage, and other work for which standard rates or allowances existed at that time, from and after November 1, 1902, and during the life of this award; and also to the legal representatives of such contract miners as may have died since November 1, 1902. The amount of increase under the award due for work done between November 1, 1902, and April 1, 1903, to be paid on or before June 1, 1903.

II. That engineers who are employed in hoisting water shall have an increase of 10 per cent on their earnings between November 1, 1902, and April 1, 1903, to be paid on or before June 1, 1903; and a like allowance shall be paid to the legal representatives of such employees as may have died since November 1, 1902; and from and after April 1, 1903, and during the life of the award, they shall have 8-hour shifts, with the same pay which was effective in April, 1902; and where they are now working 8-hour shifts, the 8-hour shifts shall be continued, and these engineers shall have an increase of 10 per cent on the wages which were effective in the several positions in April, 1902.

Hoisting engineers and other engineers and pumpmen, other than those employed in hoisting water, who are employed in positions which are manned continuously, shall have an increase of 10 per cent on their earnings between November 1, 1902, and April 1, 1903, to be paid on or before June 1, 1903; and a like allowance shall be paid to the legal representative of such employees as may have died since November 1, 1902; and from and after April 1, 1903, and during the life of the award, they shall have an increase of 5 per cent on the rates of wages which were effective in the several positions in April, 1902; and in addition they shall be relieved from duty on Sundays, without loss of pay, by a man provided by the employer to relieve them during the hours of the day shift.

That firemen shall have an increase of 10 per cent on their earnings between November 1, 1902, and April 1, 1903, to be paid on or before June 1, 1903; and a like allowance shall be paid to the legal representatives of such employees as may have died since November 1, 1902; and from and after April 1, 1903, and during the life of the award, they shall have 8-hour shifts, with the same wages per day, week, or month as were paid in each position in April, 1902.

That all employees or company men, other than those for whom the commission makes special awards, be paid an increase of 10 per cent on their earnings between November 1, 1902, and April 1, 1903, to be paid on or before June 1, 1903; and a like allowance shall be paid to the legal representative of such employees as may have died since November 1, 1902; and that from and after April 1, 1903, and during the life of this award, they shall be paid on the basis of a 9-hour day, receiving therefor the same wages as were paid in April, 1902, for a 10-hour day. Overtime in excess of 9 hours in any day to be paid at a proportional rate per hour.

III. That during the life of this award the present methods of payment for coal mined shall be adhered to unless changed by mutual agreement.

IV. That any difficulty or disagreement arising under this award, either as to its interpretation or application, or in any way growing out of the relations of the employers and employed, which can not be settled or adjusted by consultation between the superintendent or manager of the mine or mines, and the miner or miners directly interested, or is of a scope too large to be so settled or adjusted, shall be referred to a permanent joint committee, to be called a board of conciliation, to consist of six persons, appointed as hereinafter provided. That is to say, if there shall be a division of the whole region into three districts, in each of which there shall exist an organization representing a majority of the mine workers of such district, one of said board of conciliation shall be appointed by each of said organizations, and three other persons shall be appointed by the operators, the operators in each of said districts appointing one person.

The board of conciliation thus constituted shall take up and consider any question referred to it as aforesaid, hearing both parties to the controversy, and such evidence as may be laid before it by either party; and any award made by a majority of such board of conciliation shall be final and binding on all parties. If, however, the said board is unable to decide any question submitted, or point related thereto, that question or point shall be referred to an umpire, to be appointed, at the request of the said board, by one of the circuit judges of the third judicial circuit of the United States, whose decision shall be final and binding in the premises.

The membership of said board shall at all times be kept complete, either the operators' or miners' organization having the right, at any time when a controversy is not pending, to change their representation thereon.

At all hearings before said board the parties may be represented by such person or persons as they may respectively select.

No suspension of work shall take place, by lockout or strike, pending the adjudication of any matter so taken up for adjustment.

V. That whenever requested by a majority of the contract miners of any colliery, check weighmen or check docking bosses, or both, shall be employed. The wages of said check weighmen and check docking bosses shall be fixed, collected, and paid by the miners in such manner as the said miners shall by a majority vote elect; and when requested by a majority of said miners, the operators shall pay the wages fixed for check weighmen and check docking bosses, out of deductions made proportionately from the earnings of said miners, on such basis as the majority of said miners shall determine.

VI. That mine cars shall be distributed among miners, who are at work, as uniformly and as equitably as possible, and that there shall be no concerted effort on the part of the miners or mine workers of any colliery or collieries to limit the output of the mines or to detract from the quality of the work performed, unless such limitation of output be in conformity to an agreement between an operator or operators and an organization representing a majority of said miners in his or their employ.

VII. That in all cases where miners are paid by the car, the increase awarded to the contract miners is based upon the cars in use, the topping required, and the rates paid per car which were in force on April 1, 1902. Any increase in the size of car, or in the topping required, shall be accompanied by a proportionate increase in the rate paid per car.

VIII. That the following sliding scale of wages shall become effective April 1, 1903, and shall affect all miners and mine workers included in the awards of the commission:

The wages fixed in the awards shall be the basis of, and the minimum under, the sliding scale.

For each increase of 5 cents in the average price of white ash coal of sizes above pea coal, sold at or near New York, between Perth Amboy and Edgewater, and reported to the Bureau of Anthracite Coal Statistics, above $4.50 per ton f. o. b., the employees shall have an increase of 1 per cent in their compensation, which shall continue until a change in the average price of said coal works a reduction or an increase in said additional compensation hereunder; but the rate of compensation shall in no case be less than that fixed in the award. That is, when the price of said coal reaches $4.55 per ton, the compensation will be increased 1 per cent, to continue until the price falls below $4.55 per ton, when the 1 per cent increase will cease, or until the price reaches $4.60 per ton, when an additional 1 per cent will be added, and so on.

These average prices shall be computed monthly, by an accountant or commissioner, named by one of the circuit judges of the third judicial circuit of the United States and paid by the coal operators, such compensation as the appointing judge may fix, which compensation shall be distributed among the operators in proportion to the tonnage of each mine.

In order that the basis may be laid for the successful working of the sliding scale provided herein, it is also adjudged and awarded: That all coal-operating companies file at once with the United States Commissioner of Labor a certified statement of the rates of compensation paid in each occupation known in their companies, as they existed April 1, 1902.

IX. That no person shall be refused employment, or in any way discriminated against, on account of membership or nonmembership in any labor organization; and that there shall be no discrimination against, or interference with, any employee who is not a member of any labor organization by members of such organization.

X. That all contract miners be required to furnish within a reasonable time before each pay day, a statement of the amount of money due from them to their laborers, and such sums shall be deducted from the amount due the contract miner, and paid directly to each laborer by the company. All employees when paid shall be furnished with an itemized statement of account.

XI. That the awards herein made shall continue in force until March 31, 1906; and that any employee, or group of employees, violating any of the provisions thereof shall be subject to reasonable discipline by the employer; and, further, that the violation of any provision of these awards, either by employer or employees, shall not invalidate any of the provisions thereof.

On the termination of the period covered by these awards, on March 31, 1906, there was a suspension of operations during the month of April and a part of the month of May. On May 7, 1906, an agreement was signed between the operators and the miners providing that the "awards shall be extended and shall continue in force for three years from April 1, 1906, namely, until March 31, 1909, with like force and effect as if that had been originally prescribed as its duration," and provided that all men who had not committed violence to person or property should be reemployed after the suspension in their old positions.

The agreement for the second extension was signed on April 29, 1909, with the following additional covenants:

1. The rates which shall be paid for new work shall not be less than the rates paid under the strike commission's award for old work of a similar kind or character.

2. The arrangement and decisions of the conciliation board permitting the collection of dues on company property and the posting of notices thereon shall continue during the life of this agreement.

3. An employee discharged for being a member of a union shall have a right to appeal his case to the conciliation board for final adjustment.

4. Any dispute arising at a colliery under the terms of this agreement must first be taken up with the mine foreman and superintendent by the employee, or committee of employees directly interested, before it can be taken up with the conciliation board for final adjustment.

5. The employers shall issue pay statements designating the name of the company, the name of the employee, the colliery where employed, the half month, the amount of wages, and the class of work performed.

The third extension which carried into effect the awards of the commission for a total period of 13 years (the original awards and the first two extensions were for three years and the third extension was for four years) was as follows:

(*a*) The contract rates and wage scales for all employees shall be increased 10 per cent over and above the contract rates and wage scales established by the Anthracite Coal Strike Commission as effective April 1, 1903. The provisions of the sliding scale are by mutual consent abolished.

(*b*) All contract miners and laborers when working on consideration shall be paid not less than the rate paid company miners and laborers at the mine where the work is being performed.

(*c*) There shall be an equitable division of mine cars as set forth in the award of the Anthracite Coal Strike Commission and the decisions of the conciliation board; and further, the rates paid by any contract miner to his employees shall not be less than the standard rate for that particular class of work.

(*d*) At each mine there shall be a grievance committee consisting of not more than three employees, and such committee shall under the terms of this agreement take up for adjustment with the proper officials of the company all grievances referred to them by employees who have first taken up said grievance with the foreman and failed to effect proper settlement of the same. It is also understood that the member of the board of conciliation elected by the mine workers' organization or his representative may meet with the mine committee and company officials in adjusting disputes. In the event of the mine committee failing to adjust with the company officials any grievance properly referred to them they may refer the grievance to the members of the board of conciliation in their district for adjustment, and in case of their failure to adjust the same they shall refer the grievance to the board of conciliation for final settlement, as provided in the award of the Anthracite Coal Strike Commission and the agreements subsequent thereto, and whatever settlement is made shall date from the time the grievance is raised.

(*e*) Contract miners shall have the right to employ check weighmen and check docking bosses, as provided by the award of the Anthracite Coal Strike Commission and the decisions of the board of conciliation, and when so employed their rights shall be recognized and they shall not be interfered with in the proper performance of their work; provided they do not interfere with the proper operation of the colliery. Check weighmen and check docking bosses shall be elected by contract miners in meeting assembled specifically for that purpose, and for such term as said miners may determine, and the chairman and secretary of said meeting shall certify such election to the mine foreman.

(*f*) For the purpose of facilitating the adjustment of grievances, company officials at each mine shall meet with the grievance committee of employees and prepare a statement setting forth the rates of compensation paid for each item of work April 1, 1902, together with the rates paid under the provisions of this agreement and certify the same to the board of conciliation within 60 days after the date of this agreement.

The principal change made from the commission's awards is the provision in the agreement of 1912 that a grievance committee of not more than three employees should be permitted at each colliery. This clause was inserted in compliance with the desire of the miners who contended that the conciliation board, which for nine years had acted as a tribunal for settling disputes, worked at long range, and it was believed by the miners that many controversies could be adjudicated more promptly through the grievance committees and fewer complaints would be brought before the conciliation board. It is yet too soon to form a conclusive opinion as to the effect of this modification of the awards, but during 1912, after work was resumed, operations were interrupted by numerous strikes, which fortunately were not of long duration and were not accompanied by acts of violence. Nor did they seriously affect the total production. The shortage created by the suspension, estimated from the average monthly shipments during the 10 months of regular work, was about 10,500,000 long tons. The exceptionally mild weather of the winter of 1912–13 and favorable shipping conditions during the season when transportation is frequently interrupted by snow saved the consumers of anthracite coal from a famine in their fuel supply. The agreement of 1912 also provided for an advance of 10 per cent on all wages, over and above those established by the commission for three years from April 1, 1903, and continued by agreement for six more years, and for the abolition of the sliding scale. To meet this advance and to compensate for other increases in expenses the operators advanced the prices of prepared sizes 25 cents a ton. An advance of 25 cents on chestnut coal had been put into effect in 1911, this action having been taken in order to equalize the demand, which for this size had become in excess of the supply.

The circular prices for the several sizes of anthracite at the mines in 1910, 1911, and 1912, which are common to all the region, were as follows:

Circular prices for anthracite at the mines, 1910–1912, per long ton.

Size.	1910	1911	1912
Lump	$3.50	$3.50	$3.50
Steamboat	3.00	3.00	3.00
Broken (furnace)	[a] 3.50	[a] 3.50	[b] 3.50
Egg	[a] 3.75	[a] 3.75	[b] 3.75
Stove	[a] 3.75	[a] 3.75	[b] 4.00
Chestnut	[a] 3.75	[a] 4.00	[b] 4.15
Pea	2.00	2.00	2.50
Buckwheat	1.50	1.50	1.50
Rice	....	[c] .538	[c] .634
Barley	....	[c] .339	[c] .388

[a] Subject to 50 cents reduction in April, 40 cents in May, 30 cents in June, 20 cents in July, and 10 cents in August.
[b] Discounts omitted in April and May, but resumed in June.
[c] Average price received for all coal of these sizes sold by Philadelphia & Reading Coal & Iron Co.

Circular prices for anthracite at New York Harbor ports and at Port Richmond (Philadelphia) in 1911 and 1912 were as follows. In accordance with contracts extending over a period of about 15 years the operators received 65 per cent of the New York prices, and the carriers took 35 per cent.

Circular prices for free-burning, white-ash anthracite f. o. b. New York Harbor ports and Port Richmond in 1911 and 1912, per long ton.

Size.	New York Harbor.		Port Richmond.	
	1911	1912	1911	1912
Broken [a]	$4.75	$5.00	$4.50	$4.75
Egg [a]	5.00	5.25	4.75	5.00
Stove [a]	5.00	5.25	4.75	5.00
Chestnut [a]	5.25	5.50	5.00	5.25
Pea [b]	3.10	3.35	....	....
No. 1, buckwheat	[b] 2.20	2.45	....	....
No. 2, buckwheat	[c] 1.775	[c] 1.95	....	....
No. 3, buckwheat	[c] 1.463	[c] 1.548	....	....

[a] Philadelphia & Reading Coal & Iron Co. circular.
[b] Lehigh Coal & Navigation Co. quotations.
[c] Average prices f. o. b.

Advances on coal for line and city trade, according to the Philadelphia and Reading Coal & Iron Co. circulars, were made only on sizes between egg and buckwheat, as follows: Stove, 25 cents; chestnut, 15 cents; pea, 50 cents.

The average price at the mine for anthracite in 1912, as shown by the returns to the United States Geological Survey, was $2.36 a long ton as compared with $2.17 in 1911, $2.12 in 1910, $2.06 in 1909, and $2.13 in 1908. The previous highest average price for anthracite in recent years was in 1903, when it was $2.28 a long ton.

Of the total production of 75,322,855 long tons in 1912, 65,229,255 long tons or 86.6 per cent were loaded at the mines for shipment to distant points; 2,113,904 tons, or 2.8 per cent, were sold to local trade or used by employees, and 7,979,696 tons, or 10.6 per cent, were consumed in the generation of heat and power at the collieries. Prior to 1907, the quantity of coal consumed at the collieries was included in the production, but no value was placed upon it. In 1907 and 1908 an arbitrary value of 20 cents a ton was given this factor. Since and including 1909 the colliery consumption has been assumed to have the same value as similar coal placed upon the market. When it is apparent from the schedules returned to the Survey that the values reported include only the coal sold, the colliery consumption has been valued at 50 cents a ton. In the earlier days of anthracite mining the colliery consumption consisted of a portion of the product which otherwise would have gone to the culm banks. Nowadays there is a market for almost any grade of anthracite that will burn. No more coal goes to the culm banks except for temporary storage and subsequent recovery by washeries. The old culm banks themselves are contributing their share to the total production, and these unsightly monuments to former waste are rapidly disappearing. Even the waste from the culm-bank washeries is being made to serve a useful purpose, as it is flushed into the mines and partly fills old workings, where it cements together and furnishes supports to the roof when the coal previously left for pillars is removed. This utilization of the waste prevents, too, the injury to farm lands in the valleys, a serious cause of complaint among the farmers when, as in earlier days, the waste from the washeries was spread over their lands in flood seasons.

The recovery from the culm banks and the output of small sizes from freshly mined coal constitute about 40 per cent of the total quantity of anthracite sent to the market. In 1912, out of total shipments amounting to 65,201,253 long tons, 25,690,541 long tons, or 39.4 per cent, consisted of pea and smaller sizes, while the prepared or domestic sizes, including a relatively small quantity of lump or steamboat, made up 60.6 per cent. Of the total of 25,690,541 long tons of small coal, the culm bank washeries contributed 3,155,150 tons, or 12.3 per cent. As noted in the preceding table, the circular prices per long ton at the mines on small sizes in 1911 were for pea, $2; for buckwheat No. 1, $1.50; for buckwheat No. 2, or rice (average price for year), 54 cents; and for buckwheat No. 3, or barley, 34 cents. In 1912 the prices for these grades were, respectively, $2.50, $1.50, 63.4 cents, and 39 cents. In compiling the statistics of production in 1912, the colliery consumption, when not valued by the companies, has been given an arbitrary value of 50 cents a ton, between the value of rice and of barley. It is of interest to note how these prices compare with the cost of production. In 1909, according to a bulletin issued by the Bureau of the Census, the total expenses involved in the mining of anthracite were $139,324,467, divided into salaries and wages, $96,900,963; supplies and materials, $26,697,966; royalties and rentals, $7,980,739; contract work (outside of contract miners), $1,701,514; taxes and sundries, $6,043,285. It will be observed that these expenses do not include any offsetting charges for depreciation or amortization, or for interest on capital invested or borrowed. They are for salaries and mine expenses only. In the same year the production of anthracite amounted to 72,384,249 long tons, so that the cost of mining per ton was $1.93. The average price in that year was $2.06 or 13 cents above actual cost. The mining rates were not changed until the advance of 10 per cent was granted in the agreement of May, 1912, and it may be assumed that the other factors were proportionate, so that until the advance of wages in 1912 the cost per ton of producing anthracite was the same as in 1909, except that as the workings become deeper the expenses are gradually augmented. The circular price on pea coal, which constitutes about 28 per cent of the small sizes, was 6 cents over mining cost in 1911; on buckwheat No. 1, which makes up 34 per cent of the total, it was 44 cents below cost; on buckwheat No. 2 (22 per cent of the total) it was $1.40 below cost; and on buckwheat No. 3 (14 per cent of the total) it was $1.55 below cost.

If the advance of 10 per cent in wages in 1912 were not accompanied by any other increase in expenses, the cost of mining, exclusive of depreciation, amortization, and interest, would be increased to $2.07 a long ton; the circular price for pea coal was 43 cents above cost and the three smaller sizes were, respectively, 57 cents, $1.445, and $1.68 below cost. The average value per ton for all sizes of anthracite in 1912 was $2.36, or 29 cents above mining cost after the wage agreement went into effect. The average value per ton in 1911 was 24 cents above mining cost.

The usual spring reductions were not put into effect on April 1, 1912, owing to the suspension of mining and the apprehended scarcity of fuel. In June, however, when operations were fully resumed, the reduction of 30 cents for that month was made, followed by the 20-cent discount in July and the 10-cent discount in August, circular prices being restored in September.

The policy of allowing these spring discounts was adopted in 1901, and has been generally kept in force since that year. The inducement was offered for the purpose of encouraging consumers to lay in their winter supplies during the summer season, when operations and transportation were not liable to interruption by vicissitudes of the weather. It has resulted in steadier employment to the mine workers, as the collieries are now operated practically as actively in summer as in winter, as shown by the shipments in the normal year of 1911. The average shipments for the 6 months from April to September in that year were 5,736,070 tons; those for the first 3 months and last 3 months of the year averaged 5,924,980 tons. The prosperous condition of the anthracite region during the last 10 years has been due in large part to this cause. The effect upon the working time is exhibited by the fact that in the 10 years preceding 1903, or rather from 1892 to 1901, inclusive (1902, the year of the great strike, being abnormally short in working time), the average number of days worked in the anthracite region ranged from 150 to 198, with a mean average for the 10 years of 179 days; in the 9 years from 1903 to 1912 the average number of working days ranged from 195 (in 1906) to 246 (in 1911), with a mean average for the entire period of 216 days. The average working time in the later period shows an increase of 20.7 per cent over that of the earlier. The advance in wages given by the award of the Anthracite Commission added 10 per cent to the compensation of the mine workers and approximately 5 per cent more was earned through the operation of the sliding scale until it was abolished by the new agreement in 1912, when another flat advance of 10 per cent was granted. It may be readily seen from the foregoing statement that the average yearly earnings in the 9 years from 1903 to 1912 were about 35 per cent more than in the 10 years before the strike and before the policy of allowing the spring and summer discounts was put into force.

In spite of the seven weeks' suspension in April and May the average working time made in 1912 compares favorably even with the unusually high record in 1911 (246 days) and with the mean average for the nine years of which 1912 forms a part. As shown above, the mean average from 1903 to 1912 was 216 days. In 1912 the average working time was 231 days, the unwonted activity before and subsequent to the shutdown having made up in large part the time lost. The influence of the suspension is exhibited in the average tonnage won per man employed. In 1912 the average number of employees in the anthracite region, according to the returns to the Survey, was 174,030. The average output per man for the year was 434 long tons, and for each working day the average production per man was 1.88 tons. These figures compare with 445 tons and 1.94 tons, respectively, in 1910 and with 468 tons and 1.9 tons in 1911. The smaller ratios in the personal equation for 1912 were due to the efficiency lost in getting the collieries into working shape when work was resumed. Under such conditions, even though a full complement of men may be employed, tonnage records are not attained until the mines have been running for two or three weeks. In 1912 the agreement was signed on May 20, and work was resumed as quickly as possible, but the production for the month was less than one-fourth the normal output.

Reports to the Bureau of Mines show that there were 584 fatal accidents in the anthracite mines in 1912, against 710 in 1911 and 601 in 1910. The death rate per 1,000 employees was 3.4, and the number of tons mined for each casualty was 128,977. In 1911 the death rate per 1,000 employees was 4.1 and the quantity of coal mined for each life lost was 113,762 tons. In comparing the accident statistics of 1912 with 1911, the greater number of days worked in 1912 should be considered. In 1912, of the 584 fatalities 476 were under ground, 14 in shafts, and 94 on the surface. Falls of roof were responsible for 165 deaths, and falls of coal other than roof coal killed 72, the total deaths from falls of all kinds being 237, or almost exactly one-half of the underground fatalities. No deaths were due to explosions of gas in 1912.

The statistics of anthracite production during the last six years are presented in the following table:

Statistics of anthracite production, 1907–1912.

Year.	Quantity (long tons).	Value.	Average price per ton.	Average number of men employed.	Average number of days worked.
1907	76,432,421	$163,584,056	$2.14	167,234	220
1908	74,347,102	158,178,849	2.13	174,174	200
1909	72,384,249	149,181,587	2.06	{[a]171,195 {[b]166,801	} 205
1910	75,433,246	160,275,302	2.12	169,497	229
1911	80,771,488	175,189,392	2.17	172,585	246
1912	75,322,855	177,622,626	2.36	174,030	231

[a] State mining department figures. [b] U. S. census figures.

The production, by counties, in 1911 and 1912, with the distribution of the product for consumption, is shown in the following table:

Anthracite production in 1911 and 1912, by counties, in long tons.

1911.

County.	Shipped.	Sold to local trade and employees.	Used at mines for steam and heat.	Total.
Carbon	2,512,675	87,986	346,113	2,946,774
Columbia	918,828	11,165	135,843	1,065,836
Dauphin	651,664	51,525	142,316	845,505
Lackawanna	18,911,259	618,619	1,699,265	21,229,143
Luzerne	26,393,558	772,728	3,076,588	30,242,874
Northumberland	5,467,363	110,699	649,657	6,227,719
Schuylkill	14,427,485	304,026	2,138,081	16,869,592
Sullivan	590,396	7,203	42,963	640,562
Susquehanna	550,969	9,809	48,058	608,836
River dredges	17,400	76,643	604	94,647
Total	70,441,597	2,050,403	8,279,488	80,771,488

1912.

County.	Shipped.	Sold to local trade and employees.	Used at mines for steam and heat.	Total.
Carbon	2,163,896	118,852	285,557	2,568,305
Columbia	936,704	15,684	127,478	1,079,866
Dauphin	625,570	21,594	196,677	843,841
Lackawanna	16,901,030	644,797	1,737,987	19,283,814
Luzerne	24,645,483	822,840	2,821,556	28,289,879
Northumberland	5,238,591	116,320	665,529	6,020,440
Schuylkill	13,676,628	299,802	2,062,077	16,038,507
Sullivan	534,004	7,597	38,072	579,673
Susquehanna and Wayne	479,347	9,594	43,867	532,808
River dredges	28,002	56,824	896	85,722
Total	65,229,255	2,113,904	7,979,696	75,322,855

The following table shows the shipments, by months, during the last five years, as reported by the State bureau of anthracite statistics. The table does not include the shipments from Sullivan County nor the shipments of coal recovered from Susquehanna River:

Monthly shipments of anthracite, 1908–1912, in long tons.

Month.	1908	1909	1910	1911	1912
January	5,618,339	5,183,345	5,306,618	5,904,117	5,763,696
February	4,503,756	4,576,004	5,031,784	5,070,948	5,875,968
March	4,766,158	6,332,474	5,174,166	5,996,894	6,569,687
April	5,987,221	5,891,176	6,224,396	5,804,915	266,625
May	6,088,116	5,063,873	5,679,661	6,317,352	1,429,357
June	5,704,852	4,904,858	5,398,123	6,215,357	6,191,646
July	4,541,506	4,020,765	4,202,059	4,804,065	6,285,153
August	4,599,093	4,198,273	4,996,044	5,531,796	6,576,591
September	5,211,047	4,116,120	4,967,516	5,730,935	5,876,496
October	5,977,497	5,579,759	5,622,095	6,269,179	6,665,321
November	5,839,491	6,027,800	6,071,746	6,193,314	6,165,536
December	5,827,938	5,775,438	6,231,578	6,115,427	5,944,502
Total	64,665,014	61,969,885	64,905,786	69,954,299	63,610,578

The statistics for the last three or four years indicate that the disproportionate increase in the consumption of the smaller and unprofitable sizes has about terminated, and the probability is that the present ratio of the domestic or prepared sizes and the small or steam sizes will remain fairly steady. From 1890 to 1907 there was a marked increase in the output of steam sizes compared with the production of the prepared or domestic sizes, as shown by the fact that in the earlier years the shipments of anthracite represented by the sizes above pea coal were 76.9 per cent of the total and that 23.1 per cent was made up of pea coal and smaller. In 1907 the percentage of the sizes above pea coal had fallen to 58.6 and that of pea coal and smaller had increased to 41.4 per cent. The smallest percentage in the shipments of domestic sizes was in 1909, when these constituted 58.1 per cent of the total, while the steam sizes represented 41.9 per cent. Since 1909 the proportion of the shipments made up from pea coal and smaller has grown steadily less. Inclusive of washery output the percentages of steam sizes in 1910, 1911, and 1912 were respectively 41.5, 40.8, and 39.4, the proportions of domestic sizes increasing correspondingly. Exclusive of washery coal the percentages of shipments of small sizes during the last three years were 38.5 in 1910, 38 in 1911, and 36.5 in 1912. Owing to the suspension in the spring of 1912, the washery shipments showed a relative gain, though the quantity shipped was a little less than in 1911.

A considerable portion of this increase in the consumption of small sizes has been due to the operation of the washeries in recovering the usable fuel from the old culm banks in the anthracite region. The first washery was installed in 1890, and 41,600 long tons of coal thus recovered were shipped in that year. In 1907 this recovery had increased to 4,301,082 tons. About the time that washeries were introduced to recover this small coal from the culm banks they were also installed at the breakers, with the result that the small sizes, instead of being thrown upon the culm banks, were added to the daily production. In the following table the shipments (not production) of anthracite are given for 1890, 1900, 1910, 1911, and 1912, exclusive of the washery product obtained from the old culm banks:

Shipments of anthracite, excluding washery product, by sizes, 1890, 1900, 1910, 1911, and 1912, in long tons.

Year.	Sizes above pea.		Pea and smaller.		Total shipments.
	Quantity.	Percentage.	Quantity.	Percentage.	
1890	28,154,678	76.98	8,419,181	23.02	36,573,859
1900	29,162,459	69.4	12,885,676	30.6	42,048,135
1910	38,387,111	61.5	24,029,332	38.5	62,416,443
1911	41,667,415	62.0	25,585,104	38.0	67,252,519
1912	39,438,732	63.6	22,607,371	36.4	62,046,103

The figures showing the washery product are not absolutely exact, for the reason that a few washeries are operated at the mines, the small sizes of the freshly mined coal being washed to remove the slate, and no separate report of the coal so washed is made by the mining companies. "Washery coal" as here reported is for the most part that which is recovered from the old culm banks.

To illustrate the change in the proportion of domestic and steam sizes since 1890, the following table is appended:

Shipments of anthracite, according to sizes, 1890–1912, 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
1907	39,332,855	58.6	27,776,538	41.4	67,109,393
1908	38,319,325	59.3	26,345,689	40.7	64,665,014
1909	36,437,762	58.1	[a] 26,250,597	41.9	[a] 62,688,359
1910	38,415,323	58.5	[a] 27,297,438	41.5	[a] 65,712,761
1911	41,728,071	59.2	[a] 28,696,126	40.8	[a] 70,424,197
1912	39,538,583	60.6	[a] 25,662,670	39.4	[a] 65,201,253

[a] Exclusive of coal recovered by river dredges.

It should be noted in connection with the division of sizes that pea coal, which was for years a steam coal, is now used extensively for domestic purposes, and though it is impossible to tell what proportion is so used, the fact that it is no longer an exclusively steam size must be taken into consideration in drawing deductions from the figures presented.

To present statistically the comments made on size division, washery production, etc., the following table, showing washery production since 1890, is given:

Shipments of anthracite from washeries and total shipments, 1890–1912, 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
1907	4,301,082	67,109,393	6.41
1908	3,646,250	64,665,014	5.64
1909	3,694,470	62,688,359	5.26
1910	3,296,318	65,712,761	5.02
1911	3,171,678	70,424,197	4.50
1912	3,155,150	65,201,253	4.84

The following table shows the quantities of the different sizes of freshly mined coal and of washery coal shipped in 1911 and 1912:

Shipments, by sizes, from mines and washeries in 1911 and 1912, in long tons.

Size.	1911		1912	
	From mines.	From washeries.	From mines.	From washeries.
Lump and steamboat	530,999		418,601	
Broken	3,632,090		3,754,567	
Egg	8,464,265		8,932,305	2,759
Stove	13,062,956	26	11,825,975	3,425
Chestnut	15,977,105	60,630	14,507,284	93,667
Pea	8,094,408	187,641	6,999,919	206,272
Buckwheat:				
No. 1	9,213,372	623,266	8,115,124	582,460
No. 2 and rice	5,096,850	1,142,284	3,903,276	772,426
No. 3 and barley	2,868,930	1,055,537	3,234,598	1,483,914
Screenings	311,544	102,294	354,454	10,227
Total	67,252,519	3,171,678	62,046,103	3,155,150

As shown in the preceding table, the stove and chestnut sizes are in the greatest demand and make up over 40 per cent of the total shipments. They are essentially domestic sizes, and the relatively large proportion they make of the shipments serves as an index to the conditions governing the anthracite trade. Egg coal finds its way principally to the furnaces of residences, and pea coal is used in the same way to some extent, though it is also used for kitchen ranges and some of it goes with the buckwheat, etc., for use as steam coal. The small sizes come directly into competition with bituminous and sometimes are used mixed with bituminous coal for steam purposes, chiefly in hotels, apartment houses, and office buildings. If egg and chestnut are considered as domestic coals, the shipments of domestic sizes in 1912 aggregated 35,364,481 tons of the 62,045,940 tons of mine coal shipped during the year.

The standard screens used in the preparation of anthracite have the following dimensions:

Standard sizes of anthracite.

Size.	Through—	Over—
Broken or grate	4-inch square	$2\frac{3}{4}$-inch square.
Egg	$2\frac{3}{4}$-inch square	2-inch square.
Stove	2-inch square	$1\frac{3}{8}$-inch square.
Chestnut	$1\frac{3}{8}$-inch square	$\frac{3}{4}$-inch square.
Pea	$\frac{3}{4}$-inch square	$\frac{1}{2}$-inch square.
Buckwheat No. 1	$\frac{1}{2}$-inch square	$\frac{1}{4}$-inch square.
Buckwheat No. 2 or rice	$\frac{1}{4}$-inch square	$\frac{1}{8}$-inch square.
Buckwheat No. 3 or barley	$\frac{1}{8}$-inch square	$\frac{1}{16}$-inch round.

In the following table are presented statements showing the quantity of each size shipped from each county in 1911 and 1912, with the percentage that each size bears to the total shipments:

Quantity of each size of anthracite shipped from each county in 1911 and 1912, in long tons, and percentage of total.

1911.

County.	Lump and steamboat.	Broken.	Egg.	Stove.
Carbon	20,158	173,761	283,119	368,218
Columbia	16,395	6,488	105,783	141,185
Dauphin	....	24,562	47,729	108,862
Lackawanna	21,266	569,848	2,132,722	3,700,818
Luzerne	189,113	1,684,729	3,636,823	5,260,157
Northumberland	18,962	199,949	496,441	1,054,065
Schuylkill	265,105	922,331	1,651,102	2,255,032
Sullivan	....	12,919	54,907	74,780
Susquehanna	....	37,503	55,639	99,865
Total	530,999	3,632,090	8,464,265	13,062,982
Percentage of total	0.75	5.16	12.02	18.55

County.	Chestnut.	Pea.	Buckwheat No. 1.	Buckwheat No. 2 and rice.
Carbon	549,793	338,719	372,147	278,778
Columbia	209,097	121,523	172,920	132,193
Dauphin	93,816	55,040	139,580	141,599
Lackawanna	4,345,345	2,225,293	2,371,171	1,799,528
Luzerne	6,618,953	2,772,594	3,117,826	1,688,735
Northumberland	1,208,915	687,719	1,025,962	641,347
Schuylkill	2,775,099	1,926,524	2,556,601	1,536,952
Sullivan	109,371	75,195	....	....
Susquehanna	127,346	79,442	80,431	20,002
Total	16,037,735	8,282,049	9,836,638	6,239,134
Percentage of total	22.77	11.76	13.97	8.86

County.	Buckwheat No. 3 and barley.	Screenings.	Total.
Carbon	126,828	1,154	2,512,675
Columbia	13,244	....	918,828
Dauphin	38,913	1,563	651,664
Lackawanna	1,729,354	15,914	18,911,259
Luzerne	1,331,623	93,005	26,393,558
Northumberland	128,101	5,902	5,467,363
Schuylkill	505,663	33,076	14,427,485
Sullivan	....	263,224	590,396
Susquehanna	50,741	....	550,969
Total	3,924,467	413,838	70,424,197
Percentage of total	5.57	0.59	100.00

Quantity of each size of anthracite shipped from each county in 1911 and 1912, in long tons, and percentage of total—Continued.

1912.

County.	Lump and steam-boat.	Broken.	Egg.	Stove.
Carbon	12,465	164,130	253,626	300,390
Columbia	20,593	11,547	145,855	149,906
Dauphin		26,688	38,272	132,250
Lackawanna	17,229	578,994	2,230,739	3,212,447
Luzerne	152,717	1,790,303	3,752,474	4,778,433
Northumberland	11,200	228,907	639,230	962,872
Schuylkill	204,397	924,307	1,764,971	2,140,653
Sullivan		11,298	51,946	72,796
Susquehanna		18,393	57,951	79,653
Total	418,601	3,754,567	8,935,064	11,829,400
Percentage of total	0.64	5.76	13.70	18.14

County.	Chestnut.	Pea.	Buck-wheat No. 1.	Buck-wheat No. 2 and rice.
Carbon	425,749	293,306	309,092	292,090
Columbia	210,383	108,780	151,662	121,616
Dauphin	97,202	54,730	121,830	132,583
Lackawanna	3,785,627	1,842,760	2,012,050	929,564
Luzerne	6,026,189	2,463,387	2,722,603	1,208,348
Northumberland	1,154,954	624,010	947,288	550,698
Schuylkill	2,696,948	1,695,045	2,369,046	1,430,942
Sullivan	103,581	68,050		
Susquehanna	100,449	56,171	64,602	25,818
Total	14,601,082	7,206,239	8,698,173	4,691,659
Percentage of total	22.38	11.05	13.33	7.19

County.	Buckwheat No. 3 and barley.	Screenings.	Total.
Carbon	101,447	11,601	2,163,896
Columbia	16,362		936,704
Dauphin	32,820	995	637,370
Lackawanna	[a] 2,247,148	44,472	16,901,030
Luzerne	[b] 1,735,888	18,114	24,648,456
Northumberland	101,954	17,478	5,238,591
Schuylkill	416,669	46,879	13,689,857
Sullivan		226,333	534,004
Susquehanna	76,310		479,347
Total	4,728,598	365,872	65,229,255
Percentage of total	7.25	0.56	100.00

[a] Includes 423,673 tons of "birdseye," a mixture of buckwheat Nos. 2 and 3.
[b] Includes 251,597 tons of birdseye.

Distributed by trade regions the shipments of anthracite in 1912 were as follows:

Shipments from collieries and washeries, by regions and sizes, 1912, in long tons.

	Lehigh region.	Schuylkill region.	Wyoming region.	Total.
Lump	38,159	230,351	150,091	418,601
Broken	513,068	1,024,884	2,205,317	3,743,269
Egg	1,220,610	2,308,107	5,354,401	8,883,118
Stove	1,435,541	3,061,408	7,259,655	11,756,604
Chestnut	1,885,646	3,683,667	8,928,057	14,497,370
Pea	1,079,167	2,179,384	3,879,590	7,138,141
Buckwheat No. 1	1,299,714	3,202,299	4,195,571	8,697,584
Buckwheat No. 2	945,597	1,973,126	1,756,979	4,675,702
Buckwheat No. 3	366,372	486,573	3,865,567	4,718,512
Screenings	16,251	64,161	57,936	138,348
Total	8,800,125	18,213,960	37,653,164	64,667,249

These figures differ slightly, but not materially, from the returns made by the railroads to the bureau of anthracite statistics. Neither statement includes the shipments from Sullivan County.

The following table gives the yearly shipments of anthracite, as reported by the Pennsylvania bureau of anthracite-coal statistics, from the earliest date to the close of 1912, divided according to the three trade regions. These shipments include only coal loaded on cars for line or tide 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, 1820–1912, 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

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1912, in long tons—Continued.

Year.	Schuylkill region.		Lehigh region.		Wyoming region.		Total.
	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.	Percentage.	Quantity.
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	20.49	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	19,699,778
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
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
1907	20,141,288	30.01	8,320,653	12.41	38,638,452	57.58	67,109,393
1908	18,006,464	27.85	7,786,255	12.04	38,872,295	60.11	64,665,014
1909	16,864,147	27.21	7,532,271	12.16	37,573,467	60.63	61,969,885
1910	17,845,020	27.49	8,627,539	13.29	38,433,227	59.22	64,905,786
1911	19,375,369	27.70	9,775,018	13.97	40,803,912	58.33	69,954,299
1912	18,013,406	28.32	8,571,861	13.47	37,025,311	58.21	63,610,578
Total	594,758,510	31.59	291,829,976	15.50	996,372,777	52.91	1,882,961,263

A tabular statement of the several sections of the anthracite fields is given in the following table:

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.
	Western Schuylkill	
	Lorberry	
	Lykens Valley	
Western middle	East Mahanoy	
	West Mahanoy	
	Shamokin	

The anthracite fields are reached by 11 so-called initial railroads, as follows:

Philadelphia & Reading Railway.
Lehigh Valley Railroad.
Central Railroad of New Jersey.
Delaware, Lackawanna & Western Railroad.
Delaware & Hudson Co.'s Railroad.
Pennsylvania Railroad.
Erie Railroad.
New York, Ontario & Western Railway.
Delaware, Susquehanna & Schuylkill Railroad (part of Lehigh Valley system).
New York, Susquehanna & Western Railroad (part of Erie system).
Lehigh & New England Railroad.

PENNSYLVANIA BITUMINOUS COAL.

Total production in 1912, 161,865,488 short tons; spot value, $169,370,497.

The output of bituminous coal in Pennsylvania established a new record in 1912 and exceeded the previous maximum of 1910 by 11,343,964 short tons in quantity and by $16,340,987 in value. A slump in the iron and steel trade during 1911 resulted in a diminished output of coal, the effect in Pennsylvania being exhibited chiefly in the Connellsville coking district. Similarly the revival in the iron and steel industry in 1912 is reflected in an increased production of bituminous coal in Pennsylvania, more than two-thirds of the total increase being in Fayette and Westmoreland counties, which constitute the Connellsville district. The production decreased from 150,521,526 short tons, valued at $153,029,510, in 1910, to 144,561,257 tons, valued at $146,154,952, in 1911, the smaller production being accompanied by a slight decline in price. In 1912 prices were somewhat improved and the production increased to 161,865,488 short tons, valued at $169,370,497. The gain in quantity in 1912 over 1911 was 17,304,231 tons, or nearly 12 per cent, and the increase in value was $23,215,545, or 16 per cent. Production increased generally throughout the State, 18 out of 23 counties showing gains, but, as previously stated, by far the greatest gains were in Fayette and Westmoreland counties. The former showed a gain of 5,756,405 tons and the latter of 6,487,354 tons. These two counties in 1912 had a combined production of 62,956,116 short tons, which exceeded the entire production of Illinois, the third coal-producing State, and was equal to 94 per cent of the production of West Virginia, which ranks next to Pennsylvania as a coal producer. Washington County increased its production 1,301,355 tons, Allegheny County gained 1,003,470 tons, Cambria County increased 656,502 tons, and Somerset County, 710,723 tons. Other changes were relatively unimportant.

The average price per ton for Pennsylvania bituminous coal advanced from $1.01 in 1911 to $1.05 in 1912. The advance was significant principally from the fact that the gain of 4 cents a ton made the average in 1912 the highest price paid for bituminous coal in Pennsylvania during a period of 30 years, with the exception of the strike years, 1902 and 1903, when scarcity of all kinds of fuel inflated values abnormally. The number of men employed in the bituminous coal mines of Pennsylvania in 1912 was 165,144, who worked the unusually high average of 252 days, against 168,199 men for an average of 233 days in 1911. It is to be noted that the phenomenal activity in the Connellsville coking district is shown in Fayette County by an average of 275 days for the 22,776 men employed, and in Westmoreland County by an average of 272 days for the 25,693 men employed. These averages were considerably higher than those of other counties and materially increased the average for the State. The average annual production per man increased from 859 tons in 1911 to 980 tons in 1912, and the average daily production per man from 3.69 to 3.89 tons. The average for the year was exceeded only by West Virginia, and there were only two States in which the daily average was exceeded. The majority of the mines in the bituminous region of Pennsylvania are worked eight hours a day.

The participation of the bituminous coal miners in the wage suspension in April and May, 1912, is exhibited in the idleness of 22,538 men for an average of 24 days. The total amount of idle time was equivalent to about 1.25 per cent of the time worked, and did not affect the production for the year.

No less notable than the increase in production in 1912 was the extension of the use of mining machinery and the larger tonnage of machine-won coal. In 1911 the quantity of coal mined by machines was 69,131,923 short tons, or 47.8 per cent of the total; in 1912 this item amounted to 82,192,042 tons, or 50.8 per cent of the total. The number of machines in use in 1912 was 6,176 against 5,719 in 1911. Punchers constitute about 60 per cent of the total number of machines, 3,660 of all of those in use in 1912 being of that type; something over half as many (2,023 in 1912) were chain-breast. The remainder consisted of 52 long-wall machines, 439 short wall, and 2 radially actuated cutters.

Pennsylvania, like West Virginia, presents a commendable record in the small percentage of bituminous coal improperly mined. Of the total production in 1912, only 4,801,784 short tons, or 3 per cent, were reported as having been "mined by the powder" or shot off the solid. The quantity reported as mined by hand was 54,545,218 tons, which added to the machine-mined tonnage, makes a total of 136,737,260 tons, or 84.5 per cent of the entire production that was undercut, sheared, or otherwise "mined" before being shot or wedged down. The quantity produced in 1912 for which the methods of mining were not reported was 20,326,444 tons, or 12.5 per cent of the total.

Very little of the bituminous coal produced in Pennsylvania is washed before being sold or used in the manufacture of coke. The quantity washed in 1912 was 4,819,330 tons, or 3 per cent of the total. It yielded 4,326,162 tons of cleaned coal and 493,168 tons of refuse.

Statistics compiled by the United States Bureau of Mines show that there were 437 men killed in and about the bituminous coal mines of Pennsylvania in 1912, a decrease of 92 from 1911, when there were 529 fatalities. Of the 437 deaths in 1912, 395 were under ground, 6 in shafts or slopes, and 36 on the surface. The most prolific cause of accident was falls of roof and coal, which claimed 242 victims. Mine cars and locomotives killed 105 men, and electric shock and burns, 17. Only 1 death was due to an explosion of gas, and none occurred as a result of dust explosions. The death rate per thousand was 2.65 against 3.14 in 1911, and the number of tons mined for each life lost was 370,402 against 273,637.

The statistics of production, by counties, with the distribution of the product for consumption in 1911 and 1912, are shown in the following table:

Bituminous-coal production of Pennsylvania in 1911 and 1912, by counties, in short tons.

1911.

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	17,011,945	535,160	313,677	3,013	17,863,795	$18,897,024	$1.06	223	22,504
Armstrong	3,544,645	128,236	125,635	711	3,799,227	3,625,900	.95	240	4,988
Beaver	137,400	63,446	2,710	....	203,556	246,515	1.21	265	357
Bedford	401,165	7,968	13,230	105,807	528,170	546,573	1.03	218	972
Blair	92,594	167,606	6,786	27,062	294,048	336,451	1.14	179	467
Butler	913,669	24,799	18,606	....	957,074	1,006,195	1.05	240	1,342
Cambria	14,348,596	959,172	367,299	1,253,561	16,928,628	17,499,255	1.03	238	21,900
Center	1,116,704	20,848	2,711	....	1,140,263	1,060,519	.93	223	1,712
Clarion	1,023,959	7,496	25,935	....	1,057,390	1,022,323	.97	233	1,816
Clearfield	7,074,270	231,132	211,847	335,177	7,852,426	7,464,258	.95	221	11,685
Clinton	305,833	7,577	1,233	....	314,643	388,703	1.24	202	387
Elk	1,097,515	64,952	20,978	40,411	1,223,856	1,183,395	.97	235	2,013
Fayette	6,423,003	258,941	499,093	19,429,125	26,610,162	26,693,393	1.00	244	22,381
Huntingdon	788,619	5,682	11,898	....	806,199	976,958	1.21	244	1,158
Indiana	8,186,918	48,843	205,585	339,637	8,780,983	8,303,008	.95	247	10,934
Jefferson	4,382,608	53,927	113,069	1,001,212	5,550,816	5,225,641	.94	245	5,397
Lawrence	75,937	3,935	10,279	....	90,151	109,698	1.22	227	166
Mercer	767,103	46,339	45,913	....	859,355	1,015,683	1.18	245	1,333
Somerset	8,847,001	123,603	206,015	802	9,177,421	9,376,554	1.02	248	9,573
Tioga	785,187	34,937	10,206	....	830,330	1,310,187	1.58	162	1,931
Washington	14,069,442	106,393	369,686	798,251	15,343,772	16,155,763	1.05	214	20,433
Westmoreland	15,601,722	528,190	674,913	7,297,370	24,102,195	23,437,522	.97	241	24,555
Other counties[a] and small mines	59,483	183,550	3,764	....	246,797	273,434	1.11	102	195
Total	107,055,318	3,612,732	3,261,068	30,632,139	144,561,257	146,154,952	1.01	233	168,199

[a] Bradford, Cameron, Greene, Lycoming, and McKean.

Bituminous-coal production of Pennsylvania in 1911 and 1912, etc.—Continued.

1912.

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	18,087,903	474,116	305,096	150	18,867,265	$20,528,181	$1.09	249	20,756
Armstrong	3,849,829	126,031	127,329	1,800	4,104,989	4,054,301	.99	216	5,589
Beaver	160,937	82,912	3,616	....	247,465	309,304	1.25	261	392
Bedford	503,985	9,511	16,750	201,231	731,477	795,031	1.09	233	1,067
Blair	274,795	366	8,666	40,509	324,336	378,511	1.17	209	467
Butler	969,075	11,284	20,588	....	1,000,947	1,131,503	1.13	266	1,285
Cambria	14,563,434	1,314,170	407,268	1,300,258	17,585,130	19,200,298	1.09	241	21,356
Center	1,275,221	13,412	2,741	....	1,291,374	1,292,301	1.00	236	1,788
Clarion	1,158,837	13,249	27,236	....	1,199,322	1,223,537	1.02	229	1,629
Clearfield	7,149,021	220,326	234,867	334,123	7,938,337	8,230,763	1.04	233	10,372
Clinton	332,974	11,005	1,475	....	345,454	427,192	1.24	248	393
Elk	1,099,827	11,915	25,344	9,410	1,146,496	1,132,363	.99	245	1,727
Fayette	7,233,920	317,476	588,535	24,226,636	32,366,567	32,595,749	1.01	275	22,776
Huntingdon	811,586	6,087	16,126	1,115	834,914	1,025,646	1.23	254	1,112
Indiana	8,394,140	38,560	317,843	424,384	9,174,927	8,872,019	.97	259	10,992
Jefferson	4,367,620	59,750	109,723	879,443	5,416,536	5,168,998	.95	244	5,940
Lawrence	59,906	3,578	12,339	....	75,823	94,124	1.24	256	127
Mercer	751,772	51,111	43,345	....	846,228	1,052,367	1.24	249	1,284
Somerset	9,549,469	112,170	226,505	....	9,888,144	11,034,445	1.12	257	9,586
Tioga	956,170	29,967	11,650	....	997,787	1,569,289	1.57	218	1,865
Washington	14,972,227	122,573	367,339	1,182,988	16,645,127	18,012,167	1.08	236	18,714
Westmoreland	19,899,766	659,743	770,489	9,259,551	30,589,549	30,971,778	1.01	272	25,693
Other counties [b] and small mines	55,294	161,583	12,497	17,920	247,294	270,630	1.09	220	234
Total	116,477,708	3,850,895	3,657,367	37,879,518	161,865,488	169,370,497	1.05	252	165,144

[b] Cameron, Fulton, Greene, Lycoming, and McKean.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Bituminous-coal production of Pennsylvania, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Allegheny	14,083,843	16,087,010	18,835,336	17,863,795	18,867,265	+ 1,003,470
Armstrong	2,777,486	2,787,508	3,304,915	3,799,227	4,104,989	+ 305,762
Beaver	222,711	224,450	228,226	203,556	247,465	+ 43,909
Bedford	511,014	435,129	716,833	528,170	731,477	+ 203,307
Blair	315,167	410,161	380,870	294,048	324,336	+ 30,288
Butler	802,462	828,043	1,017,809	957,074	1,000,947	+ 43,873
Cambria	14,138,308	15,545,185	16,629,461	16,928,628	17,585,130	+ 656,502
Center	1,086,384	1,239,049	1,293,622	1,140,263	1,291,374	+ 151,111
Clarion	972,785	941,059	1,156,697	1,057,390	1,199,322	+ 141,932
Clearfield	6,247,534	7,573,322	8,463,910	7,852,426	7,938,337	+ 85,911
Clinton	253,958	272,184	310,973	314,643	345,454	+ 30,811
Elk	1,147,209	1,150,675	1,202,323	1,223,856	1,146,496	− 77,360
Fayette	19,474,417	28,866,229	31,097,233	26,610,162	32,366,567	+ 5,756,405
Greene	145,644	137,448	77,321	31,743	35,839	+ 4,096
Huntingdon	598,094	502,823	669,226	806,199	834,914	+ 28,715
Indiana	6,843,179	7,681,205	8,954,366	8,780,983	9,174,927	+ 393,944
Jefferson	4,853,313	4,934,907	5,668,883	5,550,816	5,416,536	− 134,280
Lawrence	142,639	156,749	95,102	90,151	75,823	− 14,328
Lycoming	34,626	28,016	25,725	13,271	7,777	− 5,494
Mercer	724,158	893,880	867,754	859,355	846,228	− 13,127
Somerset	7,404,945	7,902,338	8,837,682	9,177,421	9,888,144	+ 710,723
Tioga	682,099	785,922	1,037,417	830,330	997,787	+ 167,457
Washington	12,118,007	12,982,179	16,638,677	15,343,772	16,645,127	+ 1,301,355
Westmoreland	21,499,292	25,432,320	22,885,404	24,102,195	30,589,549	+ 6,487,354
Small mines	[a] 100,253	[b] 169,000	[b] 125,761	[c] 201,783	[d] 203,678	+ 1,895
Total	117,179,527	137,966,791	150,521,526	144,561,257	161,865,488	+ 17,304,231
Total value	$118,816,303	$130,085,237	$153,029,510	$146,154,952	$169,370,497	+$23,215,545

[a] Includes production of Bradford County.
[b] Includes production of Bradford and Cameron counties.
[c] Includes production of Bradford, Cameron, and McKean counties.
[d] Includes Cameron, Fulton, and McKean counties.

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 showed a production of bituminous coal in the State which amounted to 464,826 short tons. The census of 1860 showed a production of 2,690,786 short tons; that of 1870 showed a production of 7,798,518 short tons. The production for the intervening years, as shown in the table following, has been estimated from the best information obtainable. Since 1871 the records are official.

Production of bituminous coal in Pennsylvania from 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	464,826	1859	2,400,000	1878	15,120,000	1897	54,417,974
1841	475,000	1860	2,690,786	1879	16,240,000	1898	65,165,133
1842	500,000	1861	3,200,000	1880	18,425,163	1899	74,150,175
1843	650,000	1862	4,000,000	1881	22,400,000	1900	79,842,326
1844	675,000	1863	5,000,000	1882	24,640,000	1901	82,305,946
1845	700,000	1864	5,839,000	1883	26,880,000	1902	98,574,367
1846	760,000	1865	6,350,000	1884	28,000,000	1903	103,117,178
1847	399,840	1866	6,800,000	1885	26,000,000	1904	97,938,287
1848	500,000	1867	7,300,000	1886	27,094,501	1905	118,413,637
1849	750,000	1868	7,500,000	1887	31,516,856	1906	129,293,206
1850	1,000,000	1869	6,750,000	1888	33,796,727	1907	150,143,177
1851	1,200,000	1870	7,798,518	1889	36,174,089	1908	117,179,527
1852	1,400,000	1871	9,040,565	1890	42,302,173	1909	137,966,791
1853	1,500,000	1872	11,695,040	1891	42,788,490	1910	150,521,526
1854	1,650,000	1873	13,098,829	1892	46,694,576	1911	144,561,257
1855	1,780,000	1874	12,320,000	1893	44,070,724	1912	161,865,488
1856	1,850,000	1875	11,760,000	1894	39,912,463		
1857	2,000,000	1876	12,880,000	1895	50,217,228	Total	2,558,163,842
1858	2,200,000	1877	14,000,000	1896	49,557,453		

TENNESSEE.

Total production in 1912, 6,473,228 short tons; spot value, $7,379,903.

The Coal Measures of the Appalachian region cross the eastern part of Tennessee in a comparatively narrow belt (from 50 to 70 miles wide) in a northeast-southwest direction. The total area underlain by coal is about 4,400 square miles, and the greater part of the area contains one or more beds of workable thickness and quality. There are three principal basins: (1) The Wartburg, lying north of Emory River and embracing portions of Scott, Anderson, and Morgan counties; it is continuous northward with the Jellico Basin, lying partly in Tennessee and partly in Kentucky; (2) the Walden, a long and narrow basin extending southwestward from Emory River to the Georgia line, and underlying portions of Rhea, Hamilton, and Marion counties; (3) the Sewanee Basin, also long and narrow, to the west of and parallel with the Walden, underlying most of Cumberland County and portions of Bledsoe, Sequatchie, Grundy, and Marion counties. In addition to these the Cumberland Basin of Kentucky extends southward into Claiborne County, Tenn., where it is extensively developed.

All of the coals of Tennessee are bituminous, generally high-grade, and some of them make a good quality of coke. Smithing coal is produced in the southern part of the field.

The production of coal in Tennessee in 1912 showed only an insignificant increase, being 6,473,228 short tons against 6,433,156 tons in 1911. The increase was 40,072 tons, bearing out the statement issued early in January, 1913, that there would be little if any variation in the output in 1912 as compared with that of the preceding year. In sympathy with the general enhancement of values, however, there was a slight advance in the average price of Tennessee coal and the total value increased $170,169, from $7,209,734 to $7,379,903.

The coal mines of Tennessee gave employment to 10,309 men for an average of 234 days in 1912, against 10,703 men for 232 days in 1911. The average production by each man employed in 1912 was 628 tons for the year and 2.68 tons for each working day. Corresponding figures for 1911 were 601 tons and 2.59 tons.

About two-thirds of the total coal production of Tennessee is properly mined, and one-third is shot off the solid without having been undercut or sheared. In 1912 the quantity of coal mined by hand was 2,708,650 short tons, or 41.8 per cent of the total, and 1,201,895 tons, or 18.6 per cent, were mined by the use of machines. The quantity of coal shot off the solid was 2,127,917 tons, or 32.9 per cent of the total. Mines producing about 7 per cent of the entire output of the State did not report mining methods. In 1911 the quantity of coal mined by machines in Tennessee was 914,614 short tons, or 14.2 per cent of the total, indicating an increase of about 30 per cent in this item in 1912, as compared with an increase of less than 1 per cent in the total output. The number of machines employed increased from 179 in 1911 to 227 in 1912, the latter including 154 punchers, 17 chain-breast, 15 long-wall, 39 short-wall, and 2 radialaxe machines. Most of the coal used in the manufacture of coke in Tennessee is washed before being charged into the ovens. In 1912 the quantity of coal made into coke at the mines was 447,413 short tons, which included 390,994 tons of washed coal. The coal before being washed weighed 449,847 tons. The difference between these quantities, which represents the refuse, amounted to 58,853 tons.

The time lost by labor troubles in Tennessee during 1912 amounted to less than 1 per cent of the total time made and, in consequence, was not of sufficient importance to influence the production. Most of the troubles were in Anderson County. The number of men idle was 670, out of a total of 10,309 men employed. The average time lost was 30 days.

The fatalities in the coal mines of Tennessee in 1912, according to the United States Bureau of Mines, totaled 18, of which 17 occurred under ground, and of these 14 were caused by falls of roof and coal. There were no deaths due to explosions of dust or gas. The fatality record of 1912 was a notable improvement over 1911, when 115 men lost their lives, 84 of them by explosions. The death rate per thousand in 1912 was 1.75, against 10.74 in 1911, and the quantity of coal mined for each life lost was 359,624 tons, against 55,940 tons in 1911.

The statistics of production, by counties, during 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Tennessee in 1911 and 1912, by counties, in short tons.

1911.

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	713,849	7,279	14,007		735,135	$793,788	$1.20	221	1,143
Campbell	1,638,806	29,563	35,297		1,703,666	1,991,780	1.17	235	2,918
Claiborne	1,262,137	9,620	15,951		1,287,708	1,277,248	.99	205	1,780
Grundy	242,983	1,175	170	19,712	264,040	287,203	1.09	175	458
Hamilton	289,253	6,543	8,251	61,084	365,131	435,795	1.19	220	637
Marion	504,568	4,315	8,233		517,116	668,136	1.29	262	889
Morgan	352,758	3,756	10,477	91,106	458,097	479,908	1.05	266	813
Overton	73,994	525	1,150		75,669	79,683	1.05	191	121
Scott	116,536	10,296	1,896		128,728	157,799	1.23	240	451
Other counties [a]	556,520	21,483	26,714	290,061	894,778	1,033,766	1.16	255	1,493
Small mines		3,088			3,088	4,628	1.50		
Total	5,751,404	97,643	122,146	461,963	6,433,156	7,209,734	1.12	232	10,703

1912.

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	523,358	7,060	12,049		542,467	$565,782	$1.04	208	798
Campbell	1,706,104	17,511	40,303		1,763,918	2,208,877	1.25	226	2,934
Claiborne	1,226,335	3,529	21,786		1,251,650	1,264,231	1.01	226	1,565
Grundy	249,776	2,691	652	37,470	290,589	314,629	1.08	238	256
Hamilton	310,832	15,122	12,497	57,392	395,843	453,778	1.15	242	667
Marion	621,665	5,129	9,397	14,839	651,030	807,839	1.24	264	924
Morgan	342,053	2,718	8,789	73,696	427,256	425,273	1.00	264	1,035
Overton	55,714	615	1,143		57,472	62,125	1.08	195	122
Rhea	21,998	4,223	7,129	102,334	135,684	159,677	1.18	246	194
Scott	124,824	16,812	3,495		145,131	174,293	1.20	244	415
Other counties [b]	620,120	8,541	20,142	161,682	810,485	939,840	1.16	229	1,399
Small mines		1,703			1,703	3,559	2.09		
Total	5,802,779	85,654	137,382	447,413	6,473,228	7,379,903	1.14	234	10,309

[a] Bledsoe, Cumberland, Fentress, Franklin, Rhea, Roane, Sequatchie, and White.
[b] Bledsoe, Cumberland, Fentress, Roane, Sequatchie, and White.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production of Tennessee, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Anderson	854,197	822,803	808,214	735,135	542,467	− 192,668
Campbell	1,584,543	1,631,339	1,705,537	1,703,666	1,763,918	+ 60,252
Claiborne	1,158,166	1,320,290	1,495,814	1,287,708	1,251,650	− 36,058
Cumberland	22,617	67,606	49,982	28,852	36,165	+ 7,313
Grundy	572,101	422,898	354,398	264,040	290,589	+ 26,549
Hamilton	58,743	217,080	327,392	365,131	395,843	+ 30,712
Marion	392,166	480,067	564,667	517,116	651,030	+ 133,914
Morgan	585,134	469,537	482,313	458,097	427,256	− 30,841
Overton	46,078	50,864	74,035	75,669	57,472	− 18,197
Rhea	173,719	104,128	156,296	147,599	135,684	− 11,915
Roane	162,669	188,016	193,918	180,293	176,360	− 3,933
Scott	128,437	127,376	359,374	128,728	145,131	+ 16,403
White	326,729	316,510	346,206	324,339	364,112	+ 39,773
Other counties and small mines	133,872	140,131	203,234	216,783	235,551	+ 18,768
Total	6,199,171	6,358,645	7,121,380	6,433,156	6,473,228	+ 40,072
Total value	$7,118,499	$6,920,564	$7,925,350	$7,209,734	$7,379,903	+$170,169

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 1870 the production of Tennessee has increased rather regularly, but not so rapidly as that of Alabama. The annual production of the State since 1840 is shown in the following table:

Coal production of Tennessee from 1840 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	558	1859	150,000	1878	375,000	1897	2,888,849
1841	600	1860	165,300	1879	450,000	1898	3,022,896
1842	1,000	1861	150,000	1880	495,131	1899	3,330,659
1843	4,500	1862	140,000	1881	840,000	1900	3,509,562
1844	10,000	1863	100,000	1882	850,000	1901	3,633,290
1845	18,000	1864	100,000	1883	1,000,000	1902	4,382,968
1846	25,000	1865	100,000	1884	1,200,000	1903	4,798,004
1847	30,000	1866	100,000	1885	1,440,957	1904	4,782,211
1848	40,000	1867	110,000	1886	1,714,290	1905	5,766,690
1849	52,000	1868	125,000	1887	1,900,000	1906	6,259,275
1850	60,000	1869	130,000	1888	1,967,297	1907	6,810,243
1851	70,000	1870	133,418	1889	1,925,689	1908	6,199,171
1852	75,000	1871	180,000	1890	2,169,585	1909	6,358,645
1853	85,000	1872	224,000	1891	2,413,678	1910	7,121,380
1854	90,000	1873	350,000	1892	2,092,064	1911	6,433,156
1855	100,000	1874	350,000	1893	1,902,258	1912	6,473,228
1856	115,000	1875	360,000	1894	2,180,879		
1857	125,000	1876	550,000	1895	2,535,644	Total..	116,890,181
1858	135,000	1877	450,000	1896	2,663,106		

TEXAS.

Total production in 1912, 2,188,612 short tons; spot value, $3,655,744.

The coals of Texas occur in three of the geologic systems—the Carboniferous, the Cretaceous, and the Tertiary. The Carboniferous coals are found in the north-central part of the State and belong to the southwestern region. The area in Texas is about 250 miles long, with an average width of about 45 miles, and contains approximately 11,000 square miles. The productive portion is much more limited, however, and is confined to the central part of the field. The principal mining operations are in Eastland, Palo Pinto, Erath, Wise, and Young counties. Small quantities have been mined in Bowie, Coleman, and McCulloch counties. The Cretaceous coals occur in the southern part of the State and are mined near Eagle Pass, in Maverick County. These are also classed as bituminous coals. 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 is changed into a higher grade of coal, and the Webb County production is classed as bituminous. Lignite mining operations have been carried on in Anderson, Bastrop, Fayette, Hopkins, Houston, Lee, Leon, Medina, Milam, Rains, Robertson, Shelby, Titus, Van Zandt, and Wood counties. The principal operations are in Wood, Milam, Leon, Bastrop, Houston, Hopkins, and Medina counties. The development of the lignite resources of Texas began in the last decade of the last century. A temporary setback was experienced following the discovery of petroleum near Beaumont, in 1901, but with the falling off in the production of and higher prices for fuel oil a few years later interest in lignite mining was revived. The development of the gas producer, in which lignite is found to serve excellently, is giving a further impetus to production. The output of lignite in 1912 reached nearly 1,000,000 tons. The total production of coal and lignite in Texas in 1912 was 2,188,612 tons, valued at $3,655,744. This was the maximum output ever attained both in tonnage and value, and 1912 was the first year that the production amounted to as much as 2,000,000 tons. Compared with 1911, it shows an increase of 214,019 short tons, or 10.8 per cent, in quantity, and of $382,456, or 11.7 per cent, in value. The bituminous production in 1912 was 1,197,907 tons, valued at $2,774,956, and the lignite was 990,705 tons, valued at $880,788. Over two-thirds of the bituminous production, or 737,988 tons, was from Eastland and Erath counties, and more than one-third of the lignite production, 338,166 tons, was from Wood County.

The number of men employed in the coal and lignite mines of Texas in 1912 was 5,127, who worked an average of 230 days, as against 5,353 men for an average of 226 days in 1911. The number of men employed in the bituminous mines decreased from 4,037 in 1911 to 3,518 in 1912, but the number of working days increased from 230 to 248. The number employed in the lignite mines increased from 1,316 to 1,609, but the average number of days decreased from 212 to 191. The average production per man was 340.5 tons for the year and 1.37 tons per day in the bituminous mines (against 268.5 tons and 1.17 tons, respectively, in 1911), and 615.7 tons for the year and 3.22 tons per day in the lignite mines (against 676.8 tons and 3.19 tons in 1911). The general average production per man was 424 tons for the year and 1.84 tons per day in 1912, against 369 tons and 1.63 tons, respectively, in 1911.

The quantity of coal mined by machines in Texas is relatively small and is confined to the bituminous mines. In 1912 the machine-mined production was 105,400 tons, or 4.8 per cent of the total, compared with 71,085 tons, or 3.6 per cent of the total, in 1911. Washing plants have been constructed in the Eagle Pass district, and the quality of the marketed output has been materially improved. In 1912, 25,599 tons were put through the washers, yielding 20,639 tons of cleaned coal and 4,960 tons of refuse. None of the lignite is washed.

The coal mines of Texas were practically free from labor troubles in 1912. Four instances of idleness from that cause were reported, the longest being 10 days. The average time lost by the 238 men affected was 7 days.

As a usual thing the bituminous mines are worked 8 hours a day and the lignite mines 10 hours. According to statistics collected by the United States Bureau of Mines there were no fatal accidents underground in the coal or lignite mines of Texas in 1912, though 1 man was killed in a shaft and 1 on the surface. The death rate was the lowest in the country, with the exception of North Dakota where there were no fatalities in 1911, being less than 0.4 per 1,000, and the quantity of coal mined for each life lost exceeded 1,000,000 tons.

The statistics of production, by counties, in 1911 and 1912, 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 of the lignite producing counties, respectively, is combined.

Coal production of Texas in 1911 and 1912, in short tons.

1911.

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:								
Eastland								
Erath								
Maverick								
Palo Pinto	1,007,695	48,012	28,245	1,083,952	$2,491,361	$2.30	230	4,037
Webb								
Wise								
Young								
Lignite:								
Bastrop								
Hopkins								
Houston								
Lee								
Leon								
Medina	870,206	8,900	11,535	890,641	781,927	.88	212	1,316
Milam								
Rains								
Robertson								
Titus								
Van Zandt								
Wood								
Total	1,877,901	56,912	39,780	1,974,593	3,273,288	1.66	226	5,353

1912.

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:								
Eastland								
Erath								
Maverick								
Palo Pinto	1,153,231	8,688	35,988	1,197,907	$2,774,956	$2.31	248	3,518
Webb								
Wise								
Young								
Lignite:								
Bastrop								
Fayette								
Hopkins								
Houston								
Lee								
Leon	931,023	33,072	26,610	990,705	880,788	.89	191	1,609
Medina								
Milam								
Robertson								
Titus								
Wood								
Total	2,084,254	41,760	62,598	2,188,612	3,655,744	1.67	230	5,127

The first reported production of coal in Texas is contained in the volume Mineral Resources of the United States for 1884. The production reported to the United States Geological Survey for that year was 125,000 tons. The growth of the industry from that date to the close of 1912 is shown in the following table:

Coal production of Texas from 1884 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	125,000	1892	245,690	1900	968,373	1908	1,895,377
1885	100,000	1893	302,206	1901	1,107,953	1909	1,824,440
1886	100,000	1894	420,848	1902	901,912	1910	1,892,176
1887	75,000	1895	484,959	1903	926,759	1911	1,974,593
1888	90,000	1896	544,015	1904	1,195,944	1912	2,188,612
1889	128,216	1897	639,341	1905	1,200,684		
1890	184,440	1898	686,734	1906	1,312,873	Total	24,220,146
1891	172,100	1899	883,832	1907	1,648,069		

UTAH.

Total production in 1912, 3,016,149 short tons; spot value, $5,046,451.

The coal fields of Utah are important and widely distributed over the State. The areas known to contain workable beds of coal aggregate about 13,130 square miles, in addition to which there are about 2,000 square miles less known but which may contain workable coal. The largest and commercially the most important coal field in Utah is that of the great Uinta Basin, which lies parallel with and along the southern side of the Uinta Mountains. The field extends from Crested Butte about one-third of the way across Colorado on the east, to the western part of Carbon and Emery counties in Utah on the west. In Utah this basin underlies a large portion of Uinta, Wasatch, and Carbon counties, its southern border being in Grand, Emery, and Sevier counties. The coal-bearing rocks are exposed along the northern rim of the basin, but this portion of the area is far removed from transportation and has been little developed. The most important coal field is on the southern rim of the basin in the Book Cliffs of western Colorado and eastern Utah. For this reason the productive area in Utah is generally known as the Book Cliffs field. The principal mining operations are carried on in Carbon County, at Castle Gate, Sunnyside, Clear Creek, Winter Quarters, Black Hawk, Hiawatha, Kenilworth, and Pleasant Valley, more than 85 per cent of the total production of the State (2,684,731 tons in 1912) being from Carbon County. The output of Emery and Grand counties (212,818 tons in 1912) is from the same field, and if this be added to the Carbon County production the percentage of Utah's output from this area is approximately 97 per cent. A large field in the southern part of the State underlies considerable portions of Garfield, Kane, and Iron counties, and a small section in the eastern part of Washington County. This area has not been developed on a commercial scale, as it is not at present reached by any railroad and has been opened only for small local consumption. A small area in Summit County, in the northern part of the State, known as the Weber field, although only a few miles in extent in Utah, has been commercially developed, as it is convenient to the markets of Ogden and Salt Lake City. Summit County's production exceeds 100,000 tons annually, having been 122,139 short tons in 1911 and falling off to 107,857 tons in 1912. There are several other amall areas in Sanpete, Sevier, and Wayne counties. An insignificant amount of coal has been mined in Sanpete County, but the other areas are practically untouched.

The coal production of Utah reached a total exceeding 3,000,000 tons for the first time in 1912. The increase in 1912 over 1911 was 502,974 short tons, or 20 per cent, the totals for the two years being 3,016,149 and 2,513,175 tons. The value gained slightly less in proportion, from $4,248,666 to $5,046,451, an increase of $797,785, or 18.8 per cent. The increased production in 1912 is attributed to activity among the metalliferous mines and related industries and to generally prosperous conditions throughout the State. The increased consumption of fuel oil in some of the territory reached by Utah coal, particularly in California and western Nevada, has taken away some of the markets, but this has been made up by the demand from other consumers. Requirements from the transportation companies have been an important factor, and to this has been added extensive improvements by the Denver & Rio Grande Railroad, over which most of the product is shipped, including additional equipment which will materially reduce complaints of car shortage and other inadequate facilities. Operators reported a scarcity of labor in 1912 due to the exodus of foreign miners to the Balkan war, but the returns to the Survey show an increase of 10 per cent in the number of mine workers in 1912 over 1911.

The total number of men employed in 1912 was 3,328, against 3,060 during 1911. The average working time increased from 236 days to 285 days.

Although by far the larger part of Utah's production is mined by hand and a relatively small quantity is undercut by machines, the efficiency record of the miners averages with the highest among the States. In 1912 the average production per each man employed was 906 tons, with a daily average record of 3.18 tons. In 1911 the yearly average per man was 821 and the daily average 3.48, the statistics for 1912 showing that of the total output of 3,016,149 short tons, 2,805,498 tons, or 93 per cent, were mined by hand. The machine-mined product amounted to 114,716, or 3.8 per cent of the total, and the quantity of coal shot off the solid was only 91,992 tons, or 3 per cent of the total.

There were no strikes or other labor troubles reported in the mines of Utah during 1912. In 1911 there was only one instance of dissatisfaction and in that case the miners were idle for but three days. Practically all of the mines in the State are worked 8 hours a day.

The reports to the United States Bureau of Mines showed that the number of fatal accidents in the coal mines of Utah in 1912 were 18, an increase of 4 over 1911. Of the 18 fatalities, 16 occurred underground and 2 on the surface. More than 60 per cent of the deaths underground, or 11 in all, were due to falls of coal, 2 to falls of roof, and each of the remaining 5 fatalities was due to miscellaneous causes. There were no deaths due to explosions of gas or dust. The death rate per thousand was 5.4, and the quantity of coal mined for each life lost was 167,064 tons, the corresponding figures for 1911 being 4.58 per thousand and 179,513 tons mined.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are as follows:

Coal production of Utah in 1911 and 1912, by counties, in short tons.

1911.

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	1,788,791	10,409	83,142	381,696	2,264,038	$3,780,638	$1.67	241	2,566
Emery and Sanpete	109,102	8,274	2,880	....	120,256	250,741	2.09	186	255
Summit	106,999	2,372	12,768	....	122,139	200,740	1.64	232	222
Uinta	....	4,089	....	....	4,089	11,263	2.75	205	17
Small mines	....	2,653	....	....	2,653	5,284	1.99	......	......
Total	2,004,892	27,797	98,790	381,696	2,513,175	4,248,666	1.69	236	3,060

1912.

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	2,232,803	15,536	91,666	344,726	2,684,731	$4,429,857	$1.65	290	2,936
Emery and Grand	201,434	8,021	3,363	....	212,818	425,547	2.00	278	201
Summit	94,276	2,309	11,272	....	107,857	164,267	1.52	211	175
Uinta	....	6,700	100	....	6,800	17,560	2.58	208	16
Small mines	....	3,943	....	....	3,943	9,220	2.34	......	......
Total	2,528,513	36,509	106,401	344,726	3,016,149	5,046,451	1.67	285	3,328

The production by counties during the last five years, with increase and decrease in 1912 as compared with 1911, has been as follows:

Coal production of Utah, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Carbon	1,719,835	2,125,789	2,311,749	2,264,038	2,684,731	+ 420,693
Emery	3,725	1,690	40,657	a 120,256	b 212,818	+ 92,562
Morgan, Sanpete	4,500	2,000	....	....	....	....
Summit, Uinta	116,534	134,838	163,193	126,228	114,657	− 11,571
Small mines	2,198	2,582	2,210	2,653	3,943	+ 1,290
Total	1,846,792	2,266,899	2,517,809	2,513,175	3,016,149	+ 502,974
Total value	$3,119,338	$3,751,810	$4,224,556	$4,248,666	$5,046,451	+$797,785

a Includes Sanpete County. b Includes Grand County.

The Ninth United States Census recorded the first production of coal in Utah with an output of 5,800 tons. Ten years later the production amounted to less than 15,000 tons. It assumed some importance in 1882, when the production amounted to 100,000 tons and reached the million-ton mark in 1900. In 1909 it exceeded 2,000,000 tons.

The annual production since 1870 has been as follows:

Annual production of coal in Utah, 1870–1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1870	5,800	1882	100,000	1894	431,550	1906	1,772,551
1871	.....	1883	200,000	1895	471,836	1907	1,947,607
1872	.....	1884	200,000	1896	418,627	1908	1,846,792
1873	.....	1885	213,120	1897	521,560	1909	2,266,899
1874	.....	1886	200,000	1898	593,709	1910	2,517,809
1875	.....	1887	180,021	1899	786,049	1911	2,513,175
1876	50,400	1888	258,961	1900	1,147,027	1912	3,016,149
1877	50,400	1889	236,651	1901	1,322,614		
1878	67,200	1890	318,159	1902	1,574,521	Total.	30,998,006
1879	50,000	1891	371,045	1903	1,681,409		
1880	14,748	1892	361,013	1904	1,493,027		
1881	52,000	1893	413,205	1905	1,332,372		

VIRGINIA.

Total production in 1912, 7,846,638; spot value, $7,518,576.

The coal areas of Virginia which have produced or are producing coal belong to (1) the Atlantic coast region, which includes the Richmond Basin covering portions of Henrico, Chesterfield, Powhatan, Goochland, and Amelia counties, and a small area in Prince Edward, Cumberland, and Buckingham counties; (2) the Appalachian region which includes a number of separate areas extending across the western part of the State from Frederick County on the north to the Tennessee line on the south. The Richmond Basin is the only area of free-burning coal located immediately adjacent to the Atlantic seaboard. The first coal mined in the United States was from this area, mines having been opened and worked as early as 1750. The coal areas of the Appalachian region in Virginia include a portion of the Pocahontas or Flat Top, and the Big Stone Gap or Clinch Valley, fields of Tazewell, Russell, Wise, Lee, Scott, Dickenson, and Buchanan counties. It also embraces small scattered areas in Frederick, Augusta, Botetourt, Bland, and Wythe counties, which are nonproductive at present, and two areas in Montgomery and Pulaski counties. Coal mining in the last two counties was carried on to a limited extent prior to the Civil War. During the period that the zinc smelter at Bertha was in operation (the smelter was abandoned in 1911) the coal mines of Pulaski County were worked by the smelter company for its own fuel. The production at the present time amounts to between 25,000 and 40,000 tons a year. The Montgomery County production is for relatively local consumption, though a considerable amount of development work has been done by the Virginia Anthracite Coal Co.

Coal mining on an extensive scale in southwestern Virginia began with the completion of the New River division of the Norfolk & Western Railway in 1883, which opened up the Pocahontas coal field. Ten years later the completion of the Clinch Valley branch of the same line permitted the development of the Wise County coal field. There were no other new developments in Virginia until 1905 when with the construction of the Virginia & Southwestern Railway from Bristol to Pennington Gap and Appalachia the Black Mountain district of Lee County was made available. The first shipments were made from this district in 1907. Lee County is now producing at the rate of 750,000 tons a year. The latest field to be developed is in Russell County, opened up by the completion in 1908 of the Carolina, Clinchfield & Ohio Railway from Dante, Va., to Spartanburg, S. C. Russell County's production has increased from about 220,000 tons in 1908 to over 1,200,000 tons in 1912.

During the last four years new life has been introduced into the Richmond Basin areas by the reopening of the old Gayton mines in Henrico County. For many years after the opening up of the southwest Virginia and the southern West Virginia coals the mines of the Richmond Basin lay idle or were worked only for a restricted local market. A considerable tonnage was reported for each of the last two years.

Virginia recorded a notable increase in coal production in 1912 with a total output of 7,846,638 short tons for the year, valued at $7,518,578. This showed a gain of nearly 1,000,000 tons in quantity over 1911 and of over $1,250,000 in value, the exact figures of increase being 981,971 tons, or 14.3 per cent, and of $1,263,772, or 20 per cent. Over 75 per cent of the total increase was made in Wise County, whose production in 1912 amounted to 4,500,174 short tons, against 3,754,360 tons in 1911, a gain of 745,814 tons or nearly 20 per cent. Russell County's production increased about 16 per cent and smaller gains were made in Lee, Tazewell, Montgomery, and Henrico counties.

In the report for 1911 mention was made of the unfavorable comparison Virginia makes with the other States of the Appalachian Province in the quantity and percentage of coal shot off the solid. This was accentuated by the record made in 1912 when out of a total of 7,846,638 short tons, 3,741,533 tons, or 47.7 per cent were "mined" by the powder. In 1911 the percentage shot off the solid was 35.6. There was, however, an increase also in the quantity and percentage of coal mined by machines in 1912. The number of machines reported in use increased from 156 in 1911 to 185 in 1912, and the machine-mined product increased from 2,551,627 tons, or 37.1 per cent of the total, to 3,205,504 tons, or 40.8 per cent. Chain-breast and short-wall machines are in the ascendency, there being 128 of the former and 51 of the latter in use in Virginia during 1912. One long-wall and 5 puncher machines completed the equipment. The quantity of coal mined by hand in 1912 was less than half of that in 1911, the figures for 1911 being 1,865,320 tons and 898,821 tons for 1912.

In the quantity of coal produced for each man employed Virginia stands relatively high. In 1912 there were 8,678 men employed for an average of 251 days, against 7,392 men for an average of 261 days in 1911. The average production per man was 904 tons in 1912 and 929 tons in 1911, the lower tonnage rate in 1912 being due to the fewer days worked. The average daily tonnage per man was nearly the same in both years, 3.56 tons in 1911 and 3.6 tons in 1912. Most of the coal mines in Virginia operated 10 hours a day. No labor troubles of any kind were reported in either 1911 or 1912.

There are 3 coal washing plants in the State, one each at Gayton, in Henrico County, at the Parrott mine, in Pulaski County, and at Darby, in Lee County. The total quantity of coal washed in 1912 was 60,640 tons, yielding 56,925 tons of cleaned coal and 3,715 tons of refuse.

As the percentage of coal shot off the solid in Virginia is high, so is the death rate. In 1912 there were 75 fatal accidents, of which 67 were underground and 8 on the surface. Half of the deaths (33) inside the mines were due to falls of roof, 10 to explosions or burns of gas, 10 to premature blasts or similar accidents, and 9 to mine cars and locomotives. The death rate per thousand was 8.6 and the quantity of coal mined for each fatality was 104,622. In 1911 the corresponding record was 9.2 per thousand and 100,951 tons. This is about the highest death rate and the lowest tonnage per fatality in the United States.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Virginia in 1911 and 1912, in short tons.

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.
1911.									
Lee	667,611	5,656	21,830	25,598	720,695	$724,498	$1.01	250	776
Tazewell	1,027,786	25,682	38,389	189,367	1,281,224	1,209,138	.94	210	1,352
Wise	2,470,449	39,769	89,343	1,154,799	3,754,360	3,301,984	.88	274	3,582
Other counties [a] and small mines	1,065,048	11,242	32,098	....	1,108,388	1,019,184	.92	279	1,682
Total	5,230,894	82,349	181,660	1,369,764	6,864,667	6,254,804	.91	261	7,392
1912.									
Lee	718,570	5,245	15,725	11,736	751,276	$875,092	$1.16	269	1,081
Tazewell	1,057,788	26,369	36,805	181,081	1,302,043	1,318,762	1.01	203	1,367
Wise	3,008,443	65,277	90,872	1,335,582	4,500,174	4,094,905	.91	261	4,451
Other counties [a] and small mines	1,242,911	10,766	39,468	....	1,293,145	1,229,817	.95	252	1,779
Total	6,027,712	107,657	182,870	1,528,399	7,846,638	7,518,576	.96	251	8,678

[a] Henrico, Montgomery, Pulaski, and Russell.

The statistics of production, by counties, for the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production of Virginia, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−) 1912.
Lee	....	....	797,096	720,695	751,276	+ 30,581
Tazewell	980,014	975,665	1,187,146	1,281,224	1,302,043	+ 20,819
Wise	2,558,874	2,841,448	3,730,992	3,754,360	4,500,174	+ 745,814
Russell	[a] 719,954	[a] 931,276	[b] 790,066	[b] 1,107,056	[b] 1,292,365	+ 185,309
Small mines	200	3,828	2,697	1,332	780	− 552
Total	4,259,042	4,752,217	6,507,997	6,864,667	7,846,638	+ 981,971
Total value	$3,868,524	$4,251,056	$5,877,486	$6,254,804	$7,518,576	+$1,263,772

[a] Includes Lee, Montgomery, and Pulaski counties.
[b] Includes Henrico, Montgomery, and Pulaski counties.

To Virginia belongs the distinction of having produced the first bituminous coal mined in the United States. This initial output, however, was not from that portion of the State which now gives Virginia some prominence as a producer of coal, but was obtained from what is generally known as the Richmond Basin, a small area of Triassic age in the southeastern part of the State, near the city of Richmond. The basin is on the eastern margin of the Piedmont Plateau, 13 miles above tide on James River, and is included within the counties of Goochland, Henrico, Powhatan, and Chesterfield.

The occurrence of coal in this locality was known as early as 1700, though mining did not begin until the latter part of the century. In 1789 shipments were made to some of the Northern States. In 1822, according to R. C. Taylor, in his "Statistics of coal," the production amounted to 54,000 short tons. For nearly a century the Richmond Basin maintained some prominence as a coal producer, but when, in 1882, the Pocahontas district was opened up, followed shortly afterwards by the development of the New River field in West Virginia, the mines in the Richmond Basin were put at a disadvantage and operations were practically suspended.

The annual production of Virginia from 1822 to the close of 1912 is shown in the following table:

Production of coal in Virginia from 1822 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1822	54,000	1846	340,000	1870	61,803	1894	1,229,083
1823	60,000	1847	325,000	1871	70,000	1895	1,368,324
1824	67,040	1848	318,000	1872	69,440	1896	1,254,723
1825	75,000	1849	315,000	1873	67,200	1897	1,528,302
1826	88,720	1850	310,000	1874	70,000	1898	1,815,274
1827	94,000	1851	310,000	1875	60,000	1899	2,105,791
1828	100,080	1852	325,000	1876	55,000	1900	2,393,754
1829	100,000	1853	350,000	1877	50,000	1901	2,725,873
1830	102,800	1854	370,000	1878	50,000	1902	3,182,993
1831	118,000	1855	380,782	1879	45,000	1903	3,451,307
1832	132,000	1856	352,687	1880	43,079	1904	3,410,914
1833	125,000	1857	363,605	1881	50,000	1905	4,275,271
1834	124,000	1858	377,690	1882	112,000	1906	4,254,879
1835	120,000	1859	359,055	1883	252,000	1907	4,710,895
1836	124,000	1860	473,360	1884	336,000	1908	4,259,042
1837	160,000	1861	445,165	1885	567,000	1909	4,752,217
1838	300,000	1862	445,124	1886	684,951	1910	6,507,997
1839	396,000	1863	[a] 40,000	1887	825,263	1911	6,864,667
1840	424,894	1864	40,000	1888	1,073,000	1912	7,846,638
1841	379,600	1865	40,000	1889	865,786		
1842	373,640	1866	40,000	1890	784,011	Total	87,459,713
1843	370,000	1867	50,000	1891	736,399		
1844	365,000	1868	59,051	1892	675,205		
1845	350,000	1869	65,000	1893	820,339		

[a] West Virginia separated from Virginia.

WASHINGTON.

Total production in 1912, 3,360,932 short tons; spot value, $8,042,871.

The coals of Washington, although limited to six or seven somewhat scattered areas in the western half of the State, chiefly along the eastern border of Puget Sound, have a wide range in character. Lignites occur in the southwestern part of the State in Cowlitz, Lewis, and Thurston counties; and in Lewis County, as the measures approach the mountains, the coal grades into subbituminous and bituminous quality. The areas along Puget Sound contain subbituminous and bituminous coals, some of the latter possessing fair coking quality, and in the northwestern part of the State on the slopes of Mount Baker in Whatcom County anthracite has been reported. Some natural coke has been observed. The coking coals of Washington are the only ones of that grade on the Pacific coast. They are found in the Wilkeson-Carbonado district in Pierce County, in the North Puget Sound field in Skagit and Whatcom counties, and in the northern part of the Roslyn field in Kittitas County; but at present coke is made only in the Wilkeson-Carbonado district. This coal is somewhat high in ash and is usually washed before coking. The smelter at Tacoma takes most of the coke. The coal areas are divided into four principal fields known as (1) the North Puget Sound, including the counties of Whatcom and Skagit; (2) the South Puget Sound, containing the operations in King and Pierce counties; (3) the Roslyn field, in Kittitas County; and (4) the Southwestern field, embracing the counties of Cowlitz, Lewis, and Thurston. Two small subbituminous areas, one just east of Everett in Snohomish County, and the other in the northeastern part of King County, are not mined at the present time. The coal-mining industry of Washington has suffered considerably during the last few years from the competition of fuel oil from California, the Puget Sound steamers (the former principal consumers of Washington coal) and the railroads having adopted petroleum for fuel. Even the railroads that have their own coal mines immediately on their lines are using oil for their locomotives, particularly through the forested areas where the sparkless character of that fuel gives protection against fire. The cleanliness of the liquid fuel and its greater economy in labor give it a decided advantage over coal as a steam fuel on the Sound steamers.

The consumption of California oil for fuel in 1912 was approximately 50,000,000 barrels, equivalent to about four times the total production of coal in the Pacific coast States. It is estimated that the consumption of fuel oil in markets tributary to the coal mines in Washington displaced 5,000,000 tons of coal. The railroads alone used nearly 4,000,000 barrels of oil, equivalent to 1,150,000 tons of coal, or about half of the coal production of the State in 1912.

The maximum production of coal in Washington was mined in 1910, when the output amounted to 3,911,899 short tons. It decreased to 3,572,815 tons in 1911 and again to 3,360,932 tons in 1912. The decrease in 1912 compared with 1911 was 211,883 tons, or 6 per cent. The value fell off somewhat less in proportion, from $8,174,170 to $8,042,871, the decrease being $131,299, or 1.6 per cent. Pierce and Thurston were the only counties which showed an increased production in 1912, the gain in the former being due to a larger output of coke, and in the latter to larger local domestic consumption, for which the product is chiefly mined.

The number of men employed in the coal mines of Washington decreased from 6,498 in 1911 to 5,519 in 1912. The average working time was about the same in both years, being 225 days in 1911 and 226 days in 1912. The average production per man was 609 tons for the year and 2.69 tons for each day in 1912, the corresponding figures for 1911 being 550 tons and 2.44 tons.

There were 2 companies that reported the use of mining machines in 1912, all of them being of the radialaxe or post-puncher type, the only kind adaptable to the steeply inclined beds of the State. The quantity of coal mined by machines in 1912 was 258,089 tons against 188,707 tons in 1911. Most of the coal produced in Washington is mined by hand, 1,991,549 tons, or 59.3 per cent of the total in 1912 being undercut by hand; 1,102,993 tons, or 32.8 per cent, were shot off the solid. A large part of the coal produced in Washington runs high in ash and in sulphur. The quality is materially improved, however, by washing, and 16 washeries have been established. Probably a higher percentage of coal is washed in the State of Washington than in any other State in the country. In 1912 the quantity of coal washed was 863,643 tons, or over 25 per cent of the total output, and it yielded 731,521 short tons of cleaned coal and 132,122 tons of refuse. The refuse represents about 15 per cent of the coal washed.

There were only two instances of rather prolonged strikes in Washington in 1912. In one 200 men were idle for 50 days, and in the other 114 men were idle for 144 days, or more than one-half of the average number of days worked. Altogether there were 807 men idle for an average of 39 days. There was no general suspension, and there were only 5 mines at which strikes occurred during the year.

Reports to the United States Bureau of Mines show that the fatalities in the coal mines of Washington in 1912 were fewer by one-half than in 1911. The total number of men killed in 1912 was 14 against 27 the preceding year. The death rate per thousand employees was reduced from 4.16 to 2.54, and the tonnage won for each life lost was increased from 132,326 to 240,067.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Washington in 1911 and 1912, by counties, in short tons.

1911.

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	1,074,780	120,981	63,760	....	1,259,521	$2,745,507	$2.18	246	1,870
Kittitas	1,200,476	14,943	41,326	....	1,256,745	3,361,271	2.67	188	1,937
Lewis	148,722	14,949	9,063	....	172,734	325,799	1.89	183	1,036
Pierce	709,125	4,044	22,275	47,752	783,196	1,550,049	1.98	275	1,518
Other counties [a]	97,888	1,015	1,716	....	100,619	191,544	1.90	229	137
Total	3,230,991	155,932	138,140	47,752	3,572,815	8,174,170	2.29	225	6,498

1912.

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	942,296	51,266	69,548	....	1,063,110	$2,329,397	$2.19	232	1,891
Kittitas	1,182,704	14,541	40,182	....	1,237,427	3,371,651	2.72	188	1,737
Lewis	114,751	8,646	4,980	....	128,377	240,541	1.87	178	244
Pierce	660,985	4,712	45,855	76,741	788,293	1,864,838	2.37	275	1,477
Other counties [a]	140,541	1,130	2,054	....	143,725	236,444	1.65	172	170
Total	3,041,277	80,295	162,619	76,741	3,360,932	8,042,871	2.39	226	5,519

[a] Thurston and Whatcom.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Production of coal in Washington, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
King	931,643	1,216,012	1,242,340	1,259,521	1,063,110	− 196,411
Kittitas	1,414,621	1,550,539	1,661,650	1,256,745	1,237,427	− 19,318
Lewis	73,675	121,573	179,484	172,734	128,377	− 44,357
Pierce	551,678	609,467	786,096	783,196	788,293	+ 5,097
Other counties	53,326	[a] 104,672	42,329	100,619	143,725	+ 43,106
Total	3,024,943	3,602,263	3,911,899	3,572,815	3,360,932	− 211,883
Total value	$6,690,412	$9,158,999	$9,764,465	$8,174,170	$8,042,871	−$131,299

[a] Includes small mines.

Coal was first discovered in Washington in 1848, when a lignite of rather low grade was found in the Cowlitz Valley. Four years later bituminous coal was discovered on Bellingham Bay, Whatcom County, and the first mine in the State was opened on this bed. Shipments did not begin, however, until 1860. This mine was operated continuously from 1860 until 1878, when on account of a fire caused by spontaneous combustion the workings were abandoned, and they have not since been reopened. Shipments were not resumed from any of the mines in the northern district until 13 years later in 1891. Coal was discovered in King County in 1859, and mining began near the present Issaquah in 1862. Shipments to San Francisco began in 1871, since which time the Washington mines have been an important source of coal supply to the San Francisco market. About the same time the Talbot and the 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 district, also in King County, began between 1880 and 1885; and the Pierce County fields, which had been opened 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. Washington's maximum output of coal was 3,911,899 short tons, made in 1910.

The production of coal in Washington since 1860, when the industry in the State began, has amounted to 60,581,549 short tons, as shown in the following table:

Production of coal in Washington, 1860–1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	5,374	1874	30,352	1888	1,215,750	1902	2,681,214
1861	6,000	1875	99,568	1889	1,030,578	1903	3,193,273
1862	7,000	1876	110,342	1890	1,263,689	1904	3,137,681
1863	8,000	1877	120,896	1891	1,056,249	1905	2,864,926
1864	10,000	1878	131,660	1892	1,213,427	1906	3,276,184
1865	12,000	1879	142,666	1893	1,264,877	1907	3,680,532
1866	13,000	1880	145,015	1894	1,106,470	1908	3,024,943
1867	14,500	1881	196,000	1895	1,191,410	1909	3,602,263
1868	15,000	1882	177,340	1896	1,195,504	1910	3,911,899
1869	16,200	1883	244,990	1897	1,434,112	1911	3,572,815
1870	17,844	1884	166,936	1898	1,884,571	1912	3,360,932
1871	20,000	1885	380,250	1899	2,029,881		
1872	23,000	1886	423,525	1900	2,474,093	Total.	60,581,549
1873	26,000	1887	772,601	1901	2,578,217		

WEST VIRGINIA.

Total production in 1912, 66,786,687 short tons; spot value, $62,792,234.

The coal fields of West Virginia belong to the Appalachian region, all of the State west of the escarpment of the Allegheny Mountains being in the coal-bearing formation. The coal area contains about 17,000 square miles out of a total of 24,022 square miles in the State.

Nearly all of the production comes from seven principal mining districts, three in the northern part of the State and four in the southern part. The three principal districts in the northern part of West Virginia are the Fairmont (or Clarksburg), which includes Harrison and Marion counties; the Elk Garden (or Piedmont), which includes Mineral, Grant, and Tucker counties and is part of a detached basin extending northward into Maryland, where it is known as Georges Creek; and the Philippi district, which includes Preston, Barbour, and Randolph counties. The most important bed in the Fairmont and Elk Garden districts is the famous Pittsburgh, although in the Fairmont district the Waynesburg and the Sewickley coals are present, though but little worked, and in the Elk Garden the "Thomas" (Upper Freeport) and the "Davis" (Upper Kittanning) are present, both of which are extensively worked. The Fairmont district produced 10,964,896 short tons in 1912, and the Elk Garden 2,196,820 short tons. The Philippi district has developed into importance in the last few years. The coals belong to the Allegheny formation ("Lower Productive Measures"). The production from this district in 1912 was 2,947,529 tons.

The four important districts in the southern part of the State are the New River, Kanawha, Pocahontas, and Big Sandy.

The New River district, as its name implies, is chiefly within the area drained by New River and its tributaries, but includes also the drainage areas of Slab Fork and Winding Gulf, tributaries of Guyandot River. The productive portions are in Fayette and Raleigh counties, though some of the coal mined in the western part of Fayette County belongs to the coal series of the Kanawha district. The principal beds worked are the Sewell, the Beckley, and the Quinnimont. The total production of coal in Fayette and Raleigh counties in 1912 was 14,770,447 short tons. Most of the New River coal is a high-grade "smokeless" coking coal, much prized for its steaming as well as its coking quality.

The Kanawha district lies immediately west of the New River field. It includes all of Kanawha County and parts of Putnam and Boone counties. Eight different beds are worked, of which the Eagle and "No. 2 Gas" are the most important. The others are the Coalburg, North Coalburg, No. 5, Stockton, Winifrede, and Cedar Grove. The production, exclusive of the Kanawha coals in Fayette County but including about 130,000 tons from Mason County, was 6,235,599 tons in 1912.

The Pocahontas district lies in the extreme southern corner of the State in McDowell and Mercer counties and extends across the State line into Tazewell County, Va. It produces the celebrated high-carbon Pocahontas steaming and coking coal, one of the purest coals in the United States, mined from the "No. 3" bed. Pocahontas No. 4 has been extensively developed in recent years. Other beds known locally as the War Creek (Beckley), the Welch, and the Davey (Sewell) are also mined. The production in the West Virginia part of this district in 1912 was 18,918,860 short tons, or nearly 30 per cent of the total output of the State.

The Big Sandy district, like the Philippi in the northern part of the State, has become of importance through recent development. It is really a continuation of the Kanawha field into Logan and Mingo counties, and the beds worked are those of the Kanawha district. The production in 1912 was 6,794,223 short tons.

The Wheeling district, which includes the counties in the "Panhandle" along Ohio River, produces about 1,200,000 tons annually.

The coals of West Virginia are all of bituminous or semibituminous variety, and mostly high grade. Some cannel and a peculiar type known as splint are mined in the southern part of the State.

The total production of coal in West Virginia in 1912 was 66,786,687 short tons, the maximum record of the State. This was nearly as much as the total output of bituminous coal in the whole United States 30 years earlier, in 1882, and exceeded the total production of both anthracite and bituminous coal in 1877, only 35 years earlier. The production of West Virginia coal in 1911 was 59,831,580 short tons, compared with which the output in 1912 showed an increase of 6,955,107 tons, or 11.62 per cent. The value of the product increased $9,121,719, or 17 per cent, from $53,670,515 in 1911 to $62,792,234 in 1912. The average price per ton was 94 cents in 1912, against 90 cents in 1911.

West Virginia's coal production during the calendar year 1912, as reported to the Survey, differed very slightly from that of the fiscal year ended June 30, as reported to the State Department of Mines, which indicates that the improvement in trade conditions that was quite general throughout the United States during the last two or three months of the year did not materially influence coal mining in the State. The Department of Mines of West Virginia reported for the fiscal year an output of 66,731,587 short tons; the output for the calendar year reported to the Survey was 66,786,687 tons a difference of less than 55,000 tons, or 0.08 per cent.

For the last four years, including 1912, West Virginia has held second place among the States in the quantity of coal produced, having taken the lead over Illinois in 1909. When the value of the product is considered, however, West Virginia drops to a rather poor third. In 1912 the output of the State exceeded that of Illinois by 6,901,461 short tons, whereas in the value of the coal produced Illinois had the better of West Virginia by $7,502,104, notwithstanding that on a comparison of thermal efficiency the average of West Virginia's coal is higher than that of Illinois by 25 to 30 per cent. The average price of Illinois coal, on the other hand, is from 20 to 25 per cent higher than that of West Virginia. In 1912 the average value per ton at the mine of West Virginia coal was 94 cents; that of Illinois coal was $1.17. In 1911 the corresponding prices were 90 cents and $1.11, and in 1910 they were 92 cents and $1.14. It is true that conditions in West Virginia are favorable to low mining cost and that West Virginia coal can be sold at a lower rate per ton than the coal in the States with which its product comes into competition, but it is also true that West Virginia lacks an advantage which the others possess in manufacturing industries to consume the product. Fully 80 per cent of the coal mined in West Virginia is shipped to distant markets, part of the product actually crossing other producing coal fields before reaching the points of destination. More West Virginia coal was made into coke at plants in other States and distant from the mines than was made into coke at ovens in West Virginia.

In one particular the record of West Virginia's coal production, in both 1911 and 1912, is highly exemplary, that is, the manner in which the coal is mined. Of all the important coal-producing States, West Virginia shows the smallest percentage of coal improperly mined. In 1911, 96 per cent of the output was either mined by hand or by the use of machines, and only a little more than 1 per cent was "powder-mined," or shot off the solid. In 1912, out of a total of 66,786,687 tons produced, only 453,215 tons, or 0.7 per cent, were powder-mined. The machine-mined product in 1912 amounted to 34,946,394 short tons, or 52.3 per cent of the total. The quantity of coal undercut by hand was 31,101,454 short tons, or 46.6 per cent of the total output. The coal for which no method of mining was reported represented only 0.4 per cent of the total output.

During the greater part of 1912 a portion of the Kanawha district was the scene of a long and bitter controversy between the miners and the operators. The mines affected were located on Paint and Cabin creeks, principally in Kanawha County. The merits of the controversy are not within the scope of this report, which records only its effect upon the industry. The influence of these troubles upon the production of 1912 is shown in the decrease of 557,469 short tons, or about 10 per cent, in the production of Kanawha County, and of 340,554 tons in the output of Fayette County, whereas in most of the counties of the State, in fact in all of the other important counties, the production in 1912 showed good gains over the preceding year. It does not appear that many of the mines were thrown idle throughout the entire year. One group of mines employing 743 men was idle 207 days. One mine employing 140 men was idle 210 days. These were the longest periods of idleness reported. Quite a large number of mines were idle from 100 to 150 days, and still more were idle between

30 and 60 days. The total number of men reported idle because of labor troubles in West Virginia in 1912 was 12,165, or 18 per cent of the total number of men employed during the year. The total number of working-days lost was 606,588, or an average of 50 days for each of the 12,165 men affected. The total time lost was a little less than 4 per cent of the total working time made by the coal-mine workers in the State, so that although the production of Fayette and Kanawha counties fell off because of the strike, the effect upon the State as a whole was negligible. The average time made by the 68,248 men employed in 1912 was 266 days, a gain of 45 days, or 20 per cent in average working time over 1911. The productive efficiency of the men employed in the coal mines of West Virginia compares favorably with that of the miners in any other State in the Union, a record for the average production per man for the year having been made in 1912. The average production per man in 1912 was 979 short tons for the year (the highest attained in any State) and 3.68 tons for each working-day. In 1911 there were 66,730 men employed, who worked an average of 221 days; their average production was 896 short tons for the year and 4.05 tons for each working-day.

The statistics of the work done by mining machines show that in 1912 there were 2,253 machines employed in the coal mines of West Virginia against 2,044 in 1911. The quantity of machine-mined coal increased from 29,121,480 tons, or 48.7 per cent of the total output, in 1911 to 34,946,394 tons, or 52.3 per cent of the total, in 1912. Something over one-half of the total number of machines employed in 1912 (1,217) were of the chain-breast type, and about half as many (604) were of the pick or puncher type. The long-wall machines numbered 175; the short-wall, 245; and the post radial-acting machines, 12.

Only a small percentage of the West Virginia coal product is washed, the quantity thus treated in 1912 being 948,029 tons, which yielded 902,103 tons of cleaned coal and 45,926 tons of refuse.

According to reports to the United States Bureau of Mines, there were 359 fatal accidents in the coal mines of West Virginia in 1912 against 350 in 1911. Of the 359 fatalities in 1912, 346 were underground, 3 in the shafts, and 10 on the surface. Falls of roof claimed a little more than one-half of the total deaths underground, 175 fatalities being due to that cause; 12 deaths were due to falls of coal other than roof coal; 44 men were killed by mine cars and locomotives; and 90 deaths were due to explosions of gas and dust. There were 17 deaths underground due to electric shock or burns. The death rate per 1,000 in 1912 was 5.26, and the number of tons mined for each life lost was 186,035. In 1911 the death rate per thousand employees was 5.24, and the quantity of coal mined for each life lost was 170,947 tons.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of West Virginia in 1911 and 1912, by counties, in short tons.

1911.

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	992,704	4,066	20,923	7,091	1,024,784	$758,417	$0.74	211	1,046
Boone	154,205	3,470	2,848		160,523	129,281	.81	139	332
Braxton	204,818	3,224	1,125		209,167	163,789	.78	222	177
Brooke	442,779	5,683	2,968		451,430	471,388	1.04	232	549
Clay	137,135	7,353	2,225		146,713	104,746	.71	201	176
Fayette	8,966,557	125,710	221,418	663,099	9,976,784	9,562,169	.96	225	13,050
Gilmer	48,160	4,972	448		53,580	44,300	.83	218	67
Harrison	4,175 796	18,000	47,302		4,241,098	3,154,222	.74	185	4,511
Kanawha	5,485,136	95,720	90,170		5,671,026	5,382,133	.95	207	7,317
Lincoln	81,050	720			81,770	75,356	.92	300	120
Logan	3,084,351	32,286	33,034		3,149,671	2,757,324	.88	218	2,701
McDowell	11,248,028	158,529	249,052	1,731,140	13,386,749	12,409,508	.93	238	12,792
Marion	4,602,497	23,257	109,523	95,263	4,830,540	4,051,397	.84	234	4,678
Marshall	515,287	153,773	9,112		678,172	644,127	.95	254	692
Mason	162,682	36,446	2,815		201,943	195,868	.97	229	308
Mercer	2,506,060	36,884	41,585	340,185	2,924,714	2,548,944	.87	218	2,895
Mineral	603,332	3,238	4,157		610,727	518,109	.85	189	821
Mingo	2,269,817	26,603	44,580		2,341,000	2,121,209	.91	235	3,318
Monongalia	294,445	4,415	8,609	188,188	495,657	401,429	.81	243	473
Ohio	251,836	72,709	1,650		326,195	317,837	.97	245	378
Preston	566,251	8,758	22,582	272,856	870,447	593,858	.68	191	1,131
Putnam	550,818	10,424	6,980		568,222	630,494	1.11	238	998
Raleigh	4,291,861	41,775	75,794		4,409,430	4,087,984	.93	229	4,648
Randolph	377,965	10,695	6,010	159,265	553,935	446,710	.81	192	495
Taylor	735,359	6,332	3,887		745,578	517,490	.69	204	830
Tucker	1,019,654	6,321	46,572	79,569	1,152,116	1,039,018	.90	218	1,502
Upshur	31,886	4,457	1,882		38,225	28,184	.74	151	55
Other counties [a] and small mines	370,954	139,727	16 656	4 047	531,384	515,224	.97	154	670
Total	54,171,423	1,045,547	1,073,907	3,540,703	59,831,580	53,670,515	.90	221	66,730

1912.

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	1,123,533	5,077	23,479	11,272	1,163,361	$845,877	$0.73	221	1,110
Boonc	372,830	3,161	3,985		379,976	324,333	.85	210	397
Brayton	229,433	2,540	3,015		234,988	200,085	.85	189	205
Brooke	482,846	9,766	1,859		494,471	549,168	1.11	240	473
Clay	207,023	1,791	3,311		212,125	176,976	.83	209	277
Fayette	8,477,752	144,330	219,650	794,498	9,636,230	9,549,855	.99	227	11,983
Gilmer	69,675	6,060	1,000		76,735	68,887	.90	214	120
Harrison	5,092,440	18,603	53,503	7,226	5,171,772	4,173,029	.81	211	4,322
Kanawha	4,912,806	115,737	85,014		5,113,557	4,957,392	.97	181	7,040
Logan	4,121,966	29,390	45,388		4,196,744	3,779,439	.90	233	3,419
McDowell	13,634,755	216,618	302,588	1,655,328	15,809,289	15,384,767	.97	234	14,401
Marion	5,409,121	46,182	176,423	161,398	5,793,124	4,942,834	.85	258	4,603
Marshall	601,856	181,173	14,999		798,028	800,027	1.00	268	825
Mason	104,734	24,313	2,256		131,303	128,314	.98	134	327
Mercer	2,654,704	34,446	49,707	370,714	3,109,571	2,961,587	.95	231	3,010
Mineral	717,500	2,265	6,551		726,316	697,448	.96	206	922
Mingo	2,503,910	33,531	60,038		2,597,479	2,518,305	.97	231	3,300
Monongalia	299,318	6,538	3,612	100,111	409,579	325,820	.80	240	299
Ohio	320,067	90,860	1,567		412,494	408,384	.99	277	403
Preston	756,066	22,379	17,857	371,456	1,167,758	1,038,999	.89	243	1,303
Putnam	592,266	14,300	5,500		612,066	730,260	1.19	243	980
Raleigh	4,994,524	45,916	93,777		5,134,217	5,165,826	1.01	232	5,131
Randolph	379,609	10,421	8,677	217,703	616,410	527,913	.86	245	539
Taylor	836,922	5,370	7,688	21,872	871,852	655,989	.75	234	690
Tucker	1,171,351	8,572	40,725	49,930	1,270,578	1,242,301	.98	265	1,400
Upshur	40,659	4,133	1,082	13,456	59,330	46,966	.79	169	88
Other counties [b] and small mines	441,528	125,670	18,419	1,717	587,334	591,453	1.01	230	681
Total	60,549,194	1,209,142	1,251,670	3,776,681	66,786,687	62,792,234	.94	266	68,248

[a] Grant, Greenbrier, Hancock, Lewis, Nicholas, Ritchie, Wayne, and Webster.
[b] Grant, Greenbrier, Hancock, Lewis, Lincoln, Nicholas, Wayne, and Webster.

The statistics of production, by counties, during the last five years, with increase and decrease in 1912, as compared with 1911, are shown in the following table:

Coal production of West Virginia, by counties, 1908–1912, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Barbour	1,023,029	1,024,805	1,368,391	1,024,784	1,163,361	+ 138,577
Boone				160,523	379,976	+ 219,453
Braxton		105,714	167,123	209,167	234,988	+ 25,821
Brooke	433,373	380,887	470,674	451,430	494,471	+ 43,041
Clay	6,622	43,212	44,602	146,713	212,125	+ 65,412
Fayette	7,663,561	9,877,521	10,410,983	9,976,784	9,636,230	− 340,554
Gilmer		40,201	45,190	53,580	76,735	+ 23,155
Grant	217,074	190,575	283,072	209,530	199,926	− 9,604
Hancock	85,631	75,633	71,211	49,200	2,980	− 46,220
Harrison	3,262,637	3,385,291	4,641,304	4,241,098	5,171,772	+ 930,674
Kanawha	4,630,548	5,577,138	7,010,487	5,671,026	5,113,557	− 557,469
Lincoln		51,227	71,917	81,770	67,212	− 14,558
Logan	1,683,456	2,147,965	2,896,328	3,149,671	4,196,744	+ 1,047,073
McDowell	8,601,802	11,964,836	13,488,076	13,386,749	15,809,289	+ 2,422,540
Marion	3,922,398	4,195,473	4,795,549	4,830,540	5,793,124	+ 962,584
Marshall	259,769	356,619	538,402	678,172	798,028	+ 119,856
Mason	119,723	117,209	221,217	201,943	131,303	− 70,640
Mercer	2,088,343	2,511,000	2,876,834	2,924,714	3,109,571	+ 184,857
Mineral	696,226	892,245	883,586	610,727	726,316	+ 115,589
Mingo	1,800,589	2,039,640	2,442,630	2,341,000	2,597,479	+ 256,479
Monongalia	224,955	371,890	554,073	495,657	409,579	− 86,078
Nicholas	41,629	36,714	79,714	54,731	70,986	+ 16,255
Ohio	145,987	236,870	309,049	326,195	412,494	+ 86,299
Preston	659,348	996,767	1,164,382	870,447	1,167,758	+ 297,311
Putnam	532,446	575,009	540,632	568,222	612,066	+ 43,844
Raleigh	1,622,161	2,411,513	3,347,129	4,409,430	5,134,217	+ 724,787
Randolph	361,851	392,846	600,907	553,935	616,410	+ 62,475
Taylor	489,069	483,906	719,230	745,578	871,852	+ 126,274
Tucker	980,425	1,157,753	1,317,967	1,152,116	1,270,578	+ 118,462
Upshur		80,615	92,760	38,225	59,330	+ 21,105
Other counties and small mines	345,191	128,146	217,600	217,923	246,230	+ 28,307
Total	41,897,843	51,849,220	61,671,019	59,831,580	66,786,687	+ 6,955,107
Total value	$40,009,054	$44,661,716	$56,665,061	$53,670,515	$62,792,234	+$9,121,719

The most important local gains in coal production in 1912 were in McDowell County, 2,422,540 tons; Logan County, 1,047,073 tons; Marion County, 962,584 tons; Harrison County, 930,674 tons; and Raleigh County, 724,787 tons. No other county showed an increase exceeding 300,000 tons. The principal losses, as already noted, were in Kanawha County, 557,469 tons, and in Fayette County, 340,554 tons.

The statistics of coal production in West Virginia since 1863, when the State was formed out of Virginia, to the close of 1912 are shown in the following table:

Production of coal in West Virginia, 1863–1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1863	444,648	1876	896,000	1889	6,231,880	1902	24,570,826
1864	454,888	1877	1,120,000	1890	7,394,654	1903	29,337,241
1865	487,897	1878	1,120,000	1891	9,220,665	1904	32,406,752
1866	512,068	1879	1,400,000	1892	9,738,755	1905	37,791,580
1867	589,360	1880	1,829,844	1893	10,708,578	1906	43,290,350
1868	609,227	1881	1,680,000	1894	11,627,757	1907	48,091,583
1869	603,148	1882	2,240,000	1895	11,387,961	1908	41,897,843
1870	608,878	1883	2,335,833	1896	12,876,296	1909	51,849,220
1871	618,830	1884	3,360,000	1897	14,248,159	1910	61,671,019
1872	700,000	1885	3,369,062	1898	16,700,999	1911	59,831,580
1873	1,000,000	1886	4,005,796	1899	19,252,995	1912	66,786,687
1874	1,120,000	1887	4,881,620	1900	22,647,207		
1875	1,120,000	1888	5,498,800	1901	24,068,402	Total.	716,234,888

WYOMING.

Total production in 1912, 7,368,124 short tons; spot value, $11,648,088.

Probably more than half of the entire area of Wyoming is coal bearing. Coal is believed to exist in every county of the State, although in some portions it lies under such heavy cover as to be unworkable under present conditions. The reserves are estimated at approximately 424,000,000,000 short tons, a supply exceeding that of any other State, with the possible exception of North Dakota. The coals of the latter State, however, are almost entirely lignite, with a small amount of subbituminous coal, whereas those of Wyoming range from subbituminous to medium-grade bituminous. Some of the Wyoming coals go to markets as far distant as the Pacific coast. The coal fields of Wyoming are numerous, some of them of very large area, and contain many beds, some of them of great thickness. One bed in the southwestern part of the State is about 90 feet thick. The largest coal field in the area is the Powder River field, in the northeastern part of the State. It occupies a trough or basin between the Black Hills and the Big Horn Mountains and extends from the Montana line on the north to North Platte River on the south. At least 11,000 of the 15,000 square miles contained in this area are underlain by coal beds of known workable thickness. The principal mining operations are at Sheridan, Dietz, and Monarch, in Sheridan County, and at Cambria, in Weston County. The production in 1912 was 1,493,877 short tons, or about 20 per cent of the total output of the State. The Chicago, Burlington & Quincy Railroad furnishes transportation for and consumes a large part of the product.

Second in size but first in productive importance at the present time is the Green River basin in the southwestern part of the State. This field contains over 6,000 square miles believed to cover available coal. In addition to this, there are 20,000 square miles in which the coal beds are so deeply covered that their ultimate availability is doubtful. The principal mining operations are at Rock Springs, on the Union Pacific Railroad, in Sweetwater County, and some of the production in Carbon County is from this basin. Sweetwater County alone produces 40 per cent of the State's total—2,969,601 tons out of a total of 7,368,124 tons in 1912.

The Bear River region in Uinta and Lincoln counties (Lincoln County having been created out of Uinta County in 1912) is relatively small in area but second in quantity of coal produced, having in 1912 had an output of 1,930,125 tons, or more than 25 per cent of the State's total. The product is largely bituminous coal and comes chiefly from the Kemmerer district. Shipments are made over the Union Pacific Railroad.

A region that has assumed some importance in the last five years is the Big Horn basin, in the northern part of the State. In this district (at Gebo, Hot Springs County) is the one coal mine in the United States opened on public land and now operated on a royalty basis from the Federal Government under the supervision of the United States Bureau of Mines. In 1906, before railroad transportation was available, Big Horn County produced less than 5,000 tons; in 1912 the production was 194,105 tons.

The Hanna field, in the eastern part of Carbon County, is one of the older areas in point of development. The principal operations are the Union Pacific Coal Co.'s mines at Hanna, and most of the coal goes to the Union Pacific Railroad. This district produces a little less than 10 per cent of the State's total output.

The Green River and Bear River basins and a small area in Weston County produce bituminous coal. The output from the other districts is subbituminous. Other fields of minor importance are the Wind River basin, in Fremont County; the Henrys Fork field, in southern Sweetwater County; the Powder River field, in Natrona and Fremont counties; the Muddy Creek field, in the Shoshone Indian Reservation, in Fremont County; the Fall River basin and the Upper Green River field, in Uinta and Fremont counties; the Mount Leidy field, the Lander Peak field, and the Grays River field, in Uinta County.

The coal production of Wyoming in 1912 amounted to 7,368,124 short tons, valued at $11,648,088. Compared with 1911, when the production was 6,744,864 tons, valued at $10,508,863, the output in 1912 shows an increase of 623,260 short tons, or 9.2 per cent, in quantity and of $1,139,225, or 10.8 per cent, in value. The output in 1912 was with one exception (1910) the largest in the history of the State, but in 1910 conditions were abnormal, a shortage of fuel caused by a six months' strike among the coal miners in the Central and Southwestern States having created an unusual demand upon the coal-producing districts of the Rocky Mountain States. The production in 1911, although less than that of 1910, showed a normal gain over 1909, and that of 1912 exhibited a similarly normal increase over 1911. The region supplied by Wyoming coal was blessed with bountiful crops in 1912, and the metallurgical and other industries were in prosperous condition, which was reflected not only in the increase in production over 1911 but in an advance in the average price per ton from $1.56 to $1.58.

Most of the counties in the State reported increased production in 1912. The two exceptions were Converse and Sheridan, the latter bearing the principal part of the loss. An apparent decrease of 1,235,621 tons in the output of Uinta County is due to the formation from it of Lincoln County, and the larger part of the production is from the area out of which the new county was formed. The combined production of Lincoln and Uinta counties in 1912 exceeded the production of Uinta County in 1911 by over 200,000 tons. The largest increase in 1912 was from Sweetwater County, which exhibited a gain of 341,399 tons.

Coal mining in Wyoming gave employment to 8,036 men for an average of 238 days in 1912, against 7,924 men for an average of 230 days in 1911. The labor efficiency in Wyoming is among the highest in the country, usually showing an average production per man per year of over 900 tons. In 1912 this average was 917; in 1911 it was 851 tons; and in 1910 it was 969 tons. The average daily production per man was 3.85 tons in 1912 against 3.70 tons in 1911, and 3.91 tons in 1910.

Over 40 per cent (3,180,067 tons) of the total production of the State in 1912 was "powder-mined;" 32 per cent, or 2,367,882 tons, was mined by machines; and 25 per cent (1,810,559 tons) was mined by hand. There were 179 machines in use in 1912, of which 68 were punchers, 77 chain-breast, 2 long-wall, 19 short-wall, and 13 post-radial machines. In 1911 there were 155 machines in use, and the quantity of machine-mined coal was 1,948,589 tons.

According to the United States Bureau of Mines, there were 34 deaths by accident in the coal mines of Wyoming during 1912, an increase of 1 over 1911. Thirty-two of the fatalities occurred underground, and 20 of these were due to falls of roof and coal. Seven men were killed by dust explosions, and 4 in haulage-way accidents.

The statistics of production, by counties, in 1911 and 1912, with the distribution of the product for consumption, are shown in the following table:

Coal production of Wyoming in 1911 and 1912, by counties, in short tons.

1911.

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.
Carbon	571,712	8,770	17,014	597,496	$946,017	$1.58	275	576
Converse	14,205	587	2,200	16,992	29,347	1.73	130	80
Sheridan	1,095,022	20,910	24,534	1,140,466	1,372,132	1.20	236	1,139
Sweetwater	2,543,106	13,209	71,887	2,628,202	4,522,504	1.72	227	3,290
Uinta	1,584,007	22,965	118,339	1,725,311	2,563,109	1.49	233	2,040
Other counties [a]	578,884	15,024	40,022	633,930	1,069,281	1.69	197	799
Small mines		2,467		2,467	6,473	2.62		
Total	6,386,936	83,932	273,996	6,744,864	10,508,863	1.56	230	7,924

1912.

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.
Bighorn	179,960	925	13,220	194,105	$371,481	$1.91	225	273
Carbon	604,504	9,057	23,450	637,011	1,009,262	1.58	288	675
Converse	11,451	1,930	1,500	14,881	27,631	1.86	109	79
Johnson		7,675	175	7,850	13,944	1.78	218	9
Sheridan	1,050,995	17,684	17,603	1,086,282	1,324,793	1.22	201	1,233
Sweetwater	2,871,328	14,303	83,970	2,969,601	5,015,484	1.69	230	3,375
Uinta	438,819	13,793	37,078	489,690	720,308	1.47	268	530
Other counties [b]	1,836,206	11,708	114,477	1,962,391	3,153,969	1.61	258	1,862
Small mines		6,313		6,313	11,216	1.78		
Total	6,993,263	83,388	291,473	7,368,124	11,648,088	1.58	238	8,036

[a] Bighorn, Crook, Fremont, Johnson, Park, and Weston.
[b] Crook, Fremont, Lincoln, Park, and Weston.

The statistics of the production of coal, by counties, during the last five years, with increase and decrease in 1912 as compared with 1911, are shown in the following table:

Coal production of Wyoming, 1908–1912, by counties, in short tons.

County.	1908	1909	1910	1911	1912	Increase (+) or decrease (−), 1912.
Bighorn	101,275	133,389	181,259	172,884	194,105	+ 21,221
Carbon	543,009	590,969	665,659	597,496	637,011	+ 39,515
Converse	32,745	16,885	8,950	16,992	14,881	− 2,111
Lincoln	....	....	....	....	1,440,435	+ 1,440,435
Sheridan	839,533	970,165	1,303,354	1,140,466	1,086,282	− 54,184
Sweetwater	2,180,933	2,641,860	2,875,449	2,628,202	2,969,601	+ 341,399
Uinta	1,380,488	1,586,320	1,960,671	1,725,311	489,690	− 1,235,621
Weston	337,815	354,182	416,714	325,114	392,714	+ 67,600
Crook, Fremont, Johnson	73,170	[a] 91,751	[a] 118,803	[a] 135,932	[a] 137,092	+ 1,160
Small mines	934	7,588	2,229	2,467	6,313	+ 3,846
Total	5,489,902	6,393,109	7,533,088	6,744,864	7,368,124	+ 623,260
Total value	$8,868,157	$9,896,848	$11,706,187	$10,508,863	$11,648,088	+$1,139,225

[a] Crook, Fremont, Johnson, and Park.

The first production of coal in Wyoming was reported in 1865, one year later than the first reported output of coal in Colorado. This pioneer coal mining was probably carried on in connection with the construction of the Union Pacific Railroad. The total output in that year amounted to 800 tons. Five years later, when the railroad was completed, the production amounted to about 50,000 tons.

The growth of the coal-mining industry, indicating as it does, the increase in population and in industrial development in the State since 1865 and up to the close of 1912, is shown in the following table:

Production of coal in Wyoming from 1865 to 1912, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1865	800	1878	333,200	1891	2,327,841	1904	5,178,556
1866	2,500	1879	400,991	1892	2,503,839	1905	5,602,021
1867	5,000	1880	589,595	1893	2,439,311	1906	6,133,994
1868	6,925	1881	420,000	1894	2,417,463	1907	6,252,990
1869	49,382	1882	707,764	1895	2,246,911	1908	5,489,902
1870	50,000	1883	779,689	1896	2,229,624	1909	6,393,109
1871	147,328	1884	902,620	1897	2,597,886	1910	7,533,088
1872	221,745	1885	807,328	1898	2,863,812	1911	6,744,864
1873	259,700	1886	829,355	1899	3,837,392	1912	7,368,124
1874	219,061	1887	1,170,318	1900	4,014,602		
1875	300,808	1888	1,481,540	1901	4,485,374	Total	111,347,852
1876	334,550	1889	1,388,947	1902	4,429,491		
1877	342,853	1890	1,870,366	1903	4,635,293		

RECENT PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY RELATING TO COAL, COKE, LIGNITE, AND PEAT.

Compiled by John M. Nickles.

The following is a list of the more important papers dealing with coal, coke, lignite, and peat, published by the United States Geological Survey since the preparation of the bibliography published in Mineral Resources of the United States for 1910. This supplementary list, like the complete list in the report for 1910, deals with the geologic work in the several States alphabetically arranged.

ALASKA.

The Bonnifield region, Alaska, by S. R. Capps. Bull. 501, 1912, pp. 54–62.

The mining industry in 1911, by Alfred H. Brooks. Bull. 520, 1912, pp. 42–43.

The Yentna district, Alaska, by Stephen R. Capps. Bull. 534, 1913, p. 72, map of coal distribution (Pl. III in pocket).

COLORADO.

The coal resources of Gunnison Valley, Mesa and Delta counties, Colo., by E. G. Woodruff. Bull. 471, 1912, pp. 565–573.

Coal fields of Grand Mesa and the West Elk Mountains, Colo., by W. T. Lee. Bull. 510, 1912, 219 pp.

ILLINOIS.

Geology and mineral resources of the Peoria quadrangle, Illinois, by J. A. Udden. Bull. 506, 1912, pp. 80–89.

Murphysboro-Herrin folio, Illinois, description by E. W. Shaw and T. E. Savage. Geol. Atlas U. S., folio 185, 1912, pp. 13–15.

Tallula-Springfield folio, Illinois, description by E. W. Shaw and T. E. Savage. Geol. Atlas U. S., folio 188, 1913, pp. 11–12.

KENTUCKY.

Kenova folio, Kentucky-West Virginia-Ohio, description by W. C. Phalen. Geol. Atlas U. S., folio 184, 1912, pp. 8–14.

MONTANA.

The southern extension of the Milk River coal field, Chouteau County, Mont., by L. J. Pepperberg. Bull. 471, 1912, pp. 359–383.

The electric coal field, Park County, Mont., by W. R. Calvert. Bull. 471, 1912, pp. 406–422.

The Livingston and Trail Creek coal fields, Park, Gallatin, and Sweetgrass counties, Mont., by W. R. Calvert. Bull. 471, 1912, pp. 384–405.

The Culbertson lignite field, Valley County, Mont., by A. L. Beekly. Bull. 471, 1912, pp. 319–358.

The Sidney lignite field, Dawson County, Mont., by Eugene Stebinger. Bull. 471, 1912, pp. 284–318.

The Terry lignite field, Custer County, Mont., by F. A. Herald. Bull. 471, 1912, pp. 227–270.

The Glendive lignite field, Dawson County, Mont., by J. H. Hance. Bull. 471, 1912, pp. 271–283.

The Baker lignite field, Custer County, Mont., by C. F. Bowen. Bull. 471, 1912, pp. 202–226.

Geology of certain lignite fields in eastern Montana, by W. R. Calvert. Bull. 471, 1912, pp. 187–201.

NEW MEXICO.

The Tijeras coal field, Bernalillo County, N. Mex., by W. T. Lee. Bull. 471, 1912, pp. 574–578.

NORTH CAROLINA.

Coal on Dan River, North Carolina, by R. W. Stone. Bull. 471, 1912, pp. 137–169.

NORTH DAKOTA.

Lignite in the Fort Berthold Indian Reservation, North Dakota, north of Missouri River, by M. A. Pishel. Bull. 471, 1912, pp. 170–186.

Bismarck folio, North Dakota, description by A. G. Leonard. Geol. Atlas U. S., folio 181, 1912, pp. 6–7.

OHIO.

Kenova folio, Kentucky-West Virginia-Ohio, description by W. C. Phalen. Geol. Atlas U. S., folio 184, 1912, pp. 8–14.

PENNSYLVANIA.

Foxburg-Clarion folio, Pennsylvania, description by E. W. Shaw and M. J. Munn. Geol. Atlas U. S., folio 178, 1911, pp. 12–13 (field edition, pp. 97–103).

Claysville folio, Pennsylvania, description by M. J. Munn. Geol. Atlas U. S., folio 180, 1912, pp. 12–13.

SOUTH DAKOTA.

Coal near the Black Hills, Wyoming-South Dakota, by R. W. Stone. Bull. 499, 1912, 66 pp.

UTAH.

The Deep Creek district of the Vernal coal field, Uintah County, Utah, by C. T. Lupton. Bull. 471, 1912, pp. 579–594.

The Blacktail (Tabby) Mountain coal field, Wasatch County, Utah, by C. T. Lupton. Bull. 471, 1912, pp. 595–628.

WEST VIRGINIA.

Kenova folio, Kentucky-West Virginia-Ohio, description by W. C. Phalen. Geol. Atlas U. S., folio 184, 1912, pp. 8–14.

WYOMING.

The Sussex coal field, Johnson, Natrona, and Converse counties, Wyo., by C. H. Wegemann. Bull. 471, 1912, pp. 441–471.

The Little Powder River coal field, Campbell County, Wyo., by J. A. Davis. Bull. 471, 1912, pp. 423–440.

Coal fields of the Wind River region, Fremont and Natrona counties, Wyo., by E. G. Woodruff and D. E. Winchester. Bull. 471, 1912, pp. 516–564.

The Lost Spring coal field, Converse County, Wyo., by D. E. Winchester. Bull. 471, 1912, pp. 472–515.

Coal near the Black Hills, Wyoming-South Dakota, by R. W. Stone. Bull. 499, 1912, 66 pp.

TECHNOLOGIC.

Miscellaneous analyses of coal samples from various fields of the United States. Bull. 471, 1912, pp. 629–655.

Miscellaneous analyses of coal samples from various fields of the United States. Bull. 531–M, 1913, pp. 1–27.

COKE.

By Edward W. Parker.

INTRODUCTION.

In 1912, as in 1911, the most significant feature of the coke-making industry of the United States was the progress shown in the construction of retort or by-product ovens and the increase in the production of retort-oven coke. The number of retort ovens in operation increased from 4,624 in 1911 to 5,211 in 1912, a gain of 587, whereas the total number of all ovens decreased from 103,879 to 102,230, indicating that there were 2,236 fewer beehive ovens in existence in 1912 than in 1911. Some new ovens of the beehive type were built in 1912, but the number abandoned exceeded all the new ones by 1,649, which represented the decrease in the total number of ovens. There was a general increase in production of both beehive and retort-oven coke; the former by 18.7 per cent, and the latter by 41.6 per cent. The output of the retort ovens, which represent less than 5 per cent of the total number of ovens, was a little more than 25 per cent of the total. In 1911 the retort ovens contributed 22.07 per cent of the total. There were nearly 1,000 more retort ovens under construction at the close of the year, and contracts had been made for the construction of a number of additional plants. The marked progress made in retort-oven construction in the last two or three years and the activity evinced in new work under way or in contemplation are carrying forward quite rapidly the revolution in coke making which was noted in one of the earlier reports of the writer on this subject as an inevitable outcome. This revolution consists not only in the gradual substitution of retort ovens for the wasteful beehive type, but in the shifting of the coke-making industry from the vicinity of the mines to the centers of manufacture and population where the gases may be utilized and the other by-products disposed of.

Metallurgical coke [1] was first made in the United States about the middle of the last century. The year under review concludes the first 20 years of by-product coke making, the pioneer plant of this branch of the industry having been completed and put in blast in December, 1892. This plant consisted of 12 Semet-Solvay ovens built at Syracuse, N. Y., and operated in connection with the chemical works of the Solvay Process Co., an affiliated organization. The second by-product coking plant to be erected in the United States was one of 60 Otto-Hoffmann ovens (now known as "United Otto") built by the Cambria Iron Co., at Johnstown, Pa., and put in blast in 1895. Since these initial plants were constructed the development has not been confined

[1] The product obtained from the distillation or partial combustion of bituminous coal in ovens or retorts and which constitutes a fuel suitable for the blast furnace or foundry is the only coke considered in this series of reports. "Gas-house" coke is not included

to the erection of new plants. The ovens of to-day are longer, higher, and wider than those of 20 years ago, and the average capacity has been accordingly increased. The Semet-Solvay ovens erected at Syracuse in 1893 were 30 feet long, 68 inches high, and 16 inches wide at one end and 17 inches wide at the other. The first ovens built at Johnstown were 33 feet 6 inches long, 6 feet high, and 17 to 21 inches wide. The present installations of Semet-Solvay ovens are 36 feet 3 inches long, 11 feet 10 inches high, and 20 to 22 inches wide. The Otto-Hoffmann, or United-Otto, ovens of the present construction are 34 feet long, 9 feet 1½ inches high, and 17 to 20 inches wide. All of the retort ovens of recent construction taper from the discharging end from rear to front, the discharging end being usually from 3 to 4 inches wider than the pushing end. This is in order to facilitate the pushing of the coke. Until 1904, when 282 Rothberg ovens were constructed at Buffalo, N. Y., for the Lackawanna Steel Co., the ovens of the Semet-Solvay and Otto-Hoffmann designs were the only retort ovens in the United States. In 1908, four years later, the first plant of Koppers regenerative ovens were built by the Illinois Steel Co. at Joliet, Ill. In 1912 a plant of 22 Klönne ovens was built by the Central Indiana Gas Co. at Muncie, Ind. The construction of a plant of 300 Didier ovens by the Lehigh Coke Co. at South Bethlehem, Pa., was begun in 1910. Some of these ovens were fired in 1912, but the plant was not turned over to the owners before the close of the year. The details of the development of the by-product coke industry are given in the section of this report on by-product coke making.

During the last few years, and notably in the lower Connellsville district of Pennsylvania, a rectangular form of oven has been constructed in which the coking process is one of partial combustion and therefore identical with the process carried on in the beehive oven, the advantage of the rectangular oven being that the coke may be pushed from the coking chamber and does not have to be drawn, as in the case of the beehive ovens. In a few instances the utilization of the heat generated in the beehive oven has been effected by the construction of flues which convey the burning gases to the boiler house for the generation of power. A plant of 446 beehive ovens thus equipped, operated by the Stag Cañon Fuel Co. at Dawson, N. Mex., is the highest type of this sort of installation. In order to differentiate between the coke made in the retort, or by-product ovens, and that made in the beehive, rectangular, or other ovens in which the process is one of partial combustion, the term, "retort coke," will be used in the succeeding pages of this report to designate that made in retorts, whether or not with by-product recovery, while that made in the partial-combustion chambers will be designated as "oven coke."

All of the coke produced in the retorts or ovens is a fuel suitable for metallurgical purposes, but in neither case is the utilization of the product restricted to the metallurgical industries. Where the retort or by-product coke plants are constructed in the immediate vicinity of blast furnaces the coke may be considered the primary product, but where, as at Everett, Mass., Camden, N. J., Muncie and Indianapolis, Ind., the primary product is illuminating and fuel gas, the coke product becomes secondary, although still of a quality suitable for metallurgical operations. Considerable quantities of both retort and oven coke are now used for domestic purposes, and in some cases by manufacturers and railroads. The location of the plant rather than the quality of the coke determines whether the product is primary or secondary. It is impossible to make any accurate separation of the uses to which coke is put.

Of the great coal fields of the United States, the principal source of high-grade coking coal is the fields of the Appalachian province which extend from Pennsylvania on the north to Alabama on the south. As a usual thing the better class of coking coals lie in the eastern half of this elongated area. Coke is made, however, from the coals of all of the large bituminous regions or fields, which may be designated as follows:

1. The Appalachian region, embracing the great coking-coal fields of Pennsylvania, Virginia, West Virginia, Ohio, eastern Kentucky, Tennessee, Alabama, and Georgia.
2. The eastern interior region, which includes the coal fields of Illinois, Indiana, and western Kentucky.
3. The western interior region, embracing the States of Iowa, Kansas, Missouri, Nebraska, Oklahoma, and Arkansas.
4. The Rocky Mountain region, contained within the States of Colorado, New Mexico, Utah, Montana, and Wyoming.
5. The Pacific coast region, in which the only coking coals are found in the State of Washington.

PRODUCTION.

STATISTICS OF PRODUCTION IN 1912.

The year 1912 exceeded any previous record in the quantity and value of coke made. The output of 1907, which in quantity was smaller than that of 1912 by over 3,000,000 short tons, had only a slightly lower value. The quantity of coke manufactured in 1912 amounted to 43,983,599 short tons, valued at $111,736,696. This represented an increase of 8,432,110 short tons, or 23.7 per cent, in quantity, and of $27,605,847, or 32.8 per cent, over 1911, when the production amounted to 35,551,489 short tons, valued at $84,130,849. Compared with 1910, when the previous high record in production was established, the output in 1912 shows an increase of 2,274,789 short tons in quantity, and of $11,993,995 in value. In the boom year, 1907, the demand for coke was considerably in excess of the supply, and prices reached the highest points in the entire period (30 years) of which there are any statistical records, and although, as stated above, the production in that year was over 3,000,000 tons less than the output of 1912, the total value amounted to $111,539,126, or only $197,570 below that of 1912. The average price for all coke made in 1907 was $2.74; in 1912 it was $2.54. The only other year besides 1907, in three decades, that the average price exceeded that of 1912 was in 1903, the year of fuel shortage due to the prolonged strike in the anthracite region of Pennsylvania, and to similar disturbances throughout some of the bituminous fields. The average value per ton in 1912 was 17 cents higher than in 1911. Part of this higher value was due to the relatively greater production of retort or by-product coke, and this apparent increase in average value will continue to augment as the retort oven continues to supplant the beehive type, without, however, as explained later on, any necessarily increased cost to the consumer. The higher value of the coke made in 1912 did not represent so much increased return in profits on the coking operations as at first appears, as more than three-fourths of the increase in value was offset by the higher value of the coal consumed in the production of the coke. The quantity of coal consumed in the manufacture of coke in 1912 was 65,577,862 short tons, valued at $86,918,962; in 1911 it was 53,278,248 tons, valued at $65,931,502, indicating an increase in 1912 of 12,299,614 short tons in quantity and of $20,987,460 in value. The increase in the value of the coke produced was $27,605,847, or $6,618,387 in excess of the increased value of the coal consumed. As the quantity of coke produced showed a gain of 8,432,110 short tons, it appears that the excess tonnage in 1912 yielded only about 80 cents a ton, gross, though the average price per ton for the year was $2.54, against $2.37 in 1911.

Of the 43,983,599 short tons of coke made in the United States in 1912, 32,868,435 tons were beehive or "oven" coke, valued at $69,103,766, and 11,115,164 tons, valued at $42,632,930, were retort or by-product coke. In 1911 the production of oven coke was 27,703,644 tons, valued at $56,832,952, and that of retort coke was 7,847,845 tons, valued at $27,297,897. In 1912, therefore, the production of oven coke increased 5,164,791 tons, or 18.7 per cent, while that of retort coke increased 3,267,319 tons, or 41.6 per cent. Notwithstanding the increase in the production in 1912 over 1911, the output of oven coke in the later year did not attain the record made in 1910, when the production amounted to over 34,500,000 tons, or nearly 7,000,000 tons more than in 1911. Retort-coke production, on the other hand, increased in both 1911 and 1912, and, with one exception (1908), has increased each year since the first retorts were built at Syracuse, N. Y., in 1893. The percentage of by-product coke to the total output has increased from 15.91 in 1909 to 17.12 in 1910, to 22.07 in 1911, and to 25.27 in 1912. The value of the oven coke in 1912 was $69,103,766, or 21.59 per cent more than in 1911, while the value of retort coke increased $15,335,033, or 56.18 per cent.

The average price per ton for oven coke in 1912 was $2.10, against $2.05 in 1911. The average price for retort coke was $3.84 in 1912, as compared with $3.48 in 1911. The relative gain in price of retort coke over oven coke was due to the larger quantity of coke made in ovens at increased distances from the coal fields. It must be borne in mind that the higher value of retort coke is due not to the superior quality of that product but to the fact that the retort ovens are located at a distance from the coal mines and at or near the centers of consumption where the markets for coke as well as those for gas and other by-products are available. The expenses of transportation are borne by and added to the cost of the coal, whereas by far the larger part of the oven coke is made in the immediate vicinity of the mines, and the expenses of transportation are borne by the coke.

Connellsville coke is the standard by which all other cokes are judged. Therefore the demand and prices for Connellsville coke may be considered as representing conditions generally throughout the coke-making regions. According to the Connellsville Courier, the year began with coke in good demand, and at the end of January the rate of production was the highest in 18 months. Prices ranged from $1.75 to $1.85 for spot and from $1.65 to $1.70 for contract. In the middle of February demand eased off a little, but only for a very brief period, and prices were well maintained. During the spring furnace requirements brought the production well up to capacity, and prices continued to advance until in May spot coke was bringing from $2.10 to $2.50 per ton, and contracts ranged from $2.25 to $2.35 for the second half of the year. In June and July a struggle developed between producers and users, the former to make contracts at $2.50 per ton and the latter to prevent such action and even to lower prices. The buyers were at first successful, and spot coke dropped to $1.90 to $2.10 in June, and in July contracts for the balance of the year were made at $2.25. The producers got the better of it in the fall and winter months, prices steadily advancing until in November and December spot coke brought as high as $4 per ton and contracts for the first half of 1913 were made at $3 to $3.25. Shortage in labor supply was the principal handicap in the coke trade and prevented the operation of the ovens to their full capacity. The year closed with the supply much below the demand. Foundry coke was particularly scarce. The average value per ton for Connellsville coke in 1912 was $1.90, or considerably less than the prices above quoted. This is due to the fact that coke delivered in 1912 was on contracts made the preceding year.

It should also be remembered that in fixing the total value and the average selling price for the coke produced in the United States such valuations are in some cases entirely arbitrary. Many coke ovens are operated by large corporations which not only produce the coal and make the coke but also operate blast furnaces and steel mills, while coke making is merely an incidental part of the business. In such cases the value of the coke is sometimes charged to the furnace department at cost, while in other cases the percentage of profit on the coal-mining and coke-making operations is added. In some other cases the coke is valued at the average market price of similar grades of coke in the immediate vicinity. These conditions, however, continue from year to year and do not affect comparisons.

The coal consumed in the manufacture of coke in 1912 was 65,577,862 short tons, valued at $86,918,962. In 1911 the quantity of coal consumed was 53,278,248 tons, valued at $65,931,502. In the earlier year the value of the coke produced was $84,130,489, and the difference between the value of the coal used and the coke produced was $20,018,765, which represents the profit on the coke-making operations less the cost of manufacture, expenses of administration, etc. In 1912 the value of the coke produced was $111,736,696, and the difference between the value of the coal used and of the coke produced was $24,817,734. The value of the coke manufactured, over and above the value of the coal used in 1912, shows an increase over the same factor in 1911, of $4,798,969, but it must be remembered that the output of coke in 1912 exceeded that of the preceding year by 8,432,110 short tons, indicating that the actual net returns to the coke manufacturers in 1912 were less than in 1911, notwithstanding the increased production and the larger proportionate gain in value.

During both 1911 and 1912 the number of ovens dismantled and abandoned exceeded the number of new ovens constructed. In 1911 there were 18 plants and 973 ovens abandoned. In 1912 there were 22 entire plants with a total of 1,529 ovens abandoned, and in addition to these there were portions of plants amounting to 2,648 ovens which were torn down. Most of the ovens now reported as abandoned have been idle for several years. The new ovens built in 1912 numbered 2,528, including 613 of the retort or by-product type. The total number of ovens dismantled was 4,177, all but 26 of which were of the beehive type. The 26 exceptions were Rothberg ovens, 1 in New York, and 25 in Ohio. The total number of ovens in existence in the United States decreased from 103,879 in 1911 to 102,230 in 1912, a loss of 1,649. There were 2,783 new ovens in course of construction at the close of 1912, and of these 793 were of the retort or by-product type. Of the 102,230 ovens in existence at the close of the year, 29,172 were idle throughout 1912. All of the idle ovens were of the beehive type, whereas all of the retort-oven plants were operated during the year. In designating the number of idle ovens this statement refers only to those which were idle all of the year. It does not include any ovens which were idle during a portion of the time only and which contributed to the output in 1912. The 29,172 idle ovens included 12,581 that comprised the entire equipment of 120 establishments. The total number of ovens in blast during the whole or a portion of 1912 was 73,058, as compared with 63,480 active ovens in 1911. Of the 73,058 ovens making coke in 1912, 5,211 were of the retort or by-product type, and 67,847 were of the beehive or partial-combustion type. The 5,211 retort ovens produced 11,115,164 tons of coke, or an average of 2,133 tons per oven. The 67,847 beehive or partial-combustion ovens produced 32,868,345 tons, or an average of 484 tons for each oven. In 1911 there were 4,320 retort ovens which produced an average of 1,817 tons per oven, and 59,160 active beehive ovens which produced an average of 468 tons per oven. The average value per oven of the coke produced in active beehive ovens in 1912 was $1,019, and the average value of the coke and by-products produced at retort ovens was $11,265, or over 10 times the average value of the beehive production. As previously stated, at the close of 1912 there were 793 retort ovens in course of construction, and a number of additional plants under contract or in contemplation. The increased interest and activity in the development of retort-oven practice in the United States indicates that before the close of the present decade more than half of the coke manufactured in this country will be from retort ovens.

Each bank of ovens being considered as a separate establishment, the returns for 1912 show a total of 559 establishments in that year, against 570 in 1911 and 578 in 1910. It appears, therefore, that there were 11 fewer coking establishments in 1912 than in 1911, and 19 fewer than in 1910, although the production in 1912 shows a decided increase (due to the operation of retort ovens) over both of the preceding years. There were 22 establishments abandoned in 1912, and 11 new ones began construction. Of the 559 establishments in 1912, 120 were idle. The idle establishments were relatively small, having an average equipment of about 100 ovens.

The statistics of production of coke in 1911 and 1912 are presented, by States, in the following table:

Manufacture of coke, by States, in 1911 and 1912.

1911.

State	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	44	10,121	280	4,411,298	62.6	2,761,521	$7,593,594	$2.75
Colorado [a]	16	3,606	0	1,810,335	65.0	1,177,023	3,880,710	3.30
Georgia	2	225	0	72,677	51.7	37,553	135,190	3.60
Illinois	4	506	48	2,087,870	77.1	1,610,212	6,390,251	3.97
Kentucky	8	577	300	118,255	55.9	66,099	134,862	2.04
New Mexico	4	1,030	0	620,639	61.5	381,927	1,240,963	3.25
New York	4	556	0	955,067	71.8	686,172	2,883,990	4.20
Ohio	8	496	0	456,222	68.2	311,382	961,904	3.09
Pennsylvania	279	54,904	1,271	32,875,655	66.7	21,923,935	43,053,367	1.96
Tennessee	15	2,547	30	628,118	52.6	330,418	797,758	2.41
Utah	2	854	0	(b)	(b)	(b)	(b)	....
Virginia	18	5,496	100	1,425,303	63.9	910,411	1,615,609	1.77
Washington	5	235	0	60,201	66.6	40,180	216,262	5.38
West Virginia	138	19,876	130	3,754,561	60.4	2,291,049	4,236,845	1.85
Indiana, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Jersey, Oklahoma, Wisconsin	23	2,850	95	4,002,047	75.6	3,023,607	10,989,544	3.63
Total	570	103,879	2,254	53,278,248	66.7	35,551,489	84,130,849	2.37

1912.

State	Establishments.	Ovens Built.	Ovens Building.	Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke.	Price of coke per ton.
Alabama	46	10,208	100	4,585,498	64.9	2,975,489	$8,098,412	$2.72
Colorado	15	3,588	0	1,473,112	66.0	972,941	3,043,994	3.13
Georgia	2	251	0	87,300	50.0	43,158	161,842	3.75
Illinois	6	594	40	2,316,307	76.2	1,764,944	8,069,903	4.57
Indiana	4	642	169	3,198,874	81.8	2,616,339	12,528,685	4.79
Kentucky	9	1,049	291	307,162	62.4	191,555	513,734	2.68
Montana	4	451	3	0	0	0	0	0
New Mexico	4	1,030	0	679,209	60.9	413,906	1,356,946	3.28
New York	4	555	0	1,095,198	72.6	794,618	3,203,133	4.03
Ohio	7	471	119	561,426	69.2	388,669	1,365,905	3.51
Oklahoma	2	260	0	0	0	0	0	0
Pennsylvania	277	53,756	1,887	41,268,532	66.5	27,438,693	56,267,838	2.05
Tennessee	15	2,584	0	685,861	54.0	370,076	951,853	2.57
Virginia	18	5,408	0	1,555,969	62.2	967,947	1,815,975	1.88
Washington	6	313	0	78,693	62.6	49,260	279,105	5.67
West Virginia	129	19,064	0	4,061,702	60.7	2,465,986	4,692,393	1.90
Kansas, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, Utah, Wisconsin	11	2,006	174	3,623,019	69.8	2,530,018	9,386,978	3.71
Total	559	102,230	2,783	65,577,862	67.1	43,983,599	111,736,696	2.54

[a] Includes production of Utah.

[b] Production included with Colorado.

PRODUCTION IN PREVIOUS YEARS.

In the early days of the iron industry of the United States, as in other countries, charcoal was the only fuel used in the blast furnaces. Anthracite appears to have been first successfully used in the second decade of the nineteenth century. According to Swank[1] Francis

[1] Swank, James A., Iron in all ages, 1892, p. 201.

McShane established a small cut-nail factory at Wilkes-Barre "and used anthracite coal in smelting the iron." It was not, however, until about 1840 that the introduction of bituminous and anthracite coal in the blast furnaces began to have any effect on the trade. About the middle of the nineteenth century, however, the manufacture of charcoal iron began to decline, and in 1855 the quantity of iron made with anthracite fuel alone exceeded that made with charcoal. According to Fulton [1] 100 tons of pig iron were made, using coke as fuel, by F. H. Oliphant, at Fairchance in Fayette County, Pa., as early as 1837. In 1841 some coke was shipped from what is now the Connellsville district to Cincinnati. Swank refers to the use of coke in a refinery at Plumsock in Fayette County as early as 1817. An offer of a gold medal was made by the Franklin Institute in 1835 to anyone who would make iron with bituminous coal or coke from bituminous coal. It is not stated whether the medal was ever claimed. Certainly William Fernstone, who first succeeded in making iron with coke at the Mary Ann furnace in Huntingdon County, did not claim it. The use of coke did not grow rapidly in favor, and it was not until 1850 that it began to exert an appreciable influence in the manufacture of pig iron. The Seventh Census of the United States (1850) reports 4 establishments engaged in the manufacture of coke, but gave no information regarding the quantity or value of the coke produced. At the Eighth Census (1860) there were 21 coke-making establishments, and in 1870 according to the Ninth Census there were 25 establishments, but in neither of these, as at the taking of the Seventh Census, were any figures of production given. Mr. Swank is authority for the statement that it was not until 1875 that the quantity of pig iron made with coke exceeded that made with anthracite, the latter having held the supremacy for 20 years, or since it exceeded charcoal in 1855. At the present time the use of anthracite for blast furnace fuel is negligible. When used at all it is usually mixed with coke. Some bituminous, also mixed with coke, is used in blast furnaces in Ohio and Indiana, but the quantity compared with the use of coke alone is small. Charcoal is still used to a limited extent for the manufacture of special irons, but even for this purpose its use is steadily decreasing.

The first record of the quantity of coke made in the United States was in 1880, when, according to the report of the Tenth United States Census, the production is stated to have been 3,338,300 short tons. The annual production since 1880 has been published in this series of reports, the present chapter completing the record of 33 years, which is shown in the following table:

Quantity of coke produced in the United States, 1880–1912, in short tons.

1880	3,338,300	1891	10,352,688	1902	25,401,730
1881	4,113,760	1892	12,010,829	1903	25,274,281
1882	4,793,321	1893	9,477,580	1904	23,661,106
1883	5,464,721	1894	9,203,632	1905	32,231,129
1884	4,873,805	1895	13,333,714	1906	36,401,217
1885	5,106,696	1896	11,788,773	1907	40,779,564
1886	6,845,369	1897	13,288,984	1908	26,033,518
1887	7,611,705	1898	16,047,209	1909	39,315,065
1888	8,540,030	1899	19,668,569	1910	41,708,810
1889	10,258,022	1900	20,533,348	1911	35,551,489
1890	11,508,021	1901	21,795,883	1912	43,983,599

[1] Fulton, John, Treatise on coke.

The increase in the production of coke has naturally followed the rapid development of the iron and steel industries in the United States.

At the taking of the Eleventh Census in 1890 the production of coke in the United States was a little more than three times the quantity reported in 1880, and amounted to 11,508,021 short tons. By 1900 the production had grown to 20,533,348 short tons, an increase of nearly 80 per cent in 10 years. In 1910 the production was a little more than double what it was 10 years before and amounted to 41,708,810 short tons.

The 33 years of coke-making history being divided into three equal periods, it is to be noted that in the first 11 years the production of coke amounted to 72,453,750 tons; in the middle period it amounted to 157,501,209 tons; and in the 11 years concluding with 1912 it was 370,341,418 tons. The second period exceeded the first period by 117 per cent, and the third exceeded the second by 135 per cent. During the entire period of 33 years there have been 9 years of decreased production as compared with the year immediately preceding, the most important instances being in the panic years of 1893 and 1894, and in the business depression of 1908.

An unusual condition presented by the statistics of coke production in 1912 is that in no State for which figures are published separately was an exception noted in the general increase over the preceding year. The quantities of increase ranged from 5,605 tons in Georgia to 5,514,758 tons in Pennsylvania, and the percentages ranged from 2.23 in Colorado to 189.8 in Kentucky. As in 1911, the most significant increase, though not the largest in either quantity or percentage in 1912, was in Indiana, and was due chiefly to the operations of the plant of Koppers ovens at Gary. This entire plant of 560 ovens was completed and put in blast in 1912; 490 of them were fired the preceding year. The coke production of Indiana increased 1,699,928 tons, or 185.5 per cent, from 916,411 tons in 1911 to 2,616,339 tons in 1912, and placed Indiana third in rank among the States, outclassing West Virginia. Most of the coal for the Gary plant, however, and for the other by-product ovens at Indianapolis and at South Chicago and Joliet in Illinois is drawn from West Virginia mines, and about 80 per cent of the coke product of both States might be credited to West Virginia.

The largest increase in quantity was in Pennsylvania, whose output showed a gain of 5,514,758 tons, 65 per cent of the total increase for the United States in 1912. Kentucky had the distinction of the largest percentage of increase, the output in 1912 being nearly 190 per cent more than in 1911. This increase was due to the added facilities furnished by 112 new beehive ovens at Ashland, to the operations of 300 ovens by the Wisconsin Steel Co. in Harlan County, and to several smaller plants in Pike County, all of these coking activities being due to the recent developments in the Elkhorn coal district. At the close of 1912, 41 Semet-Solvay ovens were under construction at Ashland. This will be the first installation of retort ovens in the State. Alabama and West Virginia showed almost exactly the same ratio of increase, the former having a gain of 7.75 per cent and the latter of 7.64. Alabama retains its rank among the States, but West Virginia fell from third to fourth place because of the big increase in Indiana.

In the following table is shown the production of coke by States during the last five years, with the increase in 1912 as compared with 1911:

Quantity of coke produced in the United States, 1908–1912, by States, in short tons, with increase in 1912.

State.	1908	1909	1910	1911	1912	Increase in quantity of coke produced.	
						1911–12	Per cent.
Alabama	2,362,666	3,085,824	3,249,027	2,761,521	2,975,489	213,968	7.75
Colorado	[a] 982,291	[a] 1,251,805	[a] 1,346,211	951,748	972,941	21,193	2.23
Georgia	39,422	46,385	43,814	37,553	43,158	5,605	14.93
Illinois	362,182	1,276,956	1,514,504	1,610,212	1,764,944	154,732	9.61
Indiana	(b)	(b)	(b)	916,411	2,616,339	1,699,928	185.50
Kansas	2,497	....	(b)	(b)	(b)	(b)	(b)
Kentucky	(b)	46,371	53,857	66,099	191,555	125,456	189.80
New Mexico	274,565	373,967	401,646	381,927	413,906	31,979	8.37
New York	(b)	(b)	652,459	686,172	794,618	108,446	15.80
Ohio	159,578	222,711	282,315	311,382	388,669	77,287	24.82
Oklahoma	(b)	....	(b)	....	....	....	....
Pennsylvania	15,511,634	24,905,525	26,315,607	21,923,935	27,438,693	5,514,758	25.15
Tennessee	214,528	261,808	322,756	330,418	370,076	39,658	12.00
Utah	(c)	(c)	(c)	(c)	(b)	(b)	(b)
Virginia	1,162,051	1,347,478	1,493,655	910,411	967,947	57,536	6.32
Washington	38,889	42,981	59,337	40,180	49,260	9,080	22.60
West Virginia	2,637,123	3,943,948	3,803,850	2,291,049	2,465,986	174,937	7.64
Other States	2,286,092	2,509,306	2,169,772	2,332,471	2,530,018	197,547	8.47
Total	26,033,518	39,315,065	41,708,810	35,551,489	43,983,599	8,432,110	23.72

[a] Includes Utah.
[b] Included with other States having less than three producers.
[c] Included with Colorado.

In the table following is given a statement of the establishments, the number of ovens built and building, the quantity of coal used, the percentage yield of coal in coke, the quantity and value of the coke produced, and the average price per ton for the years 1880, 1890, 1900, and from 1908 to 1912, inclusive:

Statistics of the manufacture of coke in the United States in 1880, 1890, 1900, 1908–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Percentage yield of coal in coke.	Coke produced (short tons).	Total value of coke at ovens.	Price of coke at ovens, per ton.
		Built.	Building.					
1880	186	12,372	1,159	5,237,741	63.0	3,338,300	$6,631,267	$1.99
1890	253	37,158	1,547	18,005,209	64.0	11,508,021	23,215,302	2.02
1900	396	58,484	5,804	32,113,553	63.9	20,533,348	47,443,331	2.31
1908	551	101,218	2,241	39,440,837	66.0	26,033,518	62,483,983	2.40
1909	579	103,982	2,950	59,354,937	66.2	39,315,065	89,965,483	2.29
1910	578	104,440	2,567	63,088,327	66.1	41,708,810	99,742,701	2.39
1911	570	103,879	2,254	53,278,248	66.7	35,551,489	84,130,849	2.37
1912	559	102,230	2,783	65,577,862	67.1	43,983,599	111,736,696	2.54

VALUE OF COKE PRODUCED.

In addition to the general increase in production in 1912, prices advanced in every State with the exception of Alabama and New York. There was, moreover, a larger proportionate gain in the manufacture of retort coke, and for reasons already explained the price of this product is always higher than that of oven coke, so that a larger production of retort coke is reflected in higher total values and an advance in the average price. The total value of the coke produced in the United States increased from $84,130,849 in 1911 to $111,736,696 in 1912, a gain of $27,605,847, or 32.81 per cent. The percentage of increase in production was 23.72. The largest percentage gain in 1912 was in Kentucky, the value of whose product increased from $134,862 to $513,734, a gain of $378,872, or 281 per cent. The most notable increase, however, though not the largest, was in Indiana, where the value increased $8,930,490, or nearly 250 per cent, all of it being retort coke. The total value of retort coke increased from $27,297,897 to $42,632,930, a gain of $15,335,033, or 56 per cent, and the value of oven coke increased from $56,832,952 to $69,103,766, a gain of $12,270,814, or 21.6 per cent. In quantity retort coke showed an increase of 41.6 per cent, and oven coke increased 18.7 per cent. In the following tables are presented statements showing the value of coke produced in the several States for the last five years, with the value and percentage of increase in 1912 as compared with 1911, and the total value of the coke produced in the United States in each year since 1880:

Total value, at the ovens, of the coke made in the United States, 1908–1912, by States, with increase in 1912.

State.	1908	1909	1910	1911	1912	Increase in value of coke produced.	
						1911–12	Percentage.
Alabama	$7,169,901	$8,068,267	$9,165,821	$7,593,594	$8,098,412	$504,818	6.65
Colorado	[a]3,238,888	[a]4,135,931	[a]4,273,579	2,903,811	3,043,994	140,183	4.83
Georgia	137,524	159,334	173,049	135,190	161,842	26,652	19.71
Illinois	1,538,952	5,361,510	6,712,550	6,390,257	8,069,903	1,679,652	26.28
Indiana	(b)	(b)	(b)	3,598,195	12,528,685	8,930,490	248.19
Kansas	8,011	....	(b)	(b)	(b)	(b)	(b)
Kentucky	(b)	101,257	120,554	134,862	513,734	378,872	280.93
New Mexico	826,780	1,099,694	1,306,136	1,240,963	1,356,946	115,983	9.35
New York	(b)	(b)	2,635,873	2,883,990	3,203,133	319,143	11.07
Ohio	491,982	683,155	911,987	961,904	1,365,905	404,001	42.00
Oklahoma	(b)	....	(b)	....	....	....	....
Pennsylvania	32,569,621	50,377,035	55,254,599	43,053,367	56,267,838	13,214,471	30.69
Tennessee	561,789	667,723	959,104	797,758	951,853	154,095	19.32
Utah	(c)	(c)	(c)	(c)	(b)	(b)	(b)
Virginia	2,121,980	2,415,769	2,731,348	1,615,609	1,815,975	200,366	12.40
Washington	213,138	240,604	347,540	216,262	279,105	62,843	29.06
West Virginia	5,267,054	7,525,922	7,354,039	4,236,845	4,692,393	455,548	10.75
Other States	8,338,363	9,129,282	7,796,522	8,368,242	9,386,978	1,018,730	12.17
Total	62,483,983	89,965,483	99,742,701	84,130,849	111,736,696	27,605,847	32.81

[a] Includes value of Utah coke.
[b] Included in other States having less than three producers.
[c] Included with Colorado.

Total value, at the ovens, of the coke made in the United States, 1880–1912.

1880	$6,631,265	1891	$20,393,216	1902	$63,339,167
1881	7,725,175	1892	23,536,141	1903	66,498,664
1882	8,462,167	1893	16,523,714	1904	46,144,941
1883	8,121,607	1894	12,328,856	1905	72,476,196
1884	7,242,878	1895	19,234,319	1906	91,608,034
1885	7,629,118	1896	21,660,729	1907	111,539,126
1886	11,153,366	1897	22,102,514	1908	62,483,983
1887	15,321,116	1898	25,586,699	1909	89,965,483
1888	12,445,963	1899	34,670,417	1910	99,742,701
1889	16,630,301	1900	47,443,331	1911	84,130,849
1890	23,215,302	1901	44,445,923	1912	111,736,696

From the preceding statements, which show 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 explained. Some of the largest producers of coke consume their entire product in their own blast furnaces. By some such producers the value of the coke is given at the actual cost of production; by others it is based upon the cost of production, a percentage of profit on the coking operations being added; and by still others 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 accepted as indicating the general condition of the market.

The average prices of coke, by States, from 1908 to 1912, inclusive, are shown in the following tables:

Average price per short ton, at the ovens, of the coke made in the United States, 1908–1912, by States.

State.	1908	1909	1910	1911	1912
Alabama	$3.04	$2.61	$2.82	$2.75	$2.72
Colorado	[a] 3.30	[a] 3.30	[a] 3.17	[a] 3.30	3.13
Georgia	3.72	3.44	3.95	3.60	3.75
Illinois	4.25	4.20	4.43	3.97	4.57
Indiana	(b)	(b)	(b)	(b)	4.79
Kansas	3.21	....	(b)	(b)	(b)
Kentucky	(b)	2.18	2.24	2.04	2.68
New Mexico	3.01	2.94	3.25	3.25	3.28
New York	(b)	(b)	4.04	4.20	4.03
Ohio	3.08	3.07	3.23	3.09	3.51
Oklahoma	(b)	....	(b)	(b)	....
Pennsylvania	2.10	2.02	2.10	1.96	2.05
Tennessee	2.62	2.55	2.97	2.41	2.57
Utah	(c)	(c)	(c)	(c)	(b)
Virginia	1.83	1.79	1.83	1.77	1.88
Washington	5.48	5.60	5.86	5.38	5.67
West Virginia	2.00	1.99	1.93	1.85	1.90
Other States	3.65	3.64	3.53	3.75	3.71
Average	2.40	2.29	2.39	2.37	2.54

[a] Includes Utah.
[b] Included in other States having less than three producers.
[c] Included with Colorado.

The following table showing the general average prices during a period of 33 years is of interest as indicating the much higher values that have obtained during the last third of this period. In each of the first and second divisions there were only two years in which the average price exceeded $2 a ton, though those of the middle division were generally higher than the first. In the last 11 years there was only one year in which the average fell below $2, and in this year it was only 5 cents below. The mean average price for the 11 years from 1880 to 1890, inclusive, was $1.71; from 1891 to 1901 it was $1.79, and from 1902 to 1912 it was $2.42.

Average price per short ton, at the ovens, of the coke made in the United States, 1880–1912.

1880	$1.99	1891	$1.97	1902	$2.49
1881	1.88	1892	1.96	1903	2.63
1882	1.77	1893	1.74	1904	1.95
1883	1.49	1894	1.34	1905	2.25
1884	1.49	1895	1.44	1906	2.52
1885	1.49	1896	1.84	1907	2.74
1886	1.63	1897	1.66	1908	2.40
1887	2.01	1898	1.59	1909	2.29
1888	1.46	1899	1.76	1910	2.39
1889	1.62	1900	2.31	1911	2.37
1890	2.02	1901	2.04	1912	2.54

The higher prices in the later years shown in the foregoing table are only in part due to the influence on values exerted by the increasing proportion of retort coke, for, as shown in the following table, the average price for beehive coke has not fallen below $2 per ton in the last five years. The average price for retort coke during this period has ranged from $1.17 to $1.74 higher than beehive, the difference representing the transportation expenses on the coal from the mines to the ovens. The greater differences in 1911 and 1912 are due to the increased production of coke in Illinois and Indiana and their greater distances from the mines of West Virginia, which furnish the larger part of the coal used.

Comparative average prices of beehive (oven) and by-product (retort) coke, 1908–1912, per short ton.

Year.	Beehive.	By-product.	Mean average.
1908	$2.20	$3.44	$2.40
1909	2.10	3.27	2.29
1910	2.17	3.47	2.39
1911	2.05	3.48	2.37
1912	2.10	3.84	2.54

NUMBER OF COKE WORKS AND OVENS IN THE UNITED STATES.

In compiling the statistics of coke manufacture each bank of ovens is considered as a separate establishment, although in many cases these different establishments form a part only of one property and are reported from a central office. Different plants controlled or operated by one company are considered as much separate establishments as are the individual banks of ovens owned and operated by one firm or corporation. In 1912, notwithstanding the largely increased production of coke, the number of establishments and of ovens abandoned exceeded the number of plants and of ovens of new construction. There were 22 establishments abandoned and 11 new plants built, reducing the total number of plants from 570 to 559. The 22 dismantled plants had a total of 1,529 ovens. Most of these plants, it should be stated, had been idle for several years, and as they had an average of less than 70 ovens to a plant they were for the most part small plants. In addition to the 1,529 ovens contained in the 22 abandoned plants, there were 2,648 ovens, portions of operating plants, that were dismantled, making a total of 4,177 ovens abandoned during 1912. Of the 22 establishments abandoned

9 were in Pennsylvania, 6 in West Virginia, 2 in Oklahoma, and 1 each in Colorado, Indiana, Kansas, Ohio, and Utah. There were 120 establishments with a total of 12,581 ovens that were idle during the year, and 16,591 ovens, portions of other plants, that were not in blast, making a total of 29,172 idle ovens. In 1911 there were 179 idle establishments and a total of 40,399 idle ovens. The number of plants in operation in 1912 was 439 against 391 in 1911, and the number of active ovens was 73,058 against 63,480. The number of active ovens for each plant was 166 in 1912 and 162 in 1911. The 120 idle plants in 1912 averaged 105 ovens to the plant. The 439 active establishments in 1912 produced 43,983,599 tons of coke or an average of a little over 100,000 tons to the plant, an increase of nearly 10,000 tons per plant over 1911. The concentration of the coking industry into comparatively large units has progressed markedly in recent years, as indicated by the fact that in 1880 there were 186 establishments which produced a total of 3,338,300 tons, an average of 17,948 tons to an establishment; the average production of each establishment in 1912 was nearly six times the average of 1880. In 1880 there were 12,372 ovens in existence, an average of 67 to the establishment; in 1912 the average number of ovens to the establishment, including idle as well as active ovens, was 183. If instead of the number of plants the number of operating firms and corporations were considered as the unit, the concentration would appear to have been even more pronounced. An essential feature, however, in the increase in the average production per establishment and per oven during recent years has been the output from the growing number of by-product plants. In 1912 there were 5,211 active retort ovens in operation, with an average of 2,133 tons of production per oven.

The total number of establishments manufacturing coke in the United States at the end of each decade from 1850 to 1910, and at the end of each year since 1910, 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	1900, Dec. 31	396
1860 (census year)	21	1910, Dec. 31	578
1870 (census year)	25	1911, Dec. 31	570
1880, Dec. 31	186	1912, Dec. 31	559
1890, Dec. 31	253		

The following table shows the number of coke ovens in existence in each State on December 31 for each of the last five years:

Number of coke ovens in each State at close of each year, 1908–1912.

State.	1908	1909	1910	1911	1912
Alabama	10,103	10,061	10,132	10,121	10,208
Colorado	3,841	3,846	3,611	3,606	3,588
Georgia	350	350	350	225	251
Illinois	430	468	508	506	594
Indiana	46	96	90	586	642
Kansas	67	67	71	53	3
Kentucky	495	494	495	577	1,049
Maryland	200	200	200	200	200
Massachusetts	400	400	400	400	400
Michigan	150	162	162	162	165
Minnesota	50	50	50	50	50
Missouri	4	4	4	....	....
Montana	551	551	451	451	451
New Jersey	150	150	150	150	150
New Mexico	1,016	1,030	1,030	1,030	1,030
New York	540	556	556	556	555
Ohio	481	447	496	496	471
Oklahoma	486	536	408	410	260
Pennsylvania	52,606	54,506	55,656	54,904	53,756
Tennessee	2,792	2,729	2,792	2,547	2,584
Utah	864	854	854	854	650
Virginia	4,853	5,469	5,389	5,496	5,408
Washington	231	285	285	235	313
West Virginia	20,124	20,283	19,912	19,876	19,064
Wisconsin	388	388	388	388	388
Total	101,218	103,982	104,440	103,879	102,230

The following table shows in a succinct statement the number of idle establishments and ovens, the number of establishments and ovens abandoned in 1912, and the number of establishments and ovens in the course of construction at the end of the year:

Number of coke establishments idle, abandoned, and in course of construction at the end of 1912.

State.	Idle.			Abandoned.			Building.		
	Establishments.	Ovens.	Total number of ovens idle.	Establishments.	Ovens.	Total number of ovens abandoned.	Establishments.	Ovens.	Total number of ovens building.
Alabama	18	2,902	3,499	0	0	191	0	0	100
Colorado	7	893	1,827	1	18	18	0	0	0
Georgia	1	50	74	0	0	0	0	0	0
Illinois	2	26	26	0	0	0	0	0	40
Indiana	1	10	10	1	36	36	2	119	169
Kansas	1	2	2	1	50	50	0	0	0
Kentucky	2	104	264	0	0	0	2	191	291
Maryland	0	0	0	0	0	0	0	0	6
Michigan	0	0	0	0	0	0	0	0	40
Minnesota	0	0	0	0	0	0	1	92	92
Montana	4	451	451	0	0	0	0	0	3
New Mexico	1	50	50	0	0	0	0	0	0
New York	0	0	0	0	0	1	0	0	0
Ohio	0	0	0	1	25	25	1	68	119
Oklahoma	2	260	260	2	150	150	0	0	0
Pennsylvania	21	1,857	8,967	9	701	2,460	4	836	1,887
Tennessee	6	928	1,118	0	0	0	0	0	0
Utah	0	0	0	1	204	204	0	0	0
Virginia	3	326	2,432	0	0	88	0	0	0
Washington	3	100	119	0	0	0	0	0	0
West Virginia	47	4,394	9,845	6	345	954	0	0	0
Wisconsin	1	228	228	0	0	0	1	36	36
Total	120	12,581	29,172	22	1,529	4,177	11	1,342	2,783

Number of coke ovens in the United States on December 31 of each fifth year, from 1880 to 1912.

1880	12,372	1905	87,564
1885	20,116	1910	104,440
1890	37,158	1911	103,879
1895	45,565	1912	102,230
1900	58,484		

A statement of the number of ovens in course of construction at the end of each year since 1907 is shown in the following table. It is not intended by this to show the increase in the number of new 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, 1907–1912.

1907	2,546	1910	2,567
1908	2,241	1911	2,254
1909	2,950	1912	2,783

RANK OF COKE-PRODUCING STATES.

The most important change in the rank of coke-producing States resulting from the record of 1912 was the advance of Indiana from sixth to third place and the relegating of West Virginia to fourth place. In 1910 Indiana was only seventeenth in the list, the advance in the last two years being due principally to the operations of the 560 Koppers ovens by the United States Steel Corporation at Gary, and in less degree to a plant of 50 United-Otto ovens at Indianapolis, and 22 Klönne ovens, completed in 1912, at Muncie. West Virginia dropped from second to third place in 1911. It may be well, however, to repeat the statement made in earlier reports that if its importance as a coke producer were measured by the quantity of coal furnished to the coking plants, West Virginia would remain firmly fixed in second place. The larger part of the coal used at the retort plants in Ohio, Illinois, and Indiana is drawn from West Virginia mines, as is the coal used at the beehive ovens at Covington and Lowmoor, Va. The quantity of coal used in coke making in the State in 1912 was 4,061,702 tons. The quantity of West Virginia coal made into coke in retorts and ovens outside the State was probably in the neighborhood of 5,000,000 tons, or about 25 per cent more than that used at ovens near the mines.

Aside from the changes made in the standing of Indiana and West Virginia the first 10 States held the same relative positions in 1912 as in 1911. Ohio advanced from fifteenth to thirteenth and Maryland dropped from thirteenth to sixteenth. The other changes were unimportant. The positions held by the coke-producing States during the last five years are shown in the following table:

Rank of the States in production of coke, 1908–1912.

State.	1908	1909	1910	1911	1912
Pennsylvania	1	1	1	1	1
Alabama	3	3	3	2	2
Indiana	24	22	17	6	3
West Virginia	2	2	2	3	4
Illinois	9	5	4	4	5
Colorado	5	6	6	5	6
Virginia	4	4	5	7	7
New York	6	7	7	8	8
Wisconsin	8	8	8	9	9
Massachusetts	7	9	9	10	10
Michigan	13	11	11	12	11
New Mexico	10	10	10	11	12
Ohio	15	15	14	15	13
Tennessee	14	13	13	14	14
Utah	16	16	16	17	15
Maryland	11	12	12	13	16
New Jersey	12	14	15	16	17
Kentucky	20	19	20	19	18
Minnesota	17	17	18	18	19
Washington	19	20	19	20	20
Georgia	18	18	21	21	21
Kansas	23	....	24	22	22
Montana	21	21	22	....	....
Oklahoma	22	....	23	....	....

COAL CONSUMED IN THE MANUFACTURE OF COKE.

As stated in previous reports of this series, the determination of the quantity of coal consumed in the manufacture of coke is, to a considerable extent, a matter of estimate, a considerable quantity of the coal so used being 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 on the measured bushel or ton and sometimes on the cubical contents of the mine car. All these standards are likely 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 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. At some of the establishments the weight of this coal before washing is given approximately; at others the weight, after the slate, pyrite, and other impurities have been removed, is reported for the weight of the coal charged into the ovens; at still others coke ovens have been constructed chiefly for the purpose of utilizing the slack coal produced, in which case 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 previously stated, an apparent discrepancy appears between the statements regarding the quantity 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 total quantity of coal made into coke in 1912 was 65,577,862 short tons, against 53,278,248 so used in 1911, an increase of 12,299,614 tons, or 23.1 per cent.

The quantity of coal used in the manufacture of coke, as obtained for this report from the several States, from 1908 to 1912 and the quantity used during each fifth year since 1880 are shown in the following tables:

Quantity of coal used in the manufacture of coke in the United States, 1908–1912, by States, in short tons.

State.	1908	1909	1910	1911	1912
Alabama	3,875,791	5,080,764	5,272,322	4,411,298	4,585,498
Colorado	a 1,546,044	a 1,984,985	a 2,069,266	a 1,810,335	1,473,112
Georgia	71,452	86,290	80,019	72,677	87,300
Illinois	503,359	1,682,122	1,972,955	2,087,870	2,316,307
Indiana	(b)	(b)	(b)	(b)	3,198,874
Kansas	3,790	0	(b)	(b)	(b)
Kentucky	(b)	89,083	104,103	118,255	307,162
Montana	(b)	(b)	(b)	0	0
New Mexico	454,873	694,390	651,494	620,639	679,209
New York	(b)	(b)	910,293	955,067	1,095,198
Ohio	237,448	340,735	413,059	456,222	561,426
Oklahoma	(b)	0	(b)	0	....
Pennsylvania	23,215,964	36,983,568	39,455,785	32,875,655	41,268,532
Tennessee	395,936	493,283	597,658	628,118	685,861
Utah	(c)	(c)	(c)	(c)	(b)
Virginia	1,785,281	2,060,518	2,310,742	1,425,303	1,555,969
Washington	68,069	69,708	94,223	60,201	78,693
West Virginia	4,127,730	6,361,759	6,226,234	3,754,561	4,061,702
Other States	3,155,100	3,427,732	2,930,174	4,002,047	3,623,019
Total	39,440,837	59,354,937	63,088,327	53,278,248	65,577,862

a Includes coal coked in Utah.
b Included in other States having less than three producers.
c Included with Colorado.

Quantity of coal used in the manufacture of coke in the United States each fifth year, 1880–1912.

	Short tons.		Short tons.		Short tons.
1880	5,237,741	1895	20,848,323	1910	63,088,327
1885	8,071,126	1900	32,113,543	1911	53,278,248
1890	18,005,209	1905	49,530,677	1912	65,577,862

QUANTITY AND VALUE OF COAL USED IN MAKING COKE.

The quantity of coal used in the manufacture of coke in 1912 was 65,577,862 short tons, an increase of 12,299,614 tons, or 23.1 per cent, over 1911, when the quantity of coal consumed was 53,278,248 tons. The value of the coal consumed increased from $65,931,502 in 1911 to $86,918,962 in 1912, the latter year exceeding the former by $20,987,460, or 31.8 per cent. The average value of the coal used per ton was $1.33 in 1912 against $1.24 in 1911. The value of the coal per ton of coke produced was $1.86 in 1911 and $1.98 in 1912. The cost of the coal charged into the ovens in 1912 was accordingly 12 cents more per ton of coke produced than it was in 1911, while the average price per ton of coke produced showed a gain of 17 cents, indicating a net advance of 5 cents per ton for the product in 1912. The total value of the coal consumed in 1912 was $86,918,962. The total value of the coke produced in 1912 exceeded that of 1911 by $27,605,847, so that there was a difference in favor of 1912 of $6,618,387 over and above the increased value of the coal used in that year.

The total quantity and value of the coal consumed in the manufacture of coke in 1911 and 1912, with the quantity and value of the coal consumed per ton of coke produced, by States, are shown in the following table:

Quantity and value of coal used in the manufacture of coke in the United States in 1911 and 1912, and quantity and value of same per ton of coke, by States.

1911.

State.	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	4,411,298	$5,640,509	$1.28	1.597	$2.044
Colorado [a]	1,810,335	2,192,882	1.21	1.538	1.861
Georgia	72,677	113,403	1.55	1.935	2.999
Illinois	2,087,870	5,774,922	2.77	1.291	3.576
Kentucky	118,255	61,658	.52	1.789	.930
New Mexico	620,639	960,481	1.55	1.625	2.519
New York	955,067	2,258,551	2.37	1.392	3.299
Ohio	456,222	853,655	1.87	1.465	2.740
Pennsylvania	32,875,655	32,923,460	1.00	1.500	1.500
Tennessee	628,118	636,058	1.01	1.901	1.920
Virginia	1,425,302	1,132,374	.79	1.566	1.237
Washington	60,201	127,959	2.13	1.498	3.191
West Virginia	3,754,561	3,037,531	.81	1.639	1.328
Other States [b]	4,002,047	10,218,059	2.55	1.324	3.376
Total	53,278,248	65,931,502	1.24	1.499	1.859

1912.

State.	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	4,585,498	$6,177,876	$1.35	1.541	$2.080
Colorado	1,473,112	2,307,660	1.57	1.514	2.377
Georgia	87,300	130,950	1.50	2.023	3.035
Illinois	2,316,307	6,568,003	2.84	1.312	3.726
Indiana	3,198,874	9,689,756	3.03	1.223	3.706
Kentucky	307,162	254,205	.83	1.600	1.328
New Mexico	679,209	1,098,332	1.62	1.641	2.658
New York	1,095,198	2,648,981	2.42	1.378	3.335
Ohio	561,426	1,085,040	1.93	1.444	2.787
Pennsylvania	41,268,532	43,228,919	1.05	1.504	1.579
Tennessee	685,861	672,075	.98	1.762	1.727
Virginia	1,555,969	1,241,995	.80	1.607	1.286
Washington	78,693	166,227	2.11	1.598	3.372
West Virginia	4,061,702	3,403,589	.84	1.647	1.383
Other States [c]	3,623,019	8,245,354	2.28	1.432	3.265
Total	65,577,862	86,918,962	1.33	1.491	1.983

[a] Includes Utah.
[b] Includes Indiana, Kansas, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, and Wisconsin.
[c] Includes Kansas, Maryland, Massachusetts. Michigan, Minnesota, New Jersey, Utah, and Wisconsin.

The following table shows approximately the quantity of coal, given in tons and pounds, required to produce a ton of coke in 1880, 1890, 1900, and annually since 1901. It will be noted that up to 1903 the quantity of coal required to produce a short ton of coke was from 3,120 to 3,140 pounds, or 1.56 to 1.57 tons. Since 1903, except in 1910, there has been a steady decrease in the quantity of coal required, the lowest figure, 2,982 pounds, being attained in 1912.

Coal required to produce a ton of coke, in tons and pounds.

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1880	1.57	3,140	1906	1.531	3,062
1890	1.56	3,120	1907	1.519	3,038
1900	1.57	3,140	1908	1.515	3,030
1901	1.57	3,140	1909	1.510	3,020
1902	1.56	3,120	1910	1.513	3,026
1903	1.56	3,120	1911	1.499	2,998
1904	1.544	3,088	1912	1.491	2,982
1905	1.537	3,074			

YIELD OF COAL IN COKE.

As shown in the preceding table, the quantity of coal required to produce a ton of coke has gradually decreased, particularly during the last ten years, and in 1912 the quantity of coal required was about 160 pounds, or 5 per cent less than in 1901. Inferentially the yield of coal in coke has proportionately increased. The economy thus effected in coal consumption has been due to the increase, both relative and actual, in the production of coke made in retort ovens. In 1901 retort coke represented 5.4 per cent of the total output of the United States; in 1912 a little more than 25 per cent of the total production was retort coke. In 1901 the average yield of coal in coke was 63.7 per cent; in 1912 the yield was 67.1 per cent. It is probable that the yield indicated in 1901 was higher than the result actually obtained, as much of the coal used in coke making, particularly at beehive plants, was not accurately determined and was frequently estimated from the cubical content of the larry used in charging ovens or from the number and size of the mine cars sent to the coking plants. It is doubtful if in the earlier years the actual yield of coal in coke exceeded 60 per cent. In consonance, however, with improved and more exact methods in all branches of modern industry, particularly manufacturing, coke makers are keeping more accurate record of the results accomplished both in retort and beehive practice, and each year the statements of yield become more reliable. The figures for the last few years are believed to be very close to the actual results.

The influence on the yield of coal in coke by the operations of retort ovens is clearly shown in the following table. It will be observed that in Illinois, Indiana, Massachusetts, Michigan, New Jersey, New York, and Wisconsin, in which the coke product is exclusively from retorts, the yield varies from 69.6 per cent in Wisconsin to 81.8 per cent in Indiana, whereas in the States where beehive practice prevails the yield in 1912 varied from 50 per cent in Georgia to 66.5 per cent in Pennsylvania. The average yield of retort coke in 1912 was 75.3 per cent, and that from beehive ovens was 64.7 per cent.

The following tables show the percentage yield of coal in coke in each State during the last five years, and for the United States in each tenth year since 1880 and annually since 1901:

Percentage yield of coal in coke, 1908–1912, by States.

State.	1908	1909	1910	1911	1912
Alabama	61.0	60.7	61.6	62.6	64.9
Colorado	64.2	64.9	66.6	66.6	66.0
Georgia	55.2	53.8	54.8	51.7	50.0
Illinois	72.0	75.9	76.8	77.1	76.2
Indiana	70.0	44.4	78.3	80.6	81.8
Kansas	65.9	....	75.2	70.0	70.0
Kentucky	50.0	52.0	51.7	55.9	62.4
Maryland	72.1	67.9	65.6	66.2	65.8
Massachusetts	76.4	77.7	77.3	77.4	75.5
Michigan	74.5	74.1	75.7	74.2	75.4
Minnesota	66.4	67.7	68.0	67.6	69.6
Montana	58.3	44.7	44.7	....	....
New Jersey	72.3	77.7	76.1	76.2	78.4
New Mexico	60.4	53.9	61.6	61.5	60.9
New York	71.3	72.0	71.7	71.8	72.6
Ohio	67.2	65.4	68.3	68.2	69.2
Oklahoma	46.0	....	45.0	....	....
Pennsylvania	66.8	67.3	66.7	66.7	66.5
Tennessee	54.2	53.1	54.0	52.6	54.0
Utah	59.6	53.7	54.9	59.0	56.8
Virginia	65.1	65.4	64.6	63.9	62.2
Washington	57.1	61.7	63.0	66.6	62.6
West Virginia	63.9	62.0	61.1	60.4	60.7
Wisconsin	74.5	76.1	77.4	74.9	69.6
Total average	66.0	66.2	66.1	66.7	67.1

Percentage yield of coal in coke, 1880–1912.

1880	63.0	1903	64.1	1908	66.0
1890	64.0	1904	64.8	1909	66.2
1900	63.9	1905	65.1	1910	66.1
1901	63.7	1906	65.3	1911	66.7
1902	64.1	1907	65.8	1912	67.1

CONDITION IN WHICH COAL IS CHARGED INTO THE OVENS.

In the following table is to be found a statement of the condition in which the coal is charged into the ovens in the several States for the last two years and for each of the five-year periods since 1890. In a number of the coking districts the principal oven fuel is the slack coal produced in the mining operations. By far the larger quantity, however, is run of mine, some of which is crushed before being charged into the ovens, as in many cases it is found that a better and more uniform quality of coke is obtained when the coal is crushed before coking. Considerable quantities of both mine-run and slack coal are washed before being coked in order to remove the impurities consisting of slate, pyrite, etc. In 1912 18.9 per cent of all the coal charged into the coke ovens was washed and 81.1 per cent was used without other preparation than, in some instances, crushing. The mine-run coal that is crushed before coking is considered as mine-run coal and not as slack.

In Pennsylvania and West Virginia and in the by-product coke-producing States that draw their coal supplies chiefly from Pennsylvania and West Virginia the larger part of the coal used is unwashed. In West Virginia most of the coal used in making coke is unwashed slack, as a majority of the ovens in that State were constructed for the purpose of utilizing the slack. In Pennsylvania and the other States in which unwashed coal is used the greater part of it is run of mine. In Alabama most of the coal used is washed, and nearly two-thirds of the total coal used in the State is washed slack. All of the coal used in Georgia, New Mexico, and Washington is washed, and in the first two it is slack exclusively. In Colorado the larger part of the coal used is washed run of mine, and in Virginia the quantity of coal is nearly evenly divided between run of mine and slack, all of it being unwashed.

In 1912 the total quantity of coal used for coke making was 65,577,862 short tons, of which 52,682,314 tons (47,559,972 tons unwashed and 5,122,342 tons washed) were run of mine and 12,895,548 tons (5,668,166 tons unwashed and 7,227,382 tons washed) were slack. The total quantity of unwashed coal used was 53,228,138 tons and of washed coal was 12,349,724 tons.

The table following shows the quantity of run-of-mine and of slack coal, unwashed and washed, charged into the ovens in 1911 and 1912, by States, with the percentage of each:

Character of coal used in the manufacture of coke, by States, in 1911 and 1912, in short tons.

1911.

State.	Run-of-mine.		Slack.		Total.			
	Unwashed.	Washed.	Unwashed.	Washed.	Unwashed.	Percentage.	Washed.	Percentage.
Alabama	693,135	1,295,109	2,937	2,420,117	696,072	15.8	3,715,226	84.2
Colorado [a]	0	1,025,031	428,971	356,333	428,971	23.7	1,381,364	76.3
Georgia	0	0	0	72,677	0	....	72,677	100.0
Illinois	2,054,639	33,231	0	0	2,054,639	98.4	33,231	1.6
Kentucky	33,353	0	10,908	73,994	44,261	37.4	73,994	62.6
New Mexico	0	0	0	620,639	0	....	620,639	100.0
New York	760,114	128,550	25,594	40,809	785,708	82.3	169,359	17.7
Ohio	417,101	16,574	5,504	17,043	422,605	92.6	33,617	7.4
Pennsylvania	27,601,050	1,958,360	1,029,149	,287,096	28,630,199	87.1	4,245,456	12.9
Tennessee	....	283,203	0	344,915	0	....	628,118	100.0
Virginia	675,497	0	749,806	0	1,425,303	100.0	0	....
Washington	0	20,154	0	40,047	0	....	60,201	100.0
West Virginia	925,460	158,308	2,408,299	262,494	3,333,759	88.8	420,802	11.2
Indiana Kansas Maryland Massachusetts Michigan Minnesota Montana New Jersey Oklahoma Wisconsin	3,202,526	0	799,521	0	4,002,047	100.0	0	0
Total	36,362,875	4,918,520	5,460,689	6,536,164	41,823,564	78.5	11,454,684	21.5

1912.

State.	Run-of-mine.		Slack.		Total.			
	Unwashed.	Washed.	Unwashed.	Washed.	Unwashed.	Percentage.	Washed.	Percentage.
Alabama	747,305	896,421	18,793	2,922,979	766,098	16.7	3,819,400	83.3
Colorado	680	1,061,917	43,310	367,205	43,990	3.0	1,429,122	97.0
Georgia	0	0	0	87,300	0	0	87,300	100.0
Illinois	2,279,974	36,333	0	0	2,279,974	98.4	36,333	1.6
Indiana	3,167,766	108	31,000	0	3,198,766	100 0	108	0
Kentucky	172,020	0	63,880	71,262	235,900	76.8	71,262	23.2
New Mexico	0	0	0	679,209	0	0	679,209	100.0
New York	849,029	200,554	43,360	2,255	892,389	81.5	202,809	18.5
Ohio	506,883	23,541	15,598	15,404	522,481	93.1	38,945	6.9
Pennsylvania	35,344,633	2,493,661	1,098,392	2,331,846	36,443,025	88.3	4,825,507	11.7
Tennessee	0	189,887	86,678	409,296	86,678	12.6	599,183	87.4
Virginia	793,019	0	762,950	0	1,555,969	100.0	0	0
Washington	0	76,611	0	2,082	0	0	78,693	100.0
West Virginia	1,146,620	143,309	2,433,229	338,544	3,579,849	88.1	481,853	11.9
Kansas Maryland Massachusetts Michigan Minnesota New Jersey Utah Wisconsin	2,552,043	0	1,070,976	0	3,623,019	100.0	0	0
Total	47,559,972	5,122,342	5,668,166	7,227,382	53,228,138	81.1	12,349,724	18.9

[a] Includes Utah.

In the following table are given the statistics of the character of the coal used in making coke each fifth year since 1890, including 1911 and 1912:

Character of coal used in the manufacture of coke in the United States, 1890–1912, in short tons.

Year.	Run-of-mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	14,060,907	338,563	2,674,492	931,247	18,005,209
1895	15,609,875	237,468	3,052,246	1,948,734	20,848,323
1900	21,062,090	1,369,698	5,677,006	4,004,749	32,113,543
1905	31,783,314	3,187,994	8,196,226	6,363,143	49,530,677
1910	42,554,324	5,178,915	6,842,078	8,513,010	63,088,327
1911	36,362,875	4,918,520	5,460,689	6,536,164	53,278,248
1912	47,559,972	5,122,342	5,668,166	7,227,382	65,577,862

COKE MAKING IN BY-PRODUCT OVENS.

The year 1912 concludes the first 20 years of by-product coke making in the United States, the first plant of this type of oven having been completed at Syracuse, N. Y., in December, 1892. This pioneer plant consisted of 12 Semet-Solvay ovens and produced in that year 12,850 tons of coke. The plant has since been increased to 40 ovens. The second by-product plant to be constructed was one of 60 Otto-Hoffmann ovens at Johnstown, Pa., and was operated in connection with the iron and steel works of the (now) Cambria Steel Co. This plant was completed in the latter part of 1895, and did not add materially to the production, as the total quantity of retort coke made in that year was 18,521 tons. From these small beginnings the by-product branch of the coking industry has grown steadily, new plants being added each year until at the close of 1912 there were 5,211 retort ovens in operation and the production of retort coke for the year was 11,115,164 tons, or a little more than one-fourth of the total output. In the 20 years of its history[1] by-product coke making has materially developed along other lines than in the simple building of new ovens and the increased production therefrom. The ovens of the present day are longer, higher, and wider than the earlier installations, the growth in size being gradual and in keeping with the improvements in practice. The original ovens at Syracuse, N. Y., were 30 feet long, 16 inches wide at one end, 17 inches wide at the other end, and 5 feet 8 inches in height. Their charging capacity was 4.4 net tons of coal and the time required for coking was 24 hours. Even at that time a gain of 50 per cent in coking time was obtained as compared with beehive practice, which requires 48 hours for the production of furnace coke and 72 hours for the production of foundry coke. The present installations of Semet-Solvay ovens are 36 feet 3 inches long, 20 inches wide at one end and 22 inches at the other, and 11 feet 10 inches high, holding at the average about 16 tons of coal. The exact capacity depends, of course, upon the specific gravity of the coals used. The original 60 Otto-Hoffmann ovens erected at Johnstown, Pa., were 33 feet 6 inches

[1] For many of the data contained in this brief historical review the writer is indebted to Mr. William H. Blauvelt, of the Semet-Solvay Co., and Mr. Robert C. Metcalfe, of the United Coke & Gas Co.

long, 6 feet high, 17 inches wide at one end, expanding to 21 inches at the other. These ovens had a charging capacity of about 5½ tons. The latest installations of United-Otto ovens constructed at Mayville, Wis., in 1912 are 34 feet long, 9 feet 1½ inches high, and 17 to 20 inches wide. They have an average capacity of 10.33 tons of coal. The coking time has been materially reduced, so that excellent furnace coke is now made in from 16 to 18 hours. The development of modern mechanical appliances has done much to forward the efficiency of the retort oven and to reduce the labor necessary per unit of output. The same crew of men which was required to handle 25 of the small ovens 20 years ago, and which was carbonizing, say, 110 tons of coal a day, is now able with modern equipment to handle 50 or more of the larger ovens coking 1,000 tons of coal a day. This represents an increase of about ninefold in the tonnage carbonized per man employed. These developments have been accompanied by marked improvements in by-product recovery, in the manufacture of ammonia, etc. Twenty years ago the only ammonia recovered was in the form of crude liquor running from 12 to 15 per cent ammonia. At the present time coking plants are producing ammonia liquor from crude through the different grades required for the manufacture of flameless powder, etc., to the production of almost chemically pure aqua ammonia at one operation. Other plants are manufacturing sulphate either by the old or indirect process or by some of the more direct processes which have lately come into use where the gas itself is first scrubbed in sulphuric acid to recover ammonia after the tar has been removed. Still another marked development in by-product oven practice is in the adaptation of the surplus gas to the illumination of cities and towns. In the earlier days the ovens produced only a small and irregular quantity of surplus gas, which was also irregular in quality. To-day by-product ovens in the United States are selling from 40,000,000 to 50,000,000 cubic feet of gas per day for illuminating purposes. Almost the entire supply of gas in some cities is from retort ovens. Among these may be specially mentioned Boston, Mass.; Camden, N. J.; Indianapolis, Ind.; Hamilton, Ohio; Baltimore, Md.; Duluth, Minn.; South Chicago, Ill.; and Milwaukee, Wis.

Except for 282 Rothberg ovens erected at Buffalo in 1904 the Semet-Solvay and United-Otto (Otto-Hoffmann) ovens held the entire field of retort-oven practice until 1908, in which year there were constructed at Joliet, Ill., by the Illinois Steel Co. 140 Koppers regenerative by-product ovens. This plant was doubled in the following year, and a number of other plants of this type have been constructed in different parts of the country. In 1910 construction was begun on 300 Didier ovens at South Bethlehem, Pa., but although some of the ovens were fired in 1912 the plant had not been put into regular service before the close of the year. During 1912 a bank of 22 Klönne ovens were completed at Muncie, Ind. At this plant all of the gas from the ovens is supplied to the city of Munice. The coal used at this plant is Youghiogheny (Pa.) gas coal. The ovens are heated with producer gas made from the coke. Two recent installations of Semet-Solvay ovens, one at Waukegan, Ill., and the other at Indianapolis, Ind., are constructed on the same plan.

The twentieth year in the history of by-product coke making was its most notable one in the total production of coke and by-products and in the increase over the preceding year. That the coke makers of the United States have seen the light and that the wasteful beehive and similar types of ovens are giving way to more modern methods are shown by the facts that there were more of the former abandoned in each of the last two years than there were new ovens built, and that more than 29,000, or nearly 30 per cent, of the beehive or partial-combustion ovens in existence were idle. The total number of the beehive-type ovens decreased from 99,255 in 1911 to 97,019 in 1912, a difference of 2,236. The number of retort ovens, on the other hand, increased from 4,624 to 5,211, a gain of 587. The new construction, as shown by the number of ovens building at the end of the year, consisted of 793 retort ovens and of 1,990 of the beehive type. If the number of idle ovens in 1912 may be taken as indicating anything for the future, the number of ovens that will be abandoned during the current year will again exceed the number of new ovens built. Nearly all of the new partial-combustion ovens under construction were in Pennsylvania and more than half of them were of rectangular design, in which the coking process is the same as the beehive. All of the 5,211 retort ovens in 1912 were in active operation during the year. The production of retort coke increased from 7,847,845 short tons, valued at $27,297,897, in 1911 to 11,115,164 tons, valued at $42,632,930. The increase in quantity was 3,267,319 tons, or 41.6 per cent, and the gain in value was $15,335,033, or 56.18 per cent. The quantity and value of beehive coke increased 18.7 per cent and 21.59 per cent, respectively. The retort coke produced in 1912 was 25.27 per cent of the total output; in 1911 it was 22.07 per cent, and in 1910 it was 17.12 per cent.

The increase in the production of retort-oven coke compared with that of beehive coke since 1893 is shown in the following table. In the last 11 years, or from 1902 to 1912, inclusive, the increase in beehive coke has amounted to 59.4 per cent; that of retort-oven coke has amounted to 836.4 per cent. During the same period the value of the beehive product has increased 66.3 per cent and that of retort-oven coke has increased 1,362.6 per cent.

Production of by-product coke, compared with that of beehive coke, with percentage of quantity and value to the total, 1893–1912.

Year.	By-product coke.				Beehive coke.				Total.	
	Quantity.	Percentage to total.	Value.	Percentage to total.	Quantity.	Percentage to total.	Value.	Percentage to total.	Quantity.	Value.
	Short tons.				*Short tons.*				*Short tons.*	
1893...	12,850	0.01	....	....	9,464,730	99.99	....	....	9,477,580	$16,523,714
1901...	1,179,900	5.41	$2,894,077	6.51	20,615,983	94.59	$41,551,846	93.49	21,795,883	44,445,923
1907...	5,607,899	13.75	21,665,157	19.42	35,171,665	86.25	89,873,969	80.58	40,779,564	111,539,126
1908...	4,201,226	16.14	14,465,429	23.15	21,832,292	83.86	48,018,554	76.85	26,033,518	62,483,983
1909...	6,254,644	15.91	20,434,689	22.71	33,060,421	84.09	69,530,794	77.29	39,315,065	89,965,483
1910...	7,138,734	17.12	24,793,016	24.86	34,570,076	82.88	74,949,685	75.14	41,708,810	99,742,701
1911...	7,847,845	22.07	27,297,897	32.45	27,703,644	77.93	56,832,952	67.55	35,551,489	84,130,849
1912...	11,115,164	25.27	42,632,930	38.15	32,868,435	74.73	69,103,766	61.85	43,983,599	111,736,696

Distributed by States, the production of beehive and retort coke in 1912 was as follows:

Statistics of the production of coke in beehive and retort ovens in the United States, 1912, by States, in short tons.

State.	Beehive coke.		By-product coke.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	1,625,692	$4,623,996	1,349,797	$3,474,416	2,975,489	$8,098,412
Colorado	972,941	3,043,994	0	0	972,941	3,043,994
Georgia	43,158	161,842	0	0	43,158	161,842
Illinois	0	0	1,764,944	8,069,903	1,764,944	8,069,903
Indiana	0	0	2,616,339	12,528,685	2,616,339	12,528,685
Kentucky	191,555	513,734	0	0	191,555	513,734
New Mexico	413,906	1,356,946	0	0	413,906	1,356,946
New York	0	0	794,618	3,203,133	794,618	3,203,133
Ohio	(a)	(a)	(a)	(a)	388,669	1,365,905
Pennsylvania	25,464,074	50,247,455	1,974,619	6,020,383	27,438,693	56,267,838
Tennessee	370,076	951,853	0	0	370,076	951,853
Virginia	967,947	1,815,975	0	0	967,947	1,815,975
Washington	49,260	279,105	0	0	49,260	279,105
West Virginia	(a)	(a)	(a)	(a)	2,465,986	4,692,393
Kansas, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, Utah, Wisconsin	b2,769,826	b6,108,866	b2,614,847	b9,336,410	2,530,018	9,386,978
Total	32,868,435	69,103,766	11,115,164	42,632,930	43,983,599	111,736,696

a Included with combined States to avoid disclosure of individual figures.
b Includes also Ohio and West Virginia.

The average production from each retort oven in 1912 was 2,133 tons of coke, compared with 1,817 tons in 1911 and with 1,762 tons in 1910. The average production per active oven of beehive coke was 484 tons in 1912, 468 tons in 1911, and 376 tons in 1910. The average production from each retort oven in 1912 was 4.4 times that from the beehive type.

The value of the coke alone being considered, the average yield from each retort in 1912 was $8,143, and if to the value of the coke is added that of the by-products recovered the average yield from each oven was $11,265; this, when compared with $1,019 as the average yield from the beehive type of oven, shows that the yield in value from the retort oven is more than eleven times that from the beehive.

The quantity of coal consumed in the manufacture of coke and by-products in retort ovens in 1912 was 14,767,543 short tons, yielding 11,115,164 tons of coke, an average yield of coal in coke of 75.3 per cent. There appears to be a gradual increase in the percentage yield of coal in coke in retort ovens, for in 1911 the yield was 75.1 per cent, in 1910 it was 74.9 per cent, and in 1909 it was 74.5 per cent. This shows an average increase of about two-tenths of 1 per cent in each year. The average yield of coal in coke in beehive ovens in 1912 was 64.7 per cent, the difference in favor of the retort ovens being 10.6 points, or 16.4 per cent. The value of the 14,767,543 short tons of coal consumed in retort ovens was $35,569,464, an average of $2.41 per ton, as compared with an average of $2.30 per ton in 1911. The quantity of coal consumed in beehive ovens in 1912 was 50,810,319 short tons, valued at $51,349,498, an average of $1.01 per ton. The difference in the value of the coal used at retort and at beehive ovens is due to the location of the plants. In beehive practice the ovens are in the vicinity of the mines, from which the coal is delivered directly to the larries, and no transportation expenses are added to the cost of the coal. The retort-oven plants are located at a distance from the mines and near the points of consumption, so that the transportation expenses are added to the value of the coal charged into the ovens.

The value of the by-product coke in 1912 was $42,632,930, an average per ton of $3.84. The quantity of coke produced in beehive ovens in 1912 was 32,868,435 short tons, valued at $69,103,766, an average of $2.10 per ton, the difference of $1.74 in favor of the value per ton of beehive coke at the ovens being more than offset by the cost of transportation from the ovens to points of consumption. To the value of the coke produced in retort ovens must be added the value of the by-products recovered. This factor in 1912 amounted to $16,070,682, or 38 per cent of the value of the coke produced. In 1911 the value of the by-products amounted to $10,033,961, about 37 per cent of the value of the coke. The value of the by-products in both years was more than the value at the mines of the coal used. The by-products recovered in 1912 consisted of 54,491,248 thousand cubic feet of surplus gas, valued at $4,650,517; 94,306,583 gallons of tar, valued at $2,310,900; and ammonia in the form of sulphate, ammoniacal liquor or anhydrous ammonia with a total value of $8,498,713. In addition there was $610,552 worth of other products, largely coke breeze. The value of the recoverable contents of the coal used in making coke in beehive ovens, which were wasted in 1912, would, at the prices obtaining in that year, have been worth approximately $80,000,000.

The total value of the coke, gas, tar, ammonia, and other products produced at by-product recovery ovens during the last three years is shown in the following table:

Value of products obtained in manufacture of coke in retort ovens in 1910, 1911, and 1912.

	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gas.............M cubic feet..	27,692,858	$3,017,908	33,274,861	$3,781,218	54,491,248	$4,650,517
Tar....................gallons..	66,303,214	1,599,453	69,410,599	1,638,314	94,306,583	2,310,900
Ammonia, sulphate or reduced to equivalent in sulphate, pounds......................	70,247,543	1,841,062	72,920,056	1,943,761	95,275,545	3,649,144
Ammonia liquor.....gallons..	4,654,282	295,868	4,660,596	548,824	5,502,403	735,120
Anhydrous ammonia.pounds..	20,229,421	1,725,266	23,180,118	1,847,929	a 43,144,014	a 4,114,449
Other by-products............	....	....	....	273,915	....	610,552
Total value of by-products.	....	8,479,557	....	10,033,961	....	16,070,682
Coke.............short tons..	7,138,734	24,793,016	7,847,845	27,297,897	11,115,164	42,632,930
Grand total................	....	33,272,573	....	37,331,858	....	58,703,612

a Mainly ammoniacal liquor sold on pound basis of NH_3. Quantity in gallons not available.

The gas included in the foregoing statement is the "surplus" not consumed in the coking process, which is either used at manufacturing establishments operated in connection with the coke-oven plant or sold . In some cases where the surplus gas is consumed by the producing or an affiliated company both the quantity and the value of the surplus gas, become a matter of estimate, but the figures as presented are believed to be sufficiently accurate for statistical purposes. The value of the gas furnished to domestic consumers varies from 10 to 50 cents a thousand cubic feet. When the gas is consumed at industrial works operated in connection with the ovens the value is sometimes placed as low as 3 cents a thousand cubic feet. The average value of all the surplus gas in 1912 was 8.5 cents a thousand cubic feet. The lower value of gas produced in 1910, 1911, and particularly in 1912, as compared with the preceding years, is due largely to the operations of ovens connected with iron and steel works at Corey, Woodward, and Ensley, in Alabama, Joliet in Illinois, Gary in Indiana, Sparrows Point in Maryland, Buffalo and Solvay in New York, Dunbar, South Sharon, Steelton, and Lebanon in Pennsylvania, and Benwood in West Virginia. This factor represented about 70 per cent of the total production.

At the close of 1911 there were 4,624 retort ovens in operation, and 698 were building. The completed ovens consisted of 2,100 United-Otto ovens (including the Otto-Hoffmann and Schniewind types), 1,387 Semet-Solvay, 307 Rothberg, and 830 Koppers. At the close of 1912 there were 5,211 ovens in blast, an increase of 587 over 1911. There were 793 ovens building. The new construction added in 1912 consisted of 56 Semet-Solvay ovens, 385 Koppers, and 22 Klönne ovens. There were 26 Rothberg ovens abandoned, 25 in Ohio and 1 in New York. The ovens building included, in addition to the 150 Didier by-product ovens at South Bethlehem, Pa., being one-half of 300 ovens which have been under construction for the last three years, 311 Koppers ovens, 246 Semet-Solvay ovens, and 86 United-Otto ovens.

The statistical history of by-product coke making in the United States since the first ovens were completed in 1893 is shown in the table following.

Record of by-product coke making, 1893–1912.

Year.	Ovens.		Production (short tons).	Year.	Ovens.		Production (short tons).
	Built.	Building.			Built.	Building.	
1893	12	0	12,850	1903	1,956	1,335	1,882,394
1894	12	60	16,500	1904	2,910	832	2,608,229
1895	72	60	18,521	1905	3,103	417	3,462,348
1896	160	120	83,038	1906	3,547	112	4,558,127
1897	280	240	261,912	1907	3,684	330	5,607,899
1898	520	500	294,445	1908	3,799	240	4,201,226
1899	1,020	65	906,534	1909	3,989	949	6,254,644
1900	1,085	1,096	1,075,727	1910	4,078	1,200	7,138,734
1901	1,165	1,533	1,179,900	1911	4,624	698	7,847,845
1902	1,663	1,346	1,403,588	1912	[a] 5,211	[b] 793	11,115,164

[a] Includes 1,443 Semet-Solvay, 2,100 United-Otto, 281 Rothberg, 1,215 Koppers, 150 Didier, and 22 Klönne.

[b] Includes 311 Koppers, 246 Semet-Solvay, 150 Didier, and 86 United-Otto ovens.

The record of by-product ovens for the last five years, by States, is shown in the following table:

Record of by-product ovens, by States, 1908–1912.

State.	Dec. 31, 1908.		Dec. 31, 1909.		Dec. 31, 1910.		Dec. 31, 1911.		Dec. 31, 1912.	
	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.
Alabama	280	0	280	0	280	340	340	280	620	100
Illinois	300	140	440	40	480	0	480	48	568	40
Indiana	0	50	50	560	50	560	540	70	632	169
Kentucky	0	0	0	0	0	0	0	0	0	41
Maryland	200	0	200	0	200	0	200	0	200	6
Massachusetts	400	0	400	0	400	0	400	0	400	0
Michigan	150	0	162	0	162	0	162	0	165	40
Minnesota	50	0	50	0	50	0	50	0	50	92
New Jersey	150	0	150	0	150	0	150	0	150	0
New York	540	0	556	0	556	0	556	0	555	0
Ohio	155	50	125	49	174	0	174	0	149	119
Pennsylvania	1,294	0	1,296	[a] 300	1,296	300	1,292	[b] 300	1,442	150
West Virginia	120	0	120	0	120	0	120	0	120	0
Wisconsin	160	0	160	0	160	0	160	0	160	36
Total	3,799	240	3,989	949	4,078	1,200	4,624	698	5,211	793

[a] Contracted for; construction begun in 1910. [b] One-half (150) completed in latter part of 1912.

The retort ovens under construction at the close of 1912 were as follows:

Retort ovens under construction at the close of 1912.

State.	Kinds of ovens.			
	Koppers.	Semet-Solvay.	Didier.	United-Otto.
Alabama	80	20		
Illinois		40		
Indiana	65	54		50
Kentucky		41		
Maryland	6			
Michigan		40		
Minnesota	92			
Ohio	68	51		
Pennsylvania			150	
Wisconsin				36
Total	311	246	150	86

The distribution, by States and by kinds, of by-product ovens built and building in the United States at the close of 1912 is shown in the following table:

Kinds of by-product ovens built and building in the United States, by States, at the close of 1912.

State.	United-Otto.[a] built.	Semet-Solvay, built.	Koppers, built.	Rothberg, built.	Klönne, built.	Total.	
						Built.	Building.
Alabama	0	280	340	0	0	620	[b] 100
Illinois	0	253	315	0	0	568	[c] 40
Indiana	50	0	560	0	22	632	[d] 169
Kentucky	0	0	0	0	0	0	[c] 41
Maryland	200	0	0	0	0	200	[e] 6
Massachusetts	400	0	0	0	0	400	0
Michigan	30	135	0	0	0	165	[c] 40
Minnesota	50	0	0	0	0	50	[e] 92
New Jersey	150	0	0	0	0	150	0
New York	188	86	0	281	0	555	0
Ohio	100	49	0	0	0	149	[f] 119
Pennsylvania	932	360	0	0	0	[g] 1,442	[h] 150
West Virginia	0	120	0	0	0	120	0
Wisconsin	0	160	0	0	0	160	[i] 36
Total	2,100	1,443	1,215	281	22	5,211	793

[a] Includes the Otto-Hoffmann and Schniewind types.
[b] 80 Koppers and 20 Semet-Solvay ovens.
[c] Semet-Solvay ovens.
[d] 65 Koppers, 50 United-Otto, and 54 Semet-Solvay ovens.
[e] Koppers ovens.
[f] 51 Semet-Solvay and 68 Koppers ovens.
[g] Includes 150 Didier ovens.
[h] Didier ovens.
[i] United-Otto ovens.

The following table, originally compiled by Albert Ladd Colby, consulting engineer, South Bethlehem, Pa., was first published in the report for 1906. It has since been revised by C. G. Atwater, of the American Coal Products Co., Whitehall Building, New York City, and by W. H. Blauvelt, of the Semet-Solvay Co., Syracuse, N. Y.

This table shows, in addition to the number of ovens at each by-product coke-oven plant in the United States, 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.

Complete list of by-product and retort coke-oven plants of the United States, Jan. 1, 1913.

State.	Town.	System.	Name of company owning plant.	Number of installments.	Date put in operation.	Number of ovens.	Uses of coke.	Uses of surplus gas.	Remarks.
Ala.	Ensley (near Birmingham).	Semet-Solvay	Semet-Solvay Co.	First	Oct., 1898	120	Blast furnace	Fuel gas	
				Second	Mar., 1902	120	do	do	
	Tuscaloosa	do	Central Iron & Coal Co.	First	Feb., 1906	40	do	do	
	Woodward	Koppers	Woodward Iron Co.	do	1911	60	do	Fuel and power	
	do	do	do	Second	Began construction 1912.	80	do	do	
	Corey	do	Tennessee Coal, Iron & R. R. Co.	First	1912	280	do	do	
Ill.	Joliet	do	Coal Products Manufacturing Co.	do	do	35		Illuminating, domestic heating, and industrial.	
	do	do	Illinois Steel Co.	do	Completed in 1908.	140	Blast furnace	Fuel and power	
	do	do	do	Second	Mar., 1909	140	do	do	
	South Chicago, on Calumet River.	Semet-Solvay	By-products Coke Corporation.	First	Dec., 1905	120	Blast furnace, foundry, and domestic.	Illuminating	
				Second	Dec., 1906	40			
				Third	1910	40			
	do	do	do	Fourth	1912	40	do	do	
	do	do	do	Fifth	Began construction 1912.	40	do	do	
	Waukegan	do	North Shore Gas Co.	First	Sept., 1912	13	do	do	
Ind.	Gary	Koppers	Illinois Steel Co.	do	490 completed in 1911.	560	Blast furnace	Fuel	
	Indiana Harbor	do	Inland Steel Co.	do	Began construction 1912.	65	do	do	
	Muncie	Klönne	Central Indiana Gas Co.	do	1912	22	Domestic and industrial.	Illuminating	
	Indianapolis	United-Otto	Citizens' Gas Co.	do	Completed 1909.	50	Blast furnace and foundry.	Fuel and illuminating gas for Indianapolis.	
	do	do	do	Second	Began construction 1912.	50	do	do	
	do	Semet-Solvay	Indianapolis Gas Co.	First	do	41	Foundry and domestic.	Illuminating, domestic heating, and industrial.	
Ky.	Ashland	do	Kentucky Solvay Co.	do	do	54	Blast furnace and foundry.	Fuel	

Md	Sparrows Point	United-Otto	Maryland Steel Co	do	Mar., 1903	200	Blast furnace	Illuminating gas for city of Baltimore, 11 miles distant; 4,000,000 cubic feet daily.	
	do	Koppers	do	do	Began construction 1912.	6	do	Illuminating, domestic heating, and industrial.	
Mass	Everett	Otto-Hoffmann	New England Gas & Coke Co.	do	June, 1899	400	Domestic, industrial, and locomotive in about equal proportion.	Illuminating gas and fuel gas; 6,500,000 to 7,500,000 cubic feet daily of illuminating gas.	First illuminating-gas system installed.
Mich	Detroit	Semet-Solvay	The Solvay Process Co.	do	Sept., 1901	30	Furnace, foundry, domestic, and lime burning.	Illuminating and fuel	
				Second	Nov., 1902	30			
				Third	Mar., 1906	60			
				Fourth	1909	12			
				Fifth	Began construction 1912.	40			
	Wyandotte	United-Otto	Michigan Alkali Co.	First	Oct., 1902	15	Burning limestone.	Fuel gas	Use the by-products in their works.
	do	do	do	Second	Aug., 1906	15			
Minn	Duluth	do	Zenith Furnace Co.	First	July, 1904	50	Blast furnace	Illuminating gas for Duluth.	
	do	Koppers	Minnesota Steel Co.	do	Began construction 1912.	92	do	Fuel	
N. J.	Camden	Otto-Hoffmann	Camden Coke Co	do	About Jan., 1903.	100	do	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.	First to install enrichment by benzol transfer.
	do	United-Otto	do	Second	July, 1906	50	Foundry and domestic (domestic coke crushed and sized for sale).		
N. Y.	Syracuse	Semet-Solvay	Solvay Process Co.	First	Jan., 1893	12	Burning limestone; also iron foundry.	Fuel	First by-product plant in United States. Main purpose originally to obtain ammonia for alkali works.
				Second	1896	a 25			
				Third	Bet. 1900 and 1903.	a 40			
	Geneva	do	The Empire Coke Co.	First	Aug., 1904	30	Foundry and domestic.	Illuminating	
				Second	1909	a 46			
	Buffalo	United-Otto	Lackawanna Steel Co.	First	May, 1904	b 564	Blast furnace	Fuel gas	First used stamped coal, but changed to top-charging, 1907.
	do	Rothberg	do	do		282	do	do	

a Increased to.

b Contracted for, 188 completed.

Complete list of by-product and retort coke-oven plants of the United States, Jan. 1, 1913—Continued.

State.	Town.	System.	Name of company owning plant.	Number of installments.	Date put in operation.	Number of ovens.	Uses of coke.	Uses of surplus gas.	Remarks.
Ohio	Hamilton	Otto-Hoffmann	Hamilton Otto Coke Co.	First	Apr., 1901	50	Mostly domestic; some foundry. Installed crushing outfit 1905.	Illuminating gas for Hamilton; also power gas and fuel gas.	
	do	United-Otto	do	Second	1909	50	Blast furnace	do	
	Cleveland	Rothberg	Cleveland Furnace Co.	do	Oct., 1907	25	do	do	Plant closed down March, 1908. Since dismantled.
	do	Semet-Solvay	do	First	1910	49	do	Illuminating and fuel	Originally 80 Rothberg ovens; now operated by the Semet-Solvay Co.
	do	do	do	Second	Began construction 1912.	51	do	do	
	Youngstown	Koppers	Republic Iron & Steel Co.	First	do	68	do	Fuel	
Pa.	Dunbar	Semet-Solvay	Dunbar Furnace Co.	do	Aug., 1896	50	do	Fuel gas	
				Second	July, 1903	60			
	Chester	do	The Philadelphia Suburban Gas & Electric Co.	First	Apr., 1904	40	Blast furnace	Illuminating and fuel	
	South Sharon	United-Otto	Carnegie Steel Co.	do	July, 1903	212	do	Fuel	
	Glassport	Otto-Hoffmann	Pittsburgh Gas & Coke Co.	do	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.	do	Nov., 1895	60	Blast furnace	Fuel gas and power gas	
	do	United-Otto	do	Second	Mar., 1899	100	do	do	
	do	do	do	Third	Sept., 1904	100	do	do	
	do	do	do	Fourth	Feb., 1907	112	do	do	
	Lebanon	Semet-Solvay	Pennsylvania Steel Co.	First	July, 1904	90	do	Semet-Solvay Co. delivers surplus gas to Pennsylvania Steel Co., which sells it to American Iron & Steel Mfg. Co. for use in heating furnaces and gas engine. Also 4 gas engines 1,200 H. P. each, furnishing power for generating electricity to operate Cornwall Ore Banks, at Lebanon, Pa.	This last gas-engine installation is the largest one in the United States using coke-oven gas.

	do	Otto-Hoffmann	Lackawanna Iron & Steel Co.	do	Mar., 1903	228	do	Fuel gas	Went back to top-charging since resumption in September, 1905. The 5 Rothberg ovens were shut down in August, 1903, and have since been dismantled.
	do	Rothberg	do	do	May, 1903	5			
	Steelton	Semet-Solvay	Pennsylvania Steel Co.	do	Jan., 1912	120	Blast furnace	Fuel gas	
	South Bethlehem.	Didier	Lehigh Coke Co	do	1912	150			
	do	do	do	do	Not completed.	150			
W. Va	Benwood	Semet-Solvay	National Tube Co	do	Oct., 1898	60	Blast furnace	Fuel gas	
				Second	Mar., 1901	60	do	do	
Wis	Milwaukee	do	Milwaukee Coke & Gas Co.	First	Mar., 1904	80	Blast furnace, foundry, and domestic.	Illuminating and fuel	
	do	do	do	Second	Mar., 1906	80			
	Mayville	Otto-Hoffmann	Northwestern Iron Co.	First	Began construction 1912.	36			

NOTES.—1. Of the 14 active plants of Semet-Solvay ovens in the United States in 1912, 2 were operated by the owners, and the other 12 were operated by the Semet-Solvay Co., the coke produced being turned over to the company whose name appears as owner.

2. Tar and ammonia are recovered as by-products from all of the plants included in the above table.

IMPORTS AND EXPORTS.

IMPORTS.

The following table gives the quantity and value of coke imported and entered for consumption in the United States from 1907 to 1912, inclusive. In the reports of the Bureau of Foreign and Domestic Commerce, Department of Commerce, 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 Unied States, 1907–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1907	135,968	$596,366	1910	172,716	$625,130
1908	147,427	606,294	1911	77,923	254,455
1909	191,253	736,120	1912	123,614	488,398

EXPORTS.

The quantity of coke exported from the United States increased steadily from 1900 to 1907. Since 1907 the value of the exports has alternately increased and decreased each year, although, with slight fluctuations, they have remained practically stationary during the last four years. The exports in 1912 were a little less than in 1911, which in turn were slightly in excess of those of 1910. The exports during the last six years are shown in the following table, the quantities being reduced to short tons:

Coke exported from the United States since 1907, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1907	979,652	$3,206,793	1910	984,618	$3,053,293
1908	695,434	2,161,032	1911	1,023,727	3,215,990
1909	1,002,916	3,232,673	1912	912,576	3,002,742

IMPORTS OF COAL-TAR PRODUCTS.

It has been contended that the development of the by-product coking industry would have shown more rapid progress if markets for the by-products were assured. This contention pertains principally to the coal tar and its products, as there is no difficulty in disposing of the surplus gas, and there is practically at all times a fair demand for ammonia. The total value of domestic coal-tar produced in 1912 from retort coke ovens was $2,310,900. No information is available regarding the quantity and value of the products obtained from this tar, as in going to the distillers it becomes mixed with the coal tar from gas-house retorts, and even if the total quantity and value of coal-tar products were obtainable, it would be practically impossible to differentiate those obtained from retort-oven tar from those obtained from gas-house tar. It is interesting to note, however, that the coal-tar products imported into the United States amount to approximately $10,000,000 annually. In 1912 the total value of coal-tar products imported into the United States was $10,740,430, of which colors and dyes made up nearly 70 per cent. On the entire imports duty was obtained to the amount of $2,295,666, making a total value at the port of entry, exclusive of ocean freights, commissions, and other expenses, of $13,036,096. The value of these importations by the time they are in the hands of the consumer is probably between eighteen and twenty million dollars. The kinds of coal-tar products imported, the value thereof, and the amount of duty paid on each during the last five years are shown in the following table:

Coal-tar products imported into the United States, 1908–1912.

Year.	Salicylic acid.		Alizarin 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.
1908	$1,183	$345	$752,386	Free.	$450,891	Free.	$4,573,217	$1,371,965
1909			1,191,874	Free.	553,503	Free.	6,431,767	1,929,530
1910			430,393	Free.	501,369	Free.	5,867,331	1,760,098
1911	3,480	915	996,794	Free.	410,193	Free.	6,444,595	1,933,379
1912	9,543	2,469	1,514,344	Free.	354,226	Free.	7,204,453	2,161,336

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.
1908	$717,556	$143,511	$549,352	Free.	$7,044,585	$1,515,821
1909	693,608	138,768	960,724	Free.	9,831,476	2,068,298
1910	594,252	118,849	962,232	Free.	8,355,577	1,878,947
1911	659,407	131,881	1,128,409	Free.	9,642,878	2,066,175
1912	659,305	131,861	998,559	Free.	10,740,430	2,295,666

PRODUCTION OF COKE BY STATES.

ALABAMA.

Alabama's output of coke in 1912 amounted to 2,975,489 short tons, valued at $8,098,412, against 2,761,521 short tons, valued at $7,593,594, in 1911, the increase in 1912 being 213,968 tons, or 7.75 per cent, in quantity and $504,818, or 6.65 per cent, in value. Alabama retained in 1912 second place in the rank of coke-producing States, it having superseded West Virginia in 1911. The average price per ton for Alabama coke has declined from $2.82 in 1910 to $2.75 in 1911, and to $2.72 in 1912. This does not necessarily indicate an actual decline in the price of coke. A large proportion, possibly over 90 per cent, of Alabama coke is consumed in furnaces which are owned by the same interests owning and operating the coal mines and coke ovens, and the placing of a value on the coke is largely a matter of accounting. The lower value per ton of the coke produced in 1912 was in spite of the fact that the value of the coal used advanced from $1.28 in 1911 to $1.35 in 1912.

That Alabama has developed her coking industry along the lines of modern practice is evinced by the fact that in each of the last three years the only new ovens under construction on December 31 were retort ovens. During 1912 there were 195 beehive ovens abandoned and 2 were rebuilt, a net loss in this type of ovens of 193. The number of retort ovens on the other hand, increased from 340 in 1911 to 620 in 1912, and there were 100 additional retort ovens under construction at the end of the year. The present installations of retort ovens in Alabama are 280 Semet-Solvay ovens and 340 Koppers ovens. The former include 240 Semet-Solvay ovens at Ensley (one-half completed in 1898 and the other half in 1902) and 40 at Tuscaloosa, which were completed in 1906. The 340 Koppers ovens include 60 completed during 1911 by the Woodward Iron Co. at Woodward, and 280 completed in 1912 by the Tennessee Coal, Iron & Railroad Co., at Corey. The 100 new ovens under construction at the end of the year consisted of 80 Koppers ovens building at Woodward and 20 Semet-Solvay ovens building at Tuscaloosa. There were 46 establishments in Alabama in 1912, an increase of 2 over 1911, but although 280 retort ovens were added during 1912 the total number of ovens increased only 87, or from 10,121 to 10,208, indicating that there was a decrease of 193 in the number of beehive ovens. Of the 46 establishments in Alabama, 18, with a total of 2,902 ovens, were idle. In addition to these there were 597 ovens, portions of other establishments, that were idle during the year. The number of active ovens was 6,709 and the average production per oven was 444 tons, against 337 tons per oven in 1911 and 338 tons in 1910, these figures again showing the influence of the operations of retort ovens on Alabama's production.

The production of coke in Alabama in 1880, 1890, 1900, and from 1908 to 1912 is shown in the following table:

Statistics of the manufacture of coke in Alabama, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	4	316	100	106,283	57.0	60,781	$183,063	$3.01
1890	20	4,805	371	1,809,964	59.0	1,072,942	2,589,447	2.41
1900	30	6,529	690	3,582,547	58.9	2,110,837	5,629,423	2.67
1908	45	10,103	0	3,875,791	61.0	2,362,666	7,169,901	3.04
1909	43	10,061	0	5,080,764	60.7	3,085,824	8,068,267	2.61
1910	43	10,132	340	5,272,322	61.6	3,249,027	9,165,821	2.82
1911	44	10,121	280	4,411,298	62.6	2,761,521	7,593,594	2.75
1912	46	[a]10,208	[b]100	4,585,498	64.9	2,975,489	8,098,412	2.72

[a] Includes 280 Semet-Solvay and 340 Koppers ovens. [b] 80 Koppers and 20 Semet-Solvay ovens.

Most of the coal used in the manufacture of coke in Alabama is washed before being charged into the oven. In 1912, out of a total of 4,585,498 tons, 3,819,400 tons, or 83 per cent, were washed. Of the washed coal used 2,922,979 tons were slack and 896,421 tons were run of mine. The unwashed coal was principally mine run, there being 747,305 tons of unwashed run-of-mine coal used and 18,793 tons of unwashed slack.

The character of the coal used in the manufacture of coke in Alabama in 1890, 1900, and for the last five years, is shown in the following table:

Character of coal used in the manufacture of coke in Alabama, 1890–1912, 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
1900	1,729,882	152,077	165,418	1,535,170	3,582,547
1908	548,093	1,457,360	53,218	1,817,120	3,875,791
1909	713,992	2,153,081	0	2,212,971	5,080,764
1910	771,931	1,308,085	0	3,192,306	5,272,322
1911	693,135	1,295,109	2,937	2,420,117	4,411,298
1912	747,305	896,421	18,793	2,922,979	4,585,498

COLORADO.

Prior to 1912 it had been the custom to include the production of Colorado and Utah together, as there were only two establishments in the latter State and both of these are owned by one company. In 1912, however, the statistics of production in Utah are included with those of other States having less than three establishments in operation. There are 15 coking operations in Colorado and as the production amounts to nearly 1,000,000 tons annually it is deemed advisable to give the statistics of this State separate publication. Colorado's coke production in 1912 amounted to 972,941 short tons, valued at $3,043,994, against the combined production for Colorado and Utah in 1911, which was 1,177,023 tons, valued at $3,880,710. The principal coking operations are in the vicinity of Trinidad in the northern end of the Raton Mountain region, the southern end of which also forms the only coking district in New Mexico. Considerable quantities of Colorado coke are produced at plants forming parts of establishments which include coal mining, coke making, and the manufacture of iron and steel or the smelting and refining of the precious and semiprecious metals. In these cases the placing of a value on the coke is largely a matter of accounting and the variations in prices as shown in the statistics of Colorado and Utah production may have been more apparent than real. All of the ovens in Colorado are of the beehive type. Of the 15 establishments in the State in 1912 there were 7 idle throughout the entire year. The 7 idle establishments had a total of 893 ovens, in addition to which there were 934 ovens, portions of other plants which were idle, making a total of 1,827 idle ovens. One establishment of 18 ovens was abandoned during the year. The idle ovens in 1912 were a little more than half of the total number in the State.

The statistics of the manufacture of coke in Colorado and Utah in 1880, 1890, 1900, and from 1908 to 1911 are shown in the following table. The statistics for 1912 are for Colorado alone.

Statistics of the manufacture of coke in Colorado, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880a	1	200	50	51,891	49.0	25,568	$145,226	$5.68
1890a	8	916	30	407,023	60.0	245,756	959,246	3.90
1900a	14	1,692	0	997,861	62.0	618,755	1,746,732	2.82
1908a	18	4,705	0	1,546,044	63.5	982,291	3,238,888	3.30
1909a	18	4,700	0	1,984,985	63.1	1,251,805	4,135,931	3.30
1910a	18	4,465	0	2,069,266	65.1	1,346,211	4,273,579	3.17
1911a	18	4,460	0	1,810,335	65.0	1,177,023	3,880,710	3.30
1912	15	3,588	0	1,473,112	66.0	972,941	3,043,994	3.13

a Includes Utah.

The total quantity of coal used in the manufacture of coke in Colorado in 1912 was 1,473,112 short tons, of which 1,062,597 were run of mine and 410,515 were slack.

Character of coal used in the manufacture of coke in Colorado, 1890–1912.

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890 a	36,058	0	395,023	0	431,081
1900 a	229,311	0	316,527	452,023	997,861
1908 a	0	237,540	407,533	900,971	1,546,044
1909 a	117,446	1,155,233	398,762	313,544	1,984,985
1910 a	252,468	836,067	429,728	551,003	2,069,266
1911 a	0	1,025,031	428,971	356,333	1,810,335
1912	680	1,061,917	43,310	367,205	1,473,112

a Includes Utah.

GEORGIA.

Two counties, Dade and Walker, in the extreme northwest corner of Georgia, contain the only coal in the State. Portions of each of these counties are underlain by the coal measures of the Appalachian coal fields. The Walden Basin of Tennessee crosses Dade County in Georgia, and, extending southwestward, becomes the Blount Mountain and Warrior basins in Alabama. The Walker County deposit is an extension northeast of the Lookout Mountain Basin, a narrow outlying area that has its principal development in Etowah County, Ala. The coals of both basins are of coking quality, those of Dade County being confined to the Lookout sandstone. These are generally thinner than the principal coals of the overlying Walden sandstone. The production at the present time is chiefly from the coals of the Lookout Mountain Basin.

The screened coal from the Walker County mines is in good demand as a steam fuel and for the bunker trade, so that only the slack or fine coal passing through the screen is available for coke making. Most of the impurities pass through with the slack, which necessitates washing the slack before charging it into the ovens. A considerable portion of the fixed carbon is burned off in the coking process, for whereas the mine-run coal has a high content in fixed carbon (80 per cent) the yield of coke has averaged less than 55 per cent and in 1912 was only 50 per cent. All of the coke is made in beehive ovens.

Both coal mining and coke making in Georgia have shown a decreasing tendency in the last few years, due, not to any decline in demand for either coal or coke, but to an insufficient supply of labor. Formerly the mines and ovens were operated largely by convict labor leased from the State. The abolition of the lease system and the inability to procure sufficient free labor has reduced production, particularly during the last few years. There was, however, a small increase in the production of coke in 1912 over 1911, the output in 1912 being 43,158 tons against 37,553 tons in 1911. The value increased in somewhat larger ratio, from $135,190 to $161,842. The average price per ton advanced from $3.60 in 1911 to $3.75 in 1912.

The statistics of the manufacture of coke in Georgia in 1880, 1890, 1900, and from 1907 to 1912 are shown in the following table:

Statistics of the manufacture of coke in Georgia, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	1	140	40	63,402	60.0	38,041	$81,789	$2.15
1890	1	300	0	170,388	60.0	102,233	150,995	1.48
1900	2	480	0	140,988	52.4	73,928	210,646	2.85
1907	2	350	0	136,031	55.1	74,934	315,371	4.21
1908	2	350	0	71,452	55.2	39,422	137,524	3.72
1909	2	350	0	86,290	53.8	46,385	159,334	3.44
1910	2	350	0	80,019	54.8	43,814	173,049	3.95
1911	2	225	0	72,677	51.7	37,553	135,190	3.60
1912	2	251	0	87,300	50.0	43,158	161,842	3.75

ILLINOIS.

All of the coke produced in Illinois in 1911 and 1912 was made in retort ovens, much of the coal being drawn from West Virginia mines. In some instances the oven charge consists of a mixture of West Virginia and Illinois coals in the proportions of 4 to 1. This has been found to make an entirely satisfactory coke. There were 4 retort plants with a total of 568 ovens in operation in 1912. They were distributed as follows:

Semet-Solvay ovens.—The By-products Coke Corporation operated 240 ovens at South Chicago. This plant has been enlarged three times, the latest addition of 40 ovens being completed in 1912. The North Shore Gas Co., at Waukegan, operated 13 ovens completed in 1912. These ovens are heated by producer gas made from the coke. All of the retort gas goes to the city mains.

Koppers ovens.—The Illinois Steel Co. operated 280 ovens at Joliet, built in 1908 and 1909, and the Coal Products Manufacturing Co. operated 35 ovens, also at Joliet, completed in 1912. The surplus gas from the former is used at the steel plant and that from the latter is furnished to the city mains.

The new construction, incomplete at the end of 1912, consisted of 40 Semet-Solvay ovens building for the By-products Coke Corporation at South Chicago, making the fourth enlargement of this plant.

The production of coke in Illinois in 1912 amounted to 1,764,944 short tons, valued at $8,069,903, against 1,610,212 tons, valued at $6,390,251, in 1911. The average value per ton advanced from $3.97 to $4.57. In spite of the increase in production Illinois dropped from fourth to fifth place in rank among the States because of the much larger increase in Indiana, following the putting in blast of the entire plant (560 Koppers ovens) of the United States Steel Corporation at Gary, which advanced Indiana from sixth to third place.

The average yield of coal in coke in Illinois dropped from 77.1 to 76.2, probably due to larger proportions of Illinois coal used in the oven charge.

The statistics of the manufacture of coke in Illinois during the last six years are shown in the following table:

Statistics of the manufacture of coke in Illinois, 1907–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1907	5	309	280	514,983	72.3	372,697	$1,737,464	$4.66
1908	6	430	140	503,359	72.0	362,182	1,538,952	4.25
1909	5	468	40	1,682,122	75.9	1,276,956	5,361,510	4.20
1910	5	508	0	1,972,955	76.8	1,514,504	6,712,550	4.43
1911	6	506	48	2,087,870	77.1	1,610,212	6,390,251	3.97
1912	6	[a] 594	[b] 40	2,316,307	76.2	1,764,944	8,069,903	4.57

[a] Includes 253 Semet-Solvay, 315 Koppers and 24 Belgian ovens. [b] Semet-Solvay ovens.

INDIANA.

With the completion and putting in operation of the 560 Koppers ovens by the United States Steel Corporation, at Gary, Indiana advanced in 1912 to third place among the coke-producing States, displacing West Virginia, Illinois, and Colorado. In addition to these there were 50 United-Otto ovens operated by the Citizens Gas Co., at Indianapolis, and 22 Klönne ovens were completed during 1912 by the Central Indiana Gas Co., at Muncie. As the names of these operating companies indicate, the gas from the plants is furnished to the city mains. The Klönne ovens are smaller than the other retort ovens, being 18 feet long, 9 feet high, and 16 to 18 inches wide. They are heated by producer gas made from the coke in producers in front of and below the ovens. Youghiogheny, Pa., gas coal is used in the ovens, and the marketed coke is for domestic consumption. The coal used at Gary and at Indianapolis is chiefly from West Virginia.

The production of coke in Indiana in 1912 amounted to 2,616,339 short tons, valued at $12,528,685, an average of $4.79 per ton. The yield of coal in coke was the highest attained in the United States, 81.8 per cent. Indiana's production in 1912 exceeded that of West Virginia by about 150,000 tons, and was about 360,000 tons less than that of Alabama. It is probable that within two years, if not in 1913, Indiana will supplant Alabama as the second coke State, as at the close of 1912 there were 169 retort ovens in course of construction. This new work consists of 65 Koppers ovens at Indiana Harbor, 54 Semet-Solvay ovens at Indianapolis, and 50 United-Otto ovens also at Indianapolis. The 632 retort ovens in operation in 1912 produced an average of 4,140 tons each, or a little over 11 tons for every day of the year. The average retort-coke production in 1912 for the entire country was 2,133 tons per oven.

The statistics of the manufacture of coke in Indiana in 1912 are shown in the following table:

Statistics of the manufacture of coke in Indiana, 1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens	Value of coke at ovens per ton.
		Built.	Building.					
1912	4	[a] 642	[b] 169	3,198,874	81.8	2,616,339	$12,528,685	$4.79

[a] Includes 560 Koppers, 50 United-Otto, and 22 Klönne ovens.
[b] Includes 65 Koppers, 54 Semet-Solvay, and 50 United-Otto ovens.

Ten beehive ovens at Black Creek have not been in operation during the last three years.

KANSAS.

As in 1911, the only coke made in Kansas during 1912 was a small quantity produced in underground ovens operated in connection with the State penitentiary mines at Lansing. The industry has never been of great importance in the State, and the largest production (20,902 tons) was obtained in 1902. That product was made at ovens which were operated in connection with the zinc works and was used in the smelting operations.

The statistics of the manufacture of coke in Kansas in 1880, 1890, 1900, and in 1908–1912 are shown in the following table:

Statistics of the manufacture of coke in Kansas, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	2	6	0	4,800	64.0	3,070	$6,000	$1.95
1890	7	68	0	21,809	56.0	12,311	29,116	2.37
1900	9	91	0	10,303	57.7	5,948	14,985	2.52
1908	6	67	0	3,790	65.9	2,497	8,011	3.21
1909	6	67	0	0	0	0	0	0
1910	6	71	0	(a)	(a)	(a)	(a)	(a)
1911	3	53	0	(a)	(a)	(a)	(a)	(a)
1912	2	3	0	(a)	(a)	(a)	(a)	(a)

[a] Included with other States having less than three producers.

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 region, and the southern extremity of the eastern interior, or Illinois-Indiana field, is worked extensively in the western part of Kentucky. Coke has been made from coal mined in both the eastern and the western parts of the State, but although the coals of the eastern counties are in large part among the high-grade coking coals of the Appalachian field, most of the coke, until last year, has been made in the western district. Following, however, recent extensive coal-mining developments in the Elkhorn district of Pike and Harlan counties, ovens have been built and the principal coking activities have shifted to the eastern part of the State. During 1912, 472 ovens, all of the beehive type, were built and the production of coke increased to 191,555 tons from 66,099 tons in 1911. Of this quantity 155,632 tons were made in the eastern part of the State and 35,923 tons in the western part.

At the close of the year there were 291 ovens building, all in the eastern part of the State. The uncompleted ovens included 41 Semet-Solvay retort ovens building for the Kentucky-Solvay Co., of Ashland.

There were 9 coking plants in the State in 1912 with a total of 1,049 ovens, an increase of 1 establishment and of 472 ovens over 1911. Of the 9 establishments, 2 with a total of 104 ovens were idle throughout the year, in addition to which there were 160 ovens belonging to active plants idle, making a total of 264 ovens idle.

The quantity of coal used in the manufacture of coke in 1912 was 307,162 short tons. Of this quantity, 172,020 tons were mine-run, all unwashed, and 135,142 tons were slack (63,880 tons unwashed and 71,262 tons washed).

The following table gives the statistics of production in Kentucky in 1880, 1890, 1900, and for the last five years.

Statistics of the manufacture of coke in Kentucky, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	5	45	0	7,206	59.0	4,250	$12,250	$2.88
1890	9	175	103	24,372	51.0	12,343	22,191	1.80
1900	5	458	3	190,268	50.2	95,532	235,505	2.47
1908	6	495	0	(a)	(a)	37,827	(a)	(a)
1909	6	495	0	89,083	52.0	46,371	101,257	2.18
1910	6	495	0	104,103	51.7	53,857	120,554	2.24
1911	8	577	300	118,255	55.9	66,099	134,862	2.04
1912	9	1,049	b 291	307,162	62.4	191,555	513,734	2.68

a Included with other States having less than three producers. b Includes 41 Semet-Solvay ovens.

MISSOURI.

Coke making in Missouri has never been an important industry and, as in Kansas, has been limited to the coking of a small quantity of Pittsburg (Kans.) slack, the coke being used at the zinc smelters. All of the ovens have now been abandoned.

MONTANA.

Coals which possess coking qualities are found in Montana, but the attempts to utilize them for that purpose have not met with marked success. There are four establishments in the State, with a total of 451 ovens, but all of them were idle during 1912. All the 451 ovens are of the beehive type.

In the following table are given the statistics of production of coke in Montana in 1884, when the first production was reported, and in 1890, 1900, and since 1908:

Statistics of the manufacture of coke in Montana, 1884–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1884	3	5	12	165	46.0	75	$900	$12.00
1890	2	140	0	32,148	45.0	14,427	125,655	8.71
1900	3	342	111	108,710	50.3	54,731	337,079	6.16
1908	5	551	3	59,268	58.3	34,573	(a)	(a)
1909	5	551	3	82,993	44.7	37,069	(a)	(a)
1910	4	451	0	(a)	(a)	(a)	(a)	(a)
1911	4	451	0	0	0	0	0	0
1912	4	451	0	0	0	0	0	0

a Included with other States having less than three producers.

NEW MEXICO.

All the coke made in New Mexico is from coal mined from the Raton field in Colfax County. This field is the southern part of the Raton Mountain coal region, which consists of the Raton field in New Mexico and the Trinidad field in Colorado. The coal measures are continuous, but the producing areas are separated by a high divide near the Colorado-New Mexico line. A bank of 50 ovens at Waldo, in Santa Fe County, has not been in operation for several years. Slack coal is used in the manufacture of coke, and as over 25 per cent of the total output of the mines yielding coking coal goes into slack, an ample supply of fuel for the coke ovens is available.

There are 4 coking establishments in the State, including the one of 50 ovens at Waldo, which has been idle during the last four years. The total number of ovens in the State has not changed since 1909, there being altogether 1,030. Deducting the 50 idle ovens there were 980 that made coke in 1912. There were no new ovens in course of construction at the end of the year. All of the ovens in the State are of the beehive type. At Dawson, however, 446 out of a total of 570 ovens, although of beehive type in construction, are provided with underflues through which the gases are conveyed to a large flue back of the ovens and thence to the power house. The heat obtained from the oven gases renders the use of other fuel in the power plant unnecessary. The power plant, in addition to furnishing power for the operation of the mines, for ventilation, electric haulage, the coal crusher, washery, etc., furnishes also steam heat to the offices, commissary, hotel, hospital, and theater, and electric light for the city of Dawson.

The total quantity of coke produced in New Mexico in 1912 was 413,906 short tons, valued at $1,356,946, against 381,927 short tons, valued at $1,240,963, in 1911. This indicated an increase in 1912 of 31,979 tons, or 8.37 per cent, in quantity and of $115,983, or 9.35 per cent, in value. The average price per ton advanced from $3.25 to $3.28. All of the coal used for making coke in New Mexico is washed slack from the mines at Dawson, Gardiner, and Koehler. The quantity of slack used in 1912 was 679,209 short tons, and as the production of coke amounted to 413,906 short tons, the yield of coal in coke was 60.9 per cent. In 1911 the average yield was 61.5 per cent.

The statistics of production in 1882, 1890, 1900, and from 1908 to 1912 are shown in the following table:

Statistics of the manufacture of coke in New Mexico, 1882–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1882	2	0	12	1,500	66.0	1,000	$6,000	$6.00
1890	2	70	0	3,980	51.5	2,050	10,025	4.89
1900	2	126	0	74,261	60.3	44,774	130,251	2.91
1908	4	1,016	0	454,873	60.4	274,565	826,780	3.01
1909	4	1,030	0	694,390	53.9	373,967	1,099,694	2.94
1910	4	1,030	0	651,494	61.6	401,646	1,306,136	3.25
1911	4	1,030	0	620,639	61.5	381,927	1,240,963	3.25
1912	4	1,030	0	679,209	60.9	413,906	1,356,946	3.28

NEW YORK.

New York is one of the States lying outside the coal fields which produced coke in by-product recovery ovens. None of the coke made in the State is beehive coke. There are 4 establishments in the State with a total of 555 ovens, 188 of which are Otto-Hoffmann, 281 Rothberg, and 86 Semet-Solvay. The Otto-Hoffman and Rothberg ovens are operated by the Lackawanna Steel Co., at Buffalo, 40 of Semet-Solvay ovens are located at Solvay, near Syracuse, and 46 at the Empire Coke Works, at Empire. Although New York lies entirely outside the coal-producing area, it has the distinction of being the first State in which by-product ovens were built, the first 12 Semet-Solvay ovens constructed in the United States having been erected in 1893 at Solvay. This plant was increased to 25 ovens in 1896 and to 40 ovens in 1903. The production of coke in New York in 1912 amounted to 794,618 short tons, valued at $3,203,133, against 686,172 short tons, valued at $2,883,990, in 1911, an increase in 1912 amounting to 108,446 short tons, or 15.80 per cent, in quantity and to $319,143, or 11.07 per cent, in value. The average price per ton declined from $4.20 in 1911 to $4.03 in 1912, the latter figure being about the same as obtained in 1910. The quantity of coal used was 1,095,198 short tons, valued at $2,648,981, or an average value of $2.42 per ton. The value of coal per ton of coke produced was $3.34 as compared with $4.03 as the value of the coke. The yield of coal in coke was 72.6 per cent, against 71.8 per cent in 1911.

All of the coal used for coke making in New York is drawn from Pennsylvania mines. It will be noted, however, that in Pennsylvania, where most of the coke is made in beehive ovens, the yield of coal in coke in 1912 was 66.5 per cent, while in New York the retort ovens show a yield of 72.6 per cent. Most of the coal used in New York, about 93 per cent, is run-of-mine. In 1912 the coal charged into the ovens consisted of 849,029 short tons of unwashed run-of-mine, 200,554 tons of washed run-of-mine, 43,360 tons of unwashed slack, and 2,255 tons of washed slack.

The statistics of the manufacture of coke in New York in 1910, 1911, and 1912 are shown in the following table:

Statistics of the manufacture of coke in New York in 1910, 1911, and 1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1910	4	555	0	910,293	71.7	652,459	$2,635,873	$4.04
1911	4	555	0	955,067	71.8	686,172	2,883,990	4.20
1912	4	[a] 555	0	1,095,198	72.6	794,618	3,203,133	4.03

[a] Includes 188 Otto-Hoffmann, 281 Rothberg, and 86 Semet-Solvay ovens.

OHIO.

The coals of Ohio belong to the Appalachian province, and most of the beds are correlated with those of Pennsylvania and West Virginia to the east and southeast. But although the bituminous and semibituminous coals of Pennsylvania and West Virginia include the highest grade coking coals in the United States, and although those two States are the first and second in rank as coal producers, the coals seem to lose their coking qualities as the beds extend westward, and a large part of the coke made in Ohio is from coal brought from West Virginia to by-product retort ovens at Kokotto, near Cincinnati, and at Cleveland. On the other hand, some of the coal mined in Ohio is a good blast-furnace fuel in the raw state, and this obviates the necessity of coking. When used raw, however, the coal is usually mixed with coke.

Ohio ranks fourth among the States as a coal producer, but thirteenth in the manufacture of coke. Prior to 1905, when the first installation of by-product ovens was put in operation, Ohio laid little claim to importance as a producer of coke. There were 7 establishments making coke in 1912, against 8 in 1911, 1 establishment of 25 ovens having been abandoned. The 7 establishments contained a total of 471 ovens, of which 149 are of the recovery type. These consist of 100 Otto-Hoffmann ovens at Kokotto and 49 Semet-Solvay ovens at Cleveland. The total production of coke in Ohio in 1912 was 388,669 short tons, valued at $1,365,905, of which 241,725 tons, valued at $913,382, were the output of the retort ovens. The 322 beehive ovens produced 146,944 short tons of coke, valued at $452,523. As most of the coal for the beehive ovens, as well as that for the retort ovens, is from Pennsylvania and West Virginia mines, there is not such a marked difference between the values of the two cokes as is shown in some of the other States. The average value per ton of the beehive coke was $3.09 and of retort coke $3.79. It will be noted, however, that the prices are considerably higher than those obtained for coke in Pennsylvania and West Virginia.

There were 119 new ovens under construction at the close of 1912, 51 being Semet-Solvay ovens for the Cleveland Furnace Co., at Cleveland, and 68 Koppers ovens for the Republic Iron & Steel Co., at Youngstown.

The statistics of the production of coke in Ohio in 1880, 1890, and 1900, and for the last five years are shown in the following table:

Statistics of the manufacture of coke in Ohio, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	15	616	25	172,453	58.0	100,596	$255,905	$2.54
1890	13	443	1	126,921	59.0	74,633	218,090	2.92
1900	8	369	50	115,269	62.5	72,116	194,042	2.69
1908	7	481	50	237,448	67.2	159,578	491,982	3.08
1909	7	447	49	340,735	65.4	222,711	683,155	3.07
1910	8	496	0	413,059	68.3	282,315	911,987	3.23
1911	8	496	0	456,222	68.2	311,382	961,904	3.09
1912	7	[a] 471	[b] 119	561,426	69.2	388,669	1,365,905	3.51

[a] Includes 100 United-Otto and 49 Semet-Solvay ovens.
[b] Includes 51 Semet-Solvay and 68 Koppers ovens.

In 1912 the unwashed run-of-mine coal used amounted to 506,883 short tons and the unwashed slack 15,598 tons. The washed coal amounted to 38,945 short tons, of which 23,541 tons were run-of-mine and 15,404 were slack.

The character of the coal used in the manufacture of coke in Ohio in 1890, 1900, and from 1908 to 1912, 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
1900	68,175	0	17,094	30,000	115,269
1908	180,458	27,481	6,244	23,265	237,448
1909	293,554	0	12,312	34,869	340,735
1910	333,397	0	12,212	67,450	413,059
1911	417,101	16,574	5,504	17,043	456,622
1912	506,883	23,541	15,598	15,404	561,426

OKLAHOMA.

Small success has been made in the attempts to manufacture coke from Oklahoma coal. There were two establishments in the State in 1912, a decrease from four in 1911. One of them produced a small quantity of coke in 1910, but all were idle in 1911 and the two remaining ones in 1912. The details of the 1910 production are included among other States having less than three producers.

The following table gives the statistics of the manufacture of coke in Oklahoma (Indian Territory) in 1880, 1890, 1900, and 1908–1912:

Statistics of the manufacture of coke in Oklahoma (Indian Territory), 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	1	20	0	2,494	62.0	1,546	$4,638	$3.00
1890	1	80	0	13,278	50.0	6,639	21,577	3.25
1900	3	230	0	79,534	48.0	38,141	152,204	3.99
1908	5	486	50	(a)	(a)	2,944	(a)	(a)
1909	5	536	0	0	0	0	0	0
1910	4	408	0	(a)	(a)	(a)	(a)	(a)
1911	4	410	0	0	0	0	0	0
1912	2	260	0	0	0	0	0	0

[a] Included with other States having less than 3 producers.

PENNSYLVANIA.

Pennsylvania stands preeminent among the States in the production of coal and in the manufacture of coke. As a producer of coke Pennsylvania is relatively of greater importance than as a producer of coal, for, whereas, including the production of anthracite, Pennsylvania contributes less than half the entire output of coal in the United States, nearly two-thirds the total production of coke is made within that State. In 1912 the two principal coking districts of Pennsylvania—the Connellsville and the Lower Connellsville districts—both included in the two counties of Fayette and Westmoreland, produced 48 per cent of the coke product of the United States. Ever since coke became the principal fuel in the manufacture of iron (it superseded anthracite for this purpose in 1875) the Connellsville district has been the chief source of supply. What is known as the Lower Connellsville district came into existence in 1900, and in its 12 years of life has exhibited a rapidity in development that has outrivaled any coke-making district in the world. The Connellsville Basin proper is included in both Westmoreland and Fayette counties; the Lower Connellsville Basin is entirely in Fayette County, lies southwest of the southern end of the Connellsville Basin, and is separated from it by the Greensburg anticline. The Lower Connellsville district is now the second coke-producing district in the United States and will probably in a few years rival its older neighbor for first place. The year 1911 was the second one in which, since it was first opened, the Lower Connellsville district showed a decrease in the production of coke. This decrease was more than made up, however, by the increase in 1912. In both the Connellsville and the Lower Connellsville districts all but a very small quantity of the coke is made in beehive ovens or in rectangular ovens, in which the process is one of partial combustion, as in the beehive ovens, and without recovery of by-products or utilization of the heat generated in the coking process. With the exception of 110 Semet-Solvay ovens in the Connellsville district, all of the by-product recovery ovens in Pennsylvania are outside of the coking-coal mining districts.

The quantity of coke produced in Pennsylvania in 1912 was 27,438,693 short tons, valued at $56,267,838, against 21,923,935 tons, valued at $43,053,367, in 1911. The increase in 1912, compared with 1911, was 5,514,758 short tons, or 25.15 per cent, in quantity, and $13,214,471, or 30.69 per cent, in value. The average price per ton advanced from $1.96 to $2.05. In the quantity of coke made the production in 1912 was the largest on record, exceeding the previous maximum of 26,513,214 tons in 1907 by 925,479 short tons, but falling behind the earlier year in value by $11,325,186. The average price per ton obtained for the coke product of Pennsylvania in 1907 was $2.55, the highest figures attained in recent years.

The quantity of coal consumed in the manufacture of coke in 1912 was 41,268,532 short tons, and the average yield of coal in coke was 66.5 per cent. In 1911 the quantity of coal consumed was 32,875,655 tons, with an average yield of coal in coke of 66.7 per cent.

In both 1911 and 1912 decreases were noted in the number of coke-making establishments, and in the total number of ovens. The number of establishments or plants decreased from 288 in 1910 to 279 in

1911 and to 277 in 1912. There were 7 new plants constructed in 1912 and 9 old ones dismantled, making a net loss of 2. The 9 abandoned plants had a total of 701 ovens. In addition to these there were 1,759 ovens, portions of plants, that were abandoned in 1912, making a total of 2,460 abandoned ovens. The new plants and additions to old ones represented a total of 1,312 new ovens, making a net decrease in the total number of ovens of 1,148. In 1911 there were 54,904 ovens, and in 1912, 53,756. The total number of idle ovens in 1912 was 8,967, of which 1,857 were the entire equipment of 21 establishments. The 256 active establishments and 44,789 active ovens produced 27,438,693 tons of coke, an average of 107,182 tons to each establishment and of 615 tons per oven. Of the 44,789 active ovens, 1,442, or 3.3 per cent, were of the by-product recovery type, which produced 1,974,619 short tons, or 7 per cent, of the total output. The average production for each retort oven was 1,369 tons of coke, and the yield of coal in coke was 73.8 per cent. The 43,347 active ovens of beehive type produced an average of 587 tons of coke and the yield of coal in coke was 66.0 per cent.

At the close of 1912 there were 1,887 new ovens in course of construction, including 150 Didier retort ovens at South Bethlehem (150 being completed and put in operation during 1912), which were begun in 1910, and 1,083 rectangular ovens, which have achieved considerable popularity in Pennsylvania, especially in the Lower Connellsville district. The chief advantage possessed by the rectangular oven over the beehive is that the coking chamber being long and narrow like the retort oven the coke may be pushed from it and does not have to be drawn as is the case with the beehive oven. The process of carbonization is the same—that of partial combustion.

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, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	124	9,501	836	4,347,558	65.0	2,821,384	$5,255,040	$1.86
1890	106	23,430	74	13,046,143	65.6	8,560,245	16,333,674	1.91
1900	177	32,548	2,310	20,239,966	66.0	13,357,295	29,692,258	2.22
1908	252	52,606	1,720	23,215,964	66.8	15,511,634	32,569,621	2.10
1909	283	54,506	2,072	36,983,568	67.3	24,905,525	50,377,035	2.02
1910	288	55,656	1,334	39,455,785	66.7	26,315,607	55,254,599	2.10
1911	279	54,904	1,271	32,875,655	66.7	21,923,935	43,053,367	1.96
1912	277	[a]53,756	[b]1,887	41,268,532	66.5	27,438,693	56,267,838	2.05

[a] Includes 932 United-Otto, 360 Semet-Solvay, 150 Didier, 2,961 rectangular, 400 Belgian, 420 longitudinal, and 11 Ramsey ovens.
[b] Includes 1,083 rectangular and 150 Didier ovens.

By far the larger part of the coal used in coke making in Pennsylvania is unwashed run-of-mine. The coal mined in the Connellsville districts is an ideal coking coal, and requires no preparation for the coke oven, though some of it is crushed before being charged. Of the 41,268,532 short tons of coal used in 1912 for coke making in Pennsylvania, 35,344,633 tons were unwashed run-of-mine, and 1,098,392 tons were unwashed slack. The washed coal used consisted of 2,493,661 short tons of mine-run and 2,331,846 tons of slack.

The character of the coal used in the manufacture of coke in Pennsylvania in 1890, 1895, 1900, 1905, and from 1908 to 1912, 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
1905	26,148,696	1,335,631	2,436,621	1,109,397	31,030,345
1908	18,691,073	1,718,944	1,062,478	1,743,469	23,215,964
1909	31,712,482	2,278,927	1,016,576	1,975,583	36,983,568
1910	32,688,029	2,372,115	1,275,348	3,120,293	39,455,785
1911	27,601,050	1,958,360	1,029,149	2,287,096	32,875,655
1912	35,344,633	2,493,661	1,098,392	2,331,846	41,268,532

PRODUCTION BY DISTRICTS.

In previous chapters of this series of reports 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 district 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 a point 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 two of the Allegheny Valley plants have been abandoned, and the production previous to 1908 has been included in that of the Pittsburgh district. During 1911 but one of these plants was in operation. 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, those formerly operated by the Semet-Solvay Co. in Mercer County have been abandoned, and the operations of the one establishment of United-Otto ovens at South Sharon are now also included in the Pittsburgh district. The Blossburg and the Broadtop districts embrace the Blossburg and the Broadtop coal fields. The ovens of the Clearfield-Center district are chiefly in the two counties from which it derives its name. The Connellsville district is the well-known region of western Pennsylvania in Westmoreland and Fayette counties, extending from just south of Latrobe to Fairchance. The Lower Connellsville region is entirely in Fayette County and 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, Pittsburgh, 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, the 150 Didier ovens at South Bethlehem, and the United-Otto ovens at Lebanon are in what has been designated as the Lebanon-Schuylkill district. The production of the districts having less than three producers is combined.

Coke production in Pennsylvania in 1911 and 1912, by districts.

1911.

District.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke per ton.
		Built.	Building.					
Allegheny Mountain	25	2,475	0	1,182,516	69.9	826,726	$2,037,953	$2.47
Connellsville	112	23,879	227	14,420,328	66.3	9,565,013	18,471,506	1.93
Greensburg	7	2,040	0	1,142,361	65.4	747,654	1,451,130	1.94
Lower Connellsville	71	14,857	654	10,771,495	68.3	7,354,736	12,998,192	1.77
Pittsburgh	12	3,737	0	2,322,422	62.4	1,449,934	3,228,508	2.23
Reynoldsville - Walston	10	2,881	0	1,427,896	57.3	818,942	1,839,344	2.25
Upper Connellsville	21	2,819	60	514,186	64.4	330,886	576,860	1.74
Allegheny Valley, Broadtop, Clearfield-Center, Irwin, Lebanon and Schuylkill Valley	21	2,216	330	1,094,451	75.8	830,044	2,449,874	2.95
Total	279	54,904	1,271	32,875,655	66.7	21,923,935	43,053,367	1.96

1912.

District.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke per ton.
		Built.	Building.					
Allegheny Mountain	25	[a] 2,483	0	1,252,141	69.6	870,951	$2,384,725	$2.74
Allegheny Valley	2	52	0	0	0	0	0	0
Connellsville	109	[b] 22,219	148	17,772,202	66.5	11,814,588	22,463,602	1.90
Lower Connellsville	74	[c] 15,525	[d] 422	13,456,074	67.1	9,023,371	17,098,420	1.90
Greensburg	7	[e] 2,040	0	1,358,845	65.8	894,271	1,883,068	2.11
Irwin	2	289	0	0	0	0	0	0
Pittsburgh	11	[f] 3,724	[g] 796	3,560,298	64.6	2,301,362	5,813,575	2.53
Reynoldsville - Walston	10	[h] 2,881	[i] 200	1,211,655	57.9	701,667	1,586,844	2.26
Upper Connellsville	22	[j] 2,749	[k] 143	1,120,295	68.1	762,700	1,564,457	2.05
Lebanon and Schuylkill Valley	5	[l] 628	[m] 150	1,215,146	70.9	861,072	2,917,244	3.39
Broadtop, Clearfield-Center	10	1,166	28	321,876	64.8	208,711	555,903	2.66
Total	277	53,756	1,887	41,268,532	66.5	27,438,693	56,267,838	2.05

[a] Includes 372 United-Otto ovens.
[b] Includes 1,120 rectangular and 110 Semet-Solvay ovens.
[c] Includes 1,702 rectangular and 360 longitudinal ovens.
[d] Includes 314 rectangular ovens.
[e] Includes 100 Belgian ovens.
[f] Includes 332 United-Otto, 300 Belgian, and 10 rectangular ovens.
[g] Includes 476 rectangular ovens.
[h] Includes 11 Ramsay ovens.
[i] Rectangular ovens.
[j] Includes 189 rectangular ovens.
[k] Includes 93 rectangular ovens.
[l] Includes 270 Semet-Solvay, 228 United-Otto, and 150 Didier ovens.
[m] Didier ovens.

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 and lying entirely within their boundaries. It is a short distance east of the city of Pittsburgh and supplies the larger part of the fuel consumed in the iron and steel furnaces of

Pittsburgh and vicinity, the greatest iron-manufacturing center of the world. Large quantities of Connellsville coke are also shipped to distant points of consumption. 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 few 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 district, the supremacy of the region continues undisputed.

The history of the last few years indicates that there will not be much, if any, expansion in the coke trade of the Connellsville district proper in the future, although the production in 1912 was about 2,250,000 tons over that of 1911. It was only about 350,000 tons in excess of 1910 and less than 50,000 tons more than that of 1909. It is shown in the comparative records of ovens built and abandoned, however, that a practically constant rate of production has been reached. In 1911 there were fewer ovens in the Connellsville region than in any year since 1906, and the number was further reduced in 1912 by 1,660. There were only 148 ovens building at the close of the year. The number of establishments abandoned and dismantled in 1912 was 3, with a total of 298 ovens, in addition to which there were 1,528 ovens, portions of other plants, which were torn down, making a total of 1,826 abandoned ovens. There were 166 new ovens built during 1912. In 1911 the total number of ovens in existence was 23,879. In 1912 there were 22,219. Of these, 4,068 were idle during the year, making a total of 18,151 active ovens, which produced 11,814,588 tons of coke, an average of 651 tons per oven. In 1911 there were 15,517 active ovens, which produced 9,565,013 tons of coke, an average of 609 tons for each oven in operation. The production in 1912 showed an increase of 2,249,575 tons, or 24.8 per cent. The value increased from $18,471,506 to $22,463,602, a gain of $3,922,096, or 21.6 per cent. The average price per ton declined from $1.93 to $1.90. The general average price for coke in Pennsylvania was $1.96 in 1911 and $2.05 in 1912. On the face it appears that the value of Connellsville coke, which is the standard blast-furnace fuel of the United States, was less than that made in other parts of the State. This apparent inconsistency is due largely to the fact that nearly all of the coke produced in the Connellsville district is the output of beehive ovens located in the immediate vicinity of the mines, whereas considerable quantities of coal are shipped from the mines of Pennsylvania to retort-oven plants at Johnstown, Glassport, Chester, and Lebanon, and the expense of transportation added to the cost of the coal naturally appears in a higher price for the coke at the ovens. In reaching markets from the Connellsville district the transportation expenses from the ovens to points of consumption must be borne by the coke.

Of the 22,219 ovens in the Connellsville district in 1912, 110 were of the by-product recovery type. They are Semet-Solvay ovens, operated by the Semet-Solvay Co. at Dunbar. A few rectangular, or Mitchell, ovens have been constructed in the district, but in them, as in the beehive ovens, the process is one of partial combustion and not of distillation. The average yield of Connellsville coal in coke in the Connellsville district was from 66 to 68 per cent. The yield of Connellsville coal in the retort-oven plant was 73 per cent in 1912.

In the following table are presented the statistics of the manufacture of coke in the Connellsville district in 1880, 1890, 1900, and from 1908 to 1912:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	67	7,211	731	3,367,856	65.5	2,205,946	$3,948,643	$1.79
1890	28	15,865	30	9,748,449	66.3	6,464,156	11,537,370	1.94
1900	98	20,981	686	14,946,659	67.0	10,020,907	22,383,432	2.23
1908	104	24,071	118	10,238,665	67.2	6,880,951	14,025,422	2.04
1909	117	24,422	370	17,581,899	66.9	11,769,758	23,379,149	1.99
1910	118	24,481	206	17,205,615	66.6	11,459,601	23,121,556	2.02
1911	112	23,879	227	14,420,328	66.3	9,565,013	18,471,506	1.93
1912	109	[a]22,219	148	17,772,202	66.5	11,814,588	22,463,602	1.90

[a] Includes 110 Semet-Solvay by-product and 1,120 rectangular ovens.

The following table, compiled by the Courier, of Connellsville, Pa., shows the shipments of coke, by months, from the Connellsville and the Lower Connellsville districts. The figures are given in cars and tons, with the average number of cars shipped each working day of the month, and include shipments from the Lower Connellsville district as well as from the Connellsville district proper. This authority gives the shipments in 1912 at 20,032,275 short tons, whereas the combined production in the Connellsville and the Lower Connellsville districts reported to the Survey amounted to 20,837,959 short tons. It will be noted that in every month of 1912 the shipments exceeded those in corresponding months in 1911. In the former year there were only three months, September, November, and December, when the shipments showed an increase over 1910. The average daily record of cars shipped in 1912 was 1,911, against 1,570 in 1911 and 1,923 in 1910. The largest number of cars shipped in any one month during the last three years was in January, 1910—64,722 cars. The smallest number shipped was in January, 1911—36,511 cars. The largest number shipped in any one month in 1912 was 53,142 cars in May, and the minimum number of cars, 45,753, was in September.

The monthly shipments from this region, from 1908 to 1912, inclusive, reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville and Lower Connellsville regions, 1908–1912, in short tons.

Month.	1908	1909	1910	1911	1912
January	742,096	1,205,650	1,952,406	1,194,047	1,575,198
February	810,436	1,143,487	1,787,164	1,302,098	1,583 567
March	841,059	1,185,814	1,922,575	1,621,301	1,750,944
April	772,915	1,144,751	1,754,654	1,419,369	1,710,417
May	759,813	1,235,044	1,527,515	1,343,879	1,778,860
June	772,367	1,429,289	1,544,964	1,299,295	1,621,004
July	856,843	1,605,937	1,446,294	1,257,820	1,565,126
August	952,492	1,641,287	1,464,060	1,355,774	1,690,681
September	975,606	1,704,919	1,390,140	1,394,752	1,553,246
October	1,030,552	1,821,444	1,450,717	1,424,232	1,793,432
November	995,807	1,835,745	1,252,797	1,385,627	1,736,938
December	1,190,036	1,832,465	1,196,436	1,335,974	1,672,862
Total	10,700,022	17,785,832	18,689,722	16,334,168	20,032,275

The total shipments, in cars, for the last 25 years were as follows:

Total and daily average shipments, in cars, 1888–1912.

Year.	Daily average.	Total cars.	Year.	Daily average.	Total cars.	Year.	Daily average.	Total cars.
1888	905	282,441	1897	1,181	367,383	1906	2,385	745,274
1889	1,046	326,220	1898	1,415	441,249	1907	2,210	691,757
1890	1,147	355,070	1899	1,676	523,203	1908	1,173	368,222
1891	884	274,000	1900	1,619	504,410	1909	1,920	600,979
1892	1,106	347,012	1901	1,857	581,051	1910	1,923	598,706
1893	874	270,930	1902	1,986	624,198	1911	1,570	488,672
1894	900	281,677	1903	1,782	558,738	1912	1,911	595,336
1895	1,410	441,243	1904	1,623	510,759			
1896	920	289,137	1905	1,886	688,328			

Shipments of coke from the Connellsville region, including the Lower Connellsville district, in 1911 and 1912, by months.

Month.	1911			1912		
	Cars.	Daily car average.	Short tons.	Cars.	Daily car average.	Short tons.
January	36,511	1,404	1,194,047	46,537	1,723	1,546,892
February	39,726	1,655	1,302,098	47,212	1,888	1,560,182
March	49,581	1,837	1,621,301	52,015	2,000	1,747,959
April	42,700	1,708	1,419,369	50,862	1,956	1,697,734
May	39,809	1,474	1,343,879	53,142	1,968	1,776,415
June	38,322	1,474	1,299,295	48,959	1,958	1,635,824
July	37,129	1,424	1,257,820	46,723	1,797	1,564,377
August	40,264	1,491	1,355,774	50,244	1,861	1,704,307
September	41,389	1,592	1,394,752	45,753	1,830	1,555,483
October	42,582	1,638	1,424,232	52,443	1,940	1,782,302
November	41,288	1,592	1,385,627	51,261	1,971	1,736,888
December	39,371	1,651	1,335,974	50,185	2,007	1,692,510
Total	488,672	1,570	16,334,168	595,336	1,911	20,000,873

As Connellsville coke is recognized as the standard for the United States and governs largely the prices for the product of other districts, the following table is given showing the prices for furnace and foundry coke, by months, during the years 1908 to 1912. These prices are quoted from The Iron Age and are for strict Connellsville coke. "Main line" and "outside" cokes are usually quoted from 15 to 20 cents below the strict Connellsville. Owing to the depressed condition of the iron trade which obtained through the entire year 1911 prices for Connellsville coke were the lowest in 10 years, falling from 50 cents to $1 less than in the boom year 1907, the average price being lower even than in the panic year 1908. The prices in 1912, as shown in this table, were almost without exception after February considerably higher than the average value per ton as realized by the coke sold. The only explanation for this appears to be in the fact that the larger part of the output in 1912 was sold at contract prices made in the preceding year.

Prices of Connellsville furnace and foundry coke, 1909–1912, by months.

Month.	Furnace.					
	1909	1910	1911		1912	
			Spot.	Contract.	Spot.	Contract.
January	$1.50 to $2.00	$2.50 to $2.75	$1.40 to $1.55	$1.70 to $2.00	$1.75 to $1.85	$1.65 to $1.70
February	1.50 to 1.65	1.75 to 2.60	1.45 to 1.55	1.70 to 1.75	1.75 to 1.80	1.75 to 1.80
March	1.55 to 2.00	2.10 to 2.60	1.50 to 1.65	1.70 to 2.00	1.85 to 2.25	1.75 to 1.80
April	1.60 to 1.85	1.75 to 2.15	1.60 to 1.65	1.80 to 2.00	2.10 to 2.60	2.15 to 2.25
May	1.50 to 1.90	1.65 to 2.00	1.50 to 1.65	1.75 to 1.85	2.10 to 2.50	2.25 to 2.35
June	1.50 to 1.75	1.65 to 1.85	1.40 to 1.50	1.55 to 1.85	1.90 to 2.10	2.25 to 2.35
July	1.60 to 1.80	1.60 to 1.85	1.45 to 1.55	1.55 to 1.75	2.15 to 2.25	2.25
August	1.65 to 2.00	1.60 to 1.85	1.45 to 1.55	1.60 to 1.65	2.15 to 2.25	2.25
September	2.00 to 3.00	1.60 to 1.80	1.50 to 1.55	1.60 to 1.70	2.15 to 2.50	2.25 to 2.50
October	2.75 to 3.00	1.55 to 1.75	1.50 to 1.55	1.55 to 1.70	2.65 to 4.00	2.50 to 3.00
November	2.75 to 2.90	1.45 to 1.75	1.50 to 1.55	1.50 to 1.75	3.85 to 4.00	3.00 to 3.25
December	2.60 to 2.90	1.40 to 1.80	1.50 to 1.80	1.60 to 1.75	4.00	3.25

Month.	Foundry.					
	1909	1910	1911		1912	
			Spot.	Contract.	Spot.	Contract.
January	$2.00 to $2.50	$2.85 to $3.25	$1.90 to $2.50	$2.25 to $2.50	$1.90 to $2.00	$2.10 to $2.15
February	1.85 to 2.25	2.50 to 3.00	2.10 to 2.50	2.25 to 2.50	2.00 to 2.25	2.10 to 2.25
March	1.85 to 2.25	2.60 to 3.15	2.00 to 2.50	2.25 to 2.40	2.25 to 2.75	2.25 to 2.50
April	1.75 to 2.40	2.50 to 3.00	2.00 to 2.00	2.25 to 2.40	2.50 to 2.75	2.50 to 2.75
May	1.80 to 2.35	2.15 to 2.75	1.75 to 2.00	2.10 to 2.40	2.50 to 2.75	2.40 to 2.65
June	1.80 to 2.50	2.15 to 2.50	1.75 to 2.00	2.00 to 2.40	2.40	2.40 to 2.60
July	1.80 to 2.50	2.15 to 2.50	1.85 to 2.00	2.10 to 2.40	2.40	2.40 to 2.60
August	1.70 to 2.50	2.15 to 2.50	1.95 to 2.00	2.00 to 2.50	2.40	2.50
September	2.25 to 3.25	2.10 to 2.50	1.85 to 2.00	2.10 to 2.40	2.40 to 2.75	2.50 to 2.75
October	2.75 to 3.50	2.15 to 2.50	1.85 to 2.00	2.10 to 2.40	3.00 to 4.25	3.00 to 3.75
November	3.00 to 3.50	2.00 to 2.50	1.85 to 2.00	2.10 to 2.40	4.25	3.75
December	3.25 to 3.50	1.90 to 2.50	1.90 to 2.00	2.10 to 2.25	4.25 to 4.50	3.75 to 4.00

Lower Connellsville district.—This district is now the second in importance among the coke-making districts of the United States. It bids fair to rival the Connellsville district within a few years. The first ovens were built in 1900, so that at the close of 1912 the district was only a little more than 12 years old. The production of coke in the Lower Connellsville district in 1911 was 7,354,736 short tons. In 1912 it was 9,023,371 tons, an increase of 1,668,635 tons, or nearly 23 per cent. The value increased from $12,998,192 to $17,098,420, a gain of $4,100,228, or nearly 33 per cent. The average price per ton in the Lower Connellsville district advanced from $1.77 to $1.90, the same as in the Connellsville district, although the average value per ton in the latter district in 1911 was 3 cents higher than in 1912.

In contrast with the smaller number of ovens reported from the Connellsville district in 1912, as compared with 1911, the number of ovens in the Lower Connellsville district increased from 14,857 to 15,525, and there were 422 new ovens in course of construction at the end of the year against 148 in the Connellsville district. The number of establishments in the Lower Connellsville district increased from 71 to 74. One establishment of 30 ovens was abandoned, but 4 new ones were constructed. One plant of 52 ovens was idle throughout the year, and the total number of idle ovens was 1,308, leaving 14,217 ovens in active operation during all or a portion of the year. These 14,217 ovens produced an average of 642 tons per oven. The rectangular (or Mitchell) ovens, to which reference has already been made, have found their greatest favor in the Lower Connellsville district, and of the 15,525 ovens in existence at the close of 1912, 1,702 were rectangular in shape. Of the 422 ovens in course of construction at the end of the year, 314 were rectangular. There are no by-product-recovery ovens in the district.

The record of coke production in the Lower Connellsville district in 1900, 1905, and from 1908 to 1912 is as follows:

Statistics of the manufacture of coke in the Lower Connellsville district, Pennsylvania, 1900, 1905, and 1908–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1900	12	2,033	1,112	579,928	66.5	385,909	$792,886	$2.05
1905	45	7,484	1,145	5,666,812	68.3	3,871,310	7,532,382	1.95
1908	62	13,162	1,203	6,156,553	69.1	4,252,222	7,796,860	1.83
1909	70	14,215	1,036	9,781,803	69.1	6,761,335	12,490,518	1.85
1910	73	14,805	668	12,130,425	67.8	8,219,492	16,048,675	1.95
1911	71	14,857	654	10,771,495	68.3	7,354,736	12,998,192	1.77
1912	74	[a]15,525	[b]422	13,456,074	67.1	9,023,371	17,098,420	1.90

[a] Includes 1,702 rectangular and 360 longitudinal ovens. [b] Includes 314 rectangular ovens.

TENNESSEE.

The eastern part of Tennessee is crossed, in a northeast-southwest direction, by the coal measures of the Appalachian province. Coal is mined in 17 counties and coke is made in 8. The counties in which coke is made are Campbell, Grundy, Hamilton, Marion, Morgan, Rhea, Roane, and Sequatchie. The larger part of the workable coal in the State occurs in three basins, the Wartburg, the Walden, and the Sewanee. (See report on production of coal, 1910.) Each of these basins contains a number of workable coal beds, as many as seven having been noted in the Walden Basin. Nearly all of the Tennessee coals possess coking qualities, but not all to the same degree, as is attested by the number of idle ovens during the last five years. There were 15 establishments, with a total of 2,584 ovens, in the State in 1912, of which 6, with a total of 928 ovens, were idle. There were also 190 ovens, portions of other plants, which were not operated during the year. The 1,466 active ovens, all of which are of the beehive type, produced in 1912, 370,076 short tons of coke, valued at $951,853, an average of $2.57 per ton. In 1911 the production was 330,418 short tons, valued at $797,758, or an average of $2.41 per ton. The increase in 1912 was 39,658 short tons, or 12 per cent, in quantity, and $154,095, or 19.32 per cent, in value. There were no new ovens in course of construction at the close of 1912.

The quantity of coal used in the manufacture of coke in 1912 was 685,861 short tons, of which 189,887 tons were washed run-of-mine, 409,296 washed slack, and 86,678 unwashed slack.

The statistics of the manufacture of coke in Tennessee in 1880, 1890, 1900, and from 1908 to 1912, are shown in the following table:

Statistics of the manufacture of coke in Tennessee, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	6	656	68	217,656	60.0	130,609	$316,607	$2.42
1890	11	1,664	292	600,387	58.0	348,728	684,116	1.96
1900	14	2,107	340	854,789	55.6	475,432	1,269,555	2.67
1908	17	2,792	20	395,936	54.2	214,528	561,789	2.62
1909	16	2,792	0	493,283	53.1	261,808	667,723	2.55
1910	16	2,792	0	597,658	54.0	322,756	959,104	2.97
1911	15	2,547	30	628,118	52.6	330,418	797,758	2.41
1912	15	2,584	0	685,861	54.0	370,076	951,853	2.57

The character of the coal used in the manufacture of coke in Tennessee in 1890, 1900, and since 1908, is shown in the following table:

Character of coal used in the manufacture of coke in Tennessee, 1890, 1900, and 1908–1912, in short tons.

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	255,359	0	273,028	72,000	600,387
1900	150,697	349,448	24,122	330,522	854,789
1908	29,668	250,120	102,578	13,570	395,936
1909	30,361	285,591	0	177,331	493,283
1910	41,650	346,769	0	209,239	597,658
1911	0	283,203	0	344,915	628,118
1912	0	189,887	86,678	409,296	685,861

UTAH.

As there is but one company engaged in the manufacture of coke in Utah, the statistics of production are included with those of other States having less than three producers. The coals of Utah used in the manufacture of coke are practically identical in character with those of western Colorado. One establishment of 204 ovens, at Castle Gate, was abandoned in 1912, reducing the number of ovens in the State from 854 to 650.

VIRGINIA.

All of the coking coals of Virginia are contained in a few counties lying in the extreme southwestern portion of the State and within the coal fields of the Appalachian province. The development of this region began in 1883 with the completion of the New River division of the Norfolk & Western Railway, and for 10 years the manufacture of coke, as well as the production of coal in Virginia, was almost entirely from Tazewell County. Ten years from the opening of the district, or in 1893, the Norfolk & Western Railway completed a branch up the Clinch Valley and opened what is now the most important coking-coal district in Wise County. During 1906 and 1907 extensive developments in what is known as the Black Mountain field in Lee County followed the construction into that district of the Black Mountain Railroad, now operated jointly by the Southern Railway and the Louisville & Nashville Railroad.

Like West Virginia, Virginia suffers in its manufacture of coke from the handicap of having no local markets for its product, except the furnaces at Lowmoor and Covington, where the coke ovens were operated in connection with the furnaces and on coal drawn from the New River district of West Virginia. There were 18 coke-making establishments in 1912, the same number as in 1911, but the total number of ovens was reduced from 5,496 to 5,408, 88 ovens having been abandoned during the year. There were 3 establishments, with a total of 326 ovens, that were idle and 2,106 ovens, portions of other plants, that were not in operation. The 2,976 active ovens produced a total of 967,947 short tons of coke, valued at $1,815,975, an average value of $1.88 per ton. In 1911 there were 2,273 active ovens which produced 910,411 short tons, valued at $1,615,609, an average of $1.77 per ton. The increase in 1912 was 57,536 short tons, or 6.32 per cent, in quantity, and $200,366, or 12.4 per cent, in value.

The coke manufactured in Wise County, on the Clinch Valley branch of the Norfolk & Western Railway, and in the Black Mountain district in Lee County is the only coke made in Virginia from coal mined exclusively within the State. There are two plants in Virginia, one at Lowmoor and one at Covington, the coal for both of which is drawn from the 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, and a part of this coal production should properly be credited to West Virginia. The openings of the mines, however, and the coke ovens, are in Tazewell County, and it is customary to credit the coal, as well as the coke, to Virginia.

The statistics of the manufacture of coke in Virginia in 1883, when the first operations were begun, and in 1890, 1900, and from 1908 to 1912, are shown in the following table:

Statistics of the manufacture of coke in Virginia, 1883–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1883	1	200	0	39,000	65.0	25,340	$44,345	$1.75
1890	2	550	250	251,683	66.0	165,847	278,724	1.68
1900	7	2,331	300	1,083,827	63.2	685,156	1,464,556	2.14
1908	19	4,853	158	1,785,281	65.1	1,162,051	2,121,980	1.83
1909	19	5,469	100	2,060,518	65.1	1,347,478	2,415,769	1.79
1910	18	5,389	100	2,310,742	64.6	1,493,655	2,731,348	1.83
1911	18	5,496	100	1,425,303	63.9	910,411	1,615,609	1.77
1912	18	5,408	0	1,555,969	62.2	967,947	1,815,975	1.88

All the coal used in the manufacture of coke in Virginia is of exceptionally high grade, and none of it requires preparation other than crushing before being charged into the oven. The character of the coal used is nearly evenly divided between run of mine and slack. The total quantity of coal consumed in the manufacture of coke in 1912 was 1,555,969 short tons, of which 793,019 were unwashed run of mine and 762,950 tons unwashed slack.

The following table shows the character of the coal used in coke making in Virginia in 1890, 1900, and from 1908 to 1912:

Character of coal used in the manufacture of coke in Virginia, 1890–1912, 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
1908	1,438,754	0	346,527	0	1,785,281
1909	1,405,111	0	655,407	0	2,060,518
1910	1,554,784	0	755,958	0	2,310,742
1911	675,497	0	749,806	0	1,425,303
1912	793,019	0	762,950	0	1,555,969

WASHINGTON.

Washington is the only State west of the Rocky Mountains that contains coal possessing coking qualities, and the coking industry of Washington is restricted to a limited area in Pierce County. Tests made at the experimental plant of the United States Geological Survey at Denver in 1908 showed that a fair quality of coke could be made from the coal mined in the northern part of the Roslyn field in Kittitas County (the only workable coal in Washington east of the Cascades), but so far no attempt has been made to coke this coal on a commercial scale. There were 6 establishments in the State in 1912, with a total of 313 ovens, an increase of 1 establishment and of 78 ovens over 1911. Of the 6 establishments, 3, with a total of 100 ovens, were idle, in addition to which there were 19 other ovens which were not fired up during the year. The entire coke production of Washington in 1912 was from 3 plants in the Wilkeson-Carbonado field, in Pierce County. The output increased from 40,180 tons, valued at $216,262, in 1911, to 49,260 tons, valued at $279,105, in 1912. The average price per ton advanced from $5.38 to $5.67. The smelter at Tacoma consumes the greater part of the product. All of the coal used in Washington for coke manufacture is washed before being charged into the ovens. In 1912 the coal used consisted of 76,611 tons of washed run-of-mine and 2,082 tons of washed slack.

The coke industry of Washington began in 1884, when 400 tons of coke were made in pits. The first ovens were built in 1885. The statistics of production in 1884, 1890, 1900, and from 1908 to 1912 are as follows:

Statistics of the manufacture of coke in Washington, 1884–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens, per ton.
		Built.	Building.					
1884	1	0	0	700	57.0	400	$1,900	$4.75
1890	2	30	80	9,120	64.0	5,837	46,696	8.00
1900	2	90	0	54,310	61.5	33,387	160,165	4.80
1908	6	231	50	68,069	57.1	38,889	213,138	5.48
1909	6	285	0	69,708	61.7	42,981	240,604	5.60
1910	6	285	0	94,223	63.0	59,337	347,540	5.86
1911	5	235	0	60,201	66.6	40,180	216,262	5.38
1912	6	313	0	78,693	62.6	49,260	279,105	5.67

WEST VIRGINIA.

With the advance of Indiana in 1912 from sixth to third in rank among the coke-producing States, West Virginia dropped to fourth place, having been superseded as second in rank by Alabama in 1911. But although West Virginia has apparently retrograded as a manufacturer of coke, at least relatively, account should be taken of the fact that many coking establishments in other States draw their supplies of coal from West Virginia mines. This is particularly true of the retort-oven plants in Ohio, Indiana, and Illinois. In 1912 the quantity of coal made into coke in West Virginia was 4,061,702 short tons. It is probable that the quantity of West Virginia coal made into coke in ovens outside of the State exceeded 5,000,000 short tons. In the coke-making as in the coal-mining lines of industry West Virginia suffers from having relatively little home consumption for her products. Eighty per cent of the coal mined in the State, and nearly all of the coke, is sent to consumers in other States.

Next to Pennsylvania, West Virginia possesses more wealth in supplies of coking and other high-grade coals than any other State in the Union, but as long as both the coal and the coke continue to be shipped out of the State West Virginia will not attain the position she should occupy as a manufacturing State, nor will the miners of coal and makers of coke receive a just return for these products. At the present time, ranking second as a producer of coal and third in the production of coke, West Virginia stands twenty-ninth in the value of her manufactured products. The principal beneficiaries of the coal-mining and coke-making industries in the State are the transportation companies.

The quantity of coke made in West Virginia in 1912 was 2,465,986 short tons, valued at $4,692,393, against 2,291,049 tons, valued at $4,236,845, in 1911. The increase in 1912 was 174,937 short tons, or 7.64 per cent, in quantity, and $455,548, or 10.75 per cent, in value. In spite of this increase the production of coke in West Virginia in 1912 was smaller than that of any year from 1905 to 1910. The smaller production in the last two years is attributable simply to the larger production of coke from West Virginia coal at by-product plants in other States. With the exception of 120 Semet-Solvay ovens at Benwood, near Wheeling, all of the ovens in West Virginia are of the beehive type. It is to be noted that the average yield of coal in coke in West Virginia is only about 61 per cent, notwithstanding the fact that a large part of the coal used for coke making in the State contains only from 15 to 20 per cent of moisture and volatile matter. The coal should yield about 80 per cent in coke. The difference in actual results is due to the necessity of burning off at least one-fourth of the fixed carbon in the beehive oven in order to secure the heat necessary to produce a high-grade cellular coke. When it is considered that in the retort ovens to which West Virginia coal is shipped the theoretical yield is practically obtained, the shifting of coking activity from the mining districts of West Virginia to the industrial centers of the Middle West is not difficult to understand.

The number of establishments in West Virginia decreased from 138 in 1911 to 129 in 1912. Six plants with a total of 345 ovens were abandoned, and 6 others considered as having 2 sets of ovens each in previous reports should have been classed as single establishments. The total number of ovens abandoned in 1912 was 954, and there were 142 new ones built, making a net decrease of 812. Over 60 per cent (591 in all) of the abandoned ovens were in the Pocahontas district, but it should be stated that many of the early coal-land leases in this district contained a stipulation requiring the construction of certain numbers of ovens. Some of them have never been fired, and it is to be noted that in addition to the 591 abandoned ovens in this district in 1912, 4,577, or a little over half of the total number, were idle throughout the year. There were 99 ovens abandoned and 819 idle in the Kanawha district, 84 abandoned and 893 idle in the New River district, 180 abandoned and 1,328 idle in the Upper Monongahela district, 1,220 idle in the Tug River district, and 1,008 idle in the Upper Potomac and Tygarts Valley district. The total number of idle ovens in 1912 was 9,845—considerably more than half of the total of 19,064 ovens in the State. The active ovens numbered 9,219, and as they produced a total of 2,465,986 short tons of coke the average production per oven was 267 tons.

In the following table will be found the statistics of the manufacture of coke in West Virginia in 1880, 1890, 1900, and for the last five years:

Statistics of the manufacture of coke in West Virginia, 1880–1912.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1880	18	631	40	230,758	60.0	138,755	$318,797	$2.30
1890	55	4,060	334	1,395,266	60.0	833,377	1,524,746	1.83
1900	106	10,249	1,306	3,868,840	60.9	2,358,499	4,746,633	2.01
1908	138	20,124	0	4,127,730	63.9	2,637,123	5,267,054	2.00
1909	138	20,283	126	6,361,759	62.0	3,943,948	7,525,922	1.91
1910	135	19,912	230	6,226,234	61.1	3,803,850	7,354,039	1.93
1911	138	19,876	130	3,754,561	60.4	2,291,049	4,236,845	1.85
1912	129	[a]19,064	0	4,061,702	60.7	2,465,986	4,692,393	1.90

[a] Includes 120 Semet-Solvay ovens at Benwood.

The larger part of the coal used in coke making in West Virginia (nearly 70 per cent) is slack. In 1912, out of a total of 4,061,702 short tons of coal consumed in coke-making operations, 2,771,773 tons were slack. Of that quantity 2,433,229 short tons were unwashed and 338,544 tons were washed coal. The total quantity of mine-run coal used was 1,289,929 short tons, of which 1,146,620 tons were unwashed and 143,309 tons washed. The total quantity of coal washed, including run of mine and slack, was 481,853 short tons, or about 12 per cent of the total quantity of coal consumed in coke manufacture.

The character of the coal used in the manufacture of coke in West Virginia in 1890, 1900, and from 1908 to 1912, is shown in the following table:

Character of coal used in the manufacture of coke in West Virginia, 1890–1912, in short tons.

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	324,847	0	930,989	139,430	1,395,266
1900	509,960	8,000	3,140,064	210,816	3,868,840
1908	1,694,470	35,226	2,206,623	191,411	4,127,730
1909	2,282,403	32,285	3,644,271	402,800	6,361,759
1910	2,088,553	234,484	3,462,927	440,270	6,226,234
1911	925,460	158,308	2,408,299	262,494	3,754,561
1912	1,146,620	143,309	2,433,229	338,544	4,061,702

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 rivers, the Monongahela and the Potomac, by whose headwaters they are drained. The other three districts are in the southern part of the State. The New River district includes the ovens along the line of the Chesapeake & Ohio Railway and its branches from Quinnimont to Hawks Nest, near which point the coals of the New River region go below water level. The Kanawha district embraces all of the ovens along Kanawha River and its tributaries from Mount Carbon to the western limit of the coal fields. The ovens of the Gauley Mountain Coal Co. at Ansted are included in the New River district, although the Ansted coal belongs in reality to the coal series of the Kanawha district and lies about 1,000 feet above the New River coals. The Flat Top region is drained by the upper portions of New, Guyandotte, and Big Sandy rivers, 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 the Flat Top-Tug River district averages somewhat more than 50 per cent of the total coke production of the State.

The statistics of the production of coke in West Virginia, by districts, in 1911 and 1912, are shown in the following table:

Production of coke in West Virginia in 1911 and 1912, by districts.

1911.

District.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
Flat Top [a]	54	11,830	0	2,069,509	57.7	1,193,860	$2,082,945	$1.74
Kanawha	11	1,727	0	411,456	61.3	252,269	443,240	1.76
New River	23	1,787	0	254,943	63.7	162,349	352,714	2.17
Upper Monongahela	37	[b] 3,008	50	772,450	66.7	514,847	1,087,652	2.11
Upper Potomac and Tygarts Valley	13	1,524	80	246,203	68.1	167,724	270,294	1.61
Total	138	19,876	130	3,754,561	60.4	2,291,049	4,236,845	1.85

1912.

District.	Establishments.	Built.	Building.	Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
Flat Top [a]	53	11,280	0	2,094,283	56.6	1,185,978	$2,057,456	$1.73
Kanawha	10	1,628	0	499,085	62.2	310,350	515,508	1.66
New River	20	1,709	0	290,805	62.0	180,190	426,475	2.37
Upper Monongahela	33	[b] 2,873	0	887,612	66.6	591,243	1,326,661	2.24
Upper Potomac and Tygarts Valley	13	1,574	0	289,917	68.4	198,225	366,293	1.85
Total	129	19,064	0	4,061,702	60.7	2,465,986	4,692,393	1.90

[a] Includes Tug River district.

[b] Includes 120 Semet-Solvay ovens.

OTHER STATES.

In the following table are presented the statistics of coke production in those States in which there are less than three establishments in operation. Eight States are included in this table covering 1912, against 11 in 1911. Two States, Montana and Oklahoma, which were included in 1911, made no coke in 1912. Two other States, Illinois and New York, have now three coke-making establishments, and their production is reported separately. Utah, whose production prior to 1912 was included with that of Colorado, is for 1912 included with the States whose production is given in the following table. In the eight States included in this table are Kansas, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, Utah, and Wisconsin. They had, in all, 11 coke-making establishments and a total of 2,006 ovens, most of the ovens being by-product recovery in type. The inclusion of Utah, where the coke output is from beehive ovens, reduces the apparent yield of coal in coke from 75.6 per cent in 1911 to 69.8 per cent in 1912. The average yield from the retort ovens ranged from 66 to 78.4 per cent. The total production of the eight States mentioned was 2,530,018 short tons of coke, valued at $9,386,978, an average of $3.71 per ton. Five of the eight States, Maryland, Michigan, Minnesota, New Jersey, and Wisconsin, obtain their coal for coke manufacture from mines of other States. Massachusetts obtains its supply of coal from Nova Scotia and West Virginia. With the exception of 650 ovens in Utah, 3 in Kansas, and 228 in Wisconsin, all of the ovens included in the statistics for 1912 are by-product recovery ovens.

Statistics of coke production from 1900 to 1905 and from 1908 to 1912 in States having only one or two establishments.

Year.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at ovens.	Value of coke at ovens per ton.
		Built.	Building.					
1900	10	832	594	708,295	71.5	506,730	$1,454,029	$2.87
1905	12	1,666	145	2,222,723	74.7	1,660,857	5,500,337	3.31
1908	30	3,456	103	3,155,100	72.5	2,286,092	8,338,363	3.65
1909	20	2,553	563	3,427,732	73.3	2,509,306	9,129,282	3.64
1910	29	2,878	563	4,903,129	75.1	3,684,276	14,509,072	3.94
1911	23	2,850	95	4,002,047	75.6	3,023,607	10,989,538	3.63
1912	11	[a] 2,006	[b] 174	3,623,019	69.8	2,530,018	9,386,978	3.71

[a] Includes 295 Semet-Solvay and 830 United Otto ovens.
[b] Includes 98 Koppers, 40 Semet-Solvay, and 36 United Otto ovens.

FUEL BRIQUETTING.

By Edward W. Parker.

INTRODUCTION.

Although in the quantity of briquetted fuel manufactured in the United States the year 1912 did not show any material gain over the year preceding, the industry may be considered as passing out of the experimental stage and assuming more of a substantial and permanent character. The total quantity of briquetted fuel made in this country in 1912 was 220,064 short tons, valued at $952,261, as compared with 218,443 tons, valued at $808,721, in 1911. There were 19 plants that contributed to the production in 1912. Of these, 9 in the Eastern States produced 107,181 tons, valued at $370,841; 7 in the Central States produced 89,714 tons, valued at $400,624; and 3 on the Pacific coast produced 23,169 tons, valued at $180,796. Of the 19 plants in operation in 1912, 7 used anthracite culm, 9 used bituminous or semibituminous slack, 1 used carbon residue from gas manufactured from oil, 1 used mixed anthracite culm and bituminous slack, and 1 used peat. Two plants, 1 at Detroit, Mich., and 1 at Point Breeze, Philadelphia, that were constructed for the purpose principally of utilizing coke breeze, were not operated in 1912, the abrasive action of the coke dust being so destructive of the molds and machinery that the plants have been shut down.

RAW MATERIALS.

As has been stated in previous reports, the quantity of raw material available for the manufacture of briquets is ample and is obtainable at little cost. The most desirable material for producing a smokeless product is anthracite culm, a plentiful supply of which still remains in the anthracite region of Pennsylvania and more is produced daily in the mining operations. It is not too much to believe or to hope that in the near future the small sizes of anthracite, such as buckwheat and smaller, which are now sold for making steam in competition with bituminous coal and at prices below the actual cost of production, will become more valuable as raw material for the briquet manufacturer. The output of these small sizes produced by crushing the large coal to obtain the domestic grades (egg, stove, and nut) exceeds 20,000,000 long tons annually, exclusive of 3,000,000 to 4,000,000 tons that are annually recovered from the culm banks by washeries. The present revenue from this product will not exceed $30,000,000. Washery and small size coal is worth from 50 cents to $1.50 a ton, the price depending on the size. As briquetted fuel it should be worth as much as stove or egg coal, or from $3 to $4 a ton. The cost of briquetting is from $1 to $1.25 a ton. The uniform size of the briquets makes them highly desirable as a domestic fuel; besides, they are completely consumed, and when properly made do not produce that bugbear to the housekeeper—clinkers. One objection raised to the use of briquets is that they will compete with the prepared sizes of anthracite. From the viewpoint of the consumer the objection lacks logic, and this seems more evident when the apparent profit obtainable on the briquetted product is considered.

Slack from noncoking bituminous, subbituminous, and semianthracite coals is another cheap and abundant raw material. It is obtainable in all of the coal-mining regions of the Middle West where at many places it is now wasted or almost given away. Slack piles have sometimes been burned to prevent their cumbering the ground and more frequently have ignited spontaneously and devoured themselves. The 220,064 tons of briquets made in 1912 represent but a drop taken from the bucket of available material.

The vast and almost untouched areas of lignite in North Dakota and Texas contain enormous supplies of fuel that European experience has taught is well adapted to briquetting and that is much more usable in that form than in the raw state. The school of mines of the North Dakota University, under the direction of Prof. E. J. Babcock, has been making some interesting and valuable experiments in briquetting lignite and has already attained excellent results.

The large areas of peat beds in the United States are also available as a source of raw material. They are generally remote from the coal fields, and the briquetted fuel from peat, when properly prepared, makes an excellent substitute for coal. The peat now produced in the United States is used for stable litter, fertilizer, etc. None is used raw for fuel.

In order to meet with popular favor in this country briquets must be of convenient shape for shoveling and for permitting air to circulate in the fire box. They must be of sizes suitable for the purposes they are intended to serve and must possess sufficient cohesion to resist fracture and abrasion under rough handling. Some of the briquets manufactured in European countries, particularly in Germany, are made very large, for easy stowage in bunkers of steamships and tenders of locomotives, and are not adapted for use in this country. They must be handled and stowed by hand, and must be broken up before they are shoveled into the fire. The high cost of labor in this country prohibits such handling.

PRODUCTION.

The production of briquets in the United States from 1907 to 1909 and in 1911 and 1912 has been as follows:

Production of briquets in the United States in 1907, 1908, 1909, 1911, and 1912, in short tons.

Year.	Quantity.	Value.
1907	66,524	$258,426
1908	90,358	323,057
1909	139,661	452,697
1911	218,443	808,721
1912	220,064	952,261

The production of briquets in 1912, distributed by Eastern, Central, and Pacific coast States, was as follows:

Production of briquets in 1912, by groups of States, in short tons.

	Number of plants.	Quantity.	Value.
Eastern States:			
Maryland	1	107,181	$370,841
New Jersey	1		
New York	2		
Pennsylvania	3		
Rhode Island	1		
Virginia	1		
	9		
Central States:			
Illinois	1	89,714	400,624
Indiana	1		
Iowa	1		
Michigan	1		
Missouri	1		
Wisconsin	2		
	7		
Pacific coast States:			
California	2	23,169	180,796
Washington	1		
	3		
Total	19	220,064	952,261

BINDERS.

Experience in European countries and investigations carried on in the fuel-testing plant of the United States Geological Survey at St. Louis and later by the Bureau of Mines at Pittsburgh have demonstrated clearly that lignite may be successfully briquetted without the use of any additional binding material, and that for the anthracite, semianthracite, bituminous, and subbituminous coals the most satisfactory binders are coal-tar pitch, gas-tar pitch, and asphaltic pitch, or inexpensive mixtures possessing cementing and practically waterproofing qualities. Of the 19 plants in commercial operation in the United States during 1912, 10 used as a binder coal-tar pitch or compositions in which it is the chief ingredient; 1 plant used asphaltic pitch; 2 used water-gas pitch; 4 used mixed binders, the composition of which is not made public; and 2 (one operating on peat and the other on carbon residue) used no binder. From this it is seen that the plants using coal-tar pitch as a binder exceed in number all the others put together. Inorganic binders, such as cement, have not given satisfactory results, for although they may be efficient in cementing qualities they have the serious objection of increasing the ash and of adding nothing to the combustible matter in the fuel. Binders of organic material, however, such as pitches from coal tar, gas tar, or asphalt, contribute combustible matter and do not increase the amount of ash.

BRIQUETTING PLANTS IN THE UNITED STATES IN 1912.

EASTERN STATES.

American Coal Boulet Co., Phoenix mines, Maryland.—This plant, built in 1911, was erected for the purpose of utilizing bituminous slack produced at the mines of the Phoenix & Georges Creek Mining Co., with water-gas pitch as a binder in the proportions of from 93 to 95 per cent slack and 5 to 7 per cent binder. The production in 1912 was more than 16,000 tons, or a little more than double the output of 1911.

Eggette Coal Co., Trenton, N. J.—This plant began operations in 1912 under license for the manufacture of briquets with the Giles patented binder, and used anthracite culm as a raw material. The binder is composed of a mixture of organic materials, but the character and proportions are not made public. The plant was put into commission only in the latter part of the year, and produced between 500 and 1,000 tons of briquets. The product is of a "pillow" shape, about the size of nut coal, and is intended for domestic purposes. The press consists of two wheels operating tangentially. The briquets are pressed cold, and after leaving the press are dried on a traveling belt in a temperature of about 200° F. The domestic trade of Trenton affords a sufficient market for the product.

Coal Boulet Co., New York, N. Y.—The plant of this company is described in the Black Diamond, December 17, 1910. It uses anthracite culm, with a binder the nature of which is not reported. The proportion is 95 per cent of the culm and 5 per cent of the binder. The output in 1912 was 14,000 tons—an increase of about 50 per cent over the preceding year.

Robert Devillers, New York, N. Y.—Mr. Devillers is one of the active promoters of the briquetting industry, and has had a plant in successful operation for several years. It is described in United States Geological Survey Bulletin 316, in the Coal Trade Journal of June 16, 1909, the Iron Age of February 24, 1910, and the Black Diamond of October 1, 1910. The briquets are of the small-sized eggette type, and consist of 94 per cent of anthracite culm and 6 per cent of coal-tar pitch. The output of the plant is from 12,000 to 15,000 tons annually.

Scranton Anthracite Briquette Co., Dickson City, Pa.—This plant, until the completion in 1912 of the one erected by the Berwind Fuel Co., at Superior, Wis., was the largest briquetting plant in the United States. It has been described in previous reports of this series. The plant is located in close proximity to the Dickson mine of the Delaware, Lackawanna & Western Railroad Co., which furnishes the anthracite culm used as a raw material. Coal-tar pitch is used as a binder, but no statement of the proportions of culm and binder is given for publication. The briquets manufactured on a Belgian press are eggette in shape. When first put in operation the briquets weighed from 6 to 8 ounces and were intended for raising steam. Later the size of the briquets was reduced to 3 ounces, and then to 2 ounces, in order to supply the demand for a domestic fuel between stove and nut anthracite in size. In the spring of 1912, owing to the shortage of chestnut coal, the company began the manufacture, as a substitute, of a still smaller size, which it placed on the market as "Twentieth century chestnut briquets."

Downing Bros., Philadelphia, Pa.—This plant is used chiefly for demonstrating the Giles briquetting patent, about 1,200 tons having been produced during 1912. The raw material used consists of about 85 per cent of anthracite culm and 15 per cent of bituminous slack. The nature of the binder is not made public.

Lehigh Coal & Navigation Co., Lansford, Pa.—This plant was constructed by the company for the purpose of utilizing the anthracite culm from its own mines. It was operated originally in May, 1909, but was destroyed by fire about six months later. It was reconstructed and the new plant began operations in August, 1911. The production in 1912 was about 2,000 tons more than in 1911, and would probably have been considerably in excess of this except for the two months' shutdown because of the strike and the slack demand during the summer months. The materials used consist of 94 per cent culm and 6 per cent coal-tar pitch. The briquets are egg-shaped and weigh about 1½ ounces each. They are manufactured for domestic trade. The plant is described at length in the Black Diamond of May 10, 1911.

Portsmouth Coal Mining Co., Portsmouth, R. I.—In February, 1912, the Rhode Island Coal Co., which formerly owned the mine and briquetting plant at Portsmouth, went into the hands of a receiver, but continued to manufacture until about the 1st of April. On June 7 the plant was bought by the Portsmouth Coal Mining Co., but no briquets have been made since the transfer of the property. The quantity of briquets made and sold by the Rhode Island Coal Co. in 1912 was approximately 4,000 tons, which consisted of 88 per cent Rhode Island anthracite culm and 12 per cent coal-tar pitch mixed with a small quantity of crude oil.

Virginia Coal Briquetting Co., Richmond, Va.—This plant began operations on a commercial scale in November, 1912, and produced during the year 2,000 tons of briquets, using as a raw material about 75 per cent Pulaski County (Va.) semianthracite and 25 per cent Pocahontas coal. The binder used is one patented by Charles E. Hite, of Philadelphia, Pa., and is stated to be composed of crude oil and a small percentage of starchy flour, an emulsion being made by the addition of water. The binding mixture constitutes between 2 and 3 per cent of the finished briquet.

CENTRAL STATES.

Knickerbocker Briquetting Co., Murphysboro, Ill.—This plant, formerly located at Stapleton, Long Island, was moved to Murphysboro in 1909. It was destroyed by fire in February, 1912, and has not been rebuilt. The raw material used was Illinois bituminous slack with a patent binder.

Indianapolis Pressed Fuel Co., Indianapolis, Ind.—This plant, which was destroyed by fire in July, 1911, was rebuilt with improved equipment in 1912 and resumed operations in September of that year. The new plant is stated by its manager, George W. Ladley, to have a capacity of 16 tons of manufactured briquets an hour, with the employment of only 3 men, including the engineer. The press is the invention of Mr. Ladley. In the 4 months the plant was in operation in 1912 it produced about 2,000 tons of briquets, using about 95 per cent bituminous slack and 5 per cent coal-tar pitch.

Fertile Clay & Peat Co., Fertile, Iowa.—As indicated by its title, this company is interested in the briquetting of peat. About 250 short tons of peat briquets were made at its plant in 1912, without a binder.

Detroit Coalette Fuel Co., Detroit, Mich.—The plant of this company was described in the report of this series for 1909. It consists of a Renfrow press, with a crushing, heating, and mixing apparatus, and uses Pocahontas slack coal and coal-tar pitch in the proportion of 93 to 94 per cent of slack to 6 or 7 per cent of pitch. The production, regulated somewhat by the local demand, is from 5,000 to 6,000 tons a year.

Standard Briquette Fuel Co., Kansas City, Mo.—This plant, built in December, 1909, has been operating successfully with Arkansas semianthracite as a raw material and coal-tar pitch as a binder, in the proportions of 94 per cent to 6 per cent. The production in 1912 exceeded 10,000 tons, about double that of the preceding year.

Rock Island Coal Co., Hartshorne, Okla.—This plant, which is one of the pioneer briquetting commercial establishments of the Middle West and which has been described in previous reports of this series, was idle during the entire year 1912. The plant was constructed for the purpose of utilizing the superfluous slack at the Hartshorne group of mines of the Rock Island Coal Co. No superfluous slack was available in 1912, and the plant was accordingly idle.

Berwind Fuel Co., Superior, Wis.—The coal-briquetting plant of the Berwind Fuel Co. was completed in March, 1912, and celebrated the first year of its existence by an output exceeding that of any other plant in the United States. The plant, which was described in detail in the Black Diamond for November 23, 1912, operates on Pocahontas slack coal as a raw material with specially prepared coal-tar pitch as a binder, in proportions of 94 per cent slack and 6 per cent binder. The equipment includes a Rutledge press of the continuous-mold type which has a capacity of between 35 and 40 tons of briquets an hour. The total production of the plant in 1912 was slightly in excess of 50,000 short tons.

Stott Briquet Co., Superior, Wis.—This plant was briefly described in the report of this series covering 1909, its operation having begun in November of that year. It utilizes screenings from the coal yards at the head of Lake Superior, the average mixture consisting of 87 per cent anthracite culm, 4 per cent bituminous slack, and 9 per cent coal-tar pitch. The plant was described in the Black Diamond for September 11, 1909, and in the Coal Trade Journal for June 22, 1909. The output in 1912 was approximately 20,000 short tons, or about one-third more than in the preceding year.

PACIFIC COAST STATES.

Los Angeles Gas & Electric Corporation, Los Angeles, Cal.—This plant has been in continuous operation since 1905. It was constructed for the purpose of utilizing the carbon residue obtained in the manufacture of illuminating gas from petroleum. This material, water free, contains about 88 per cent of carbon, 11 per cent of volatile combustible matter, principally tar, 0.5 per cent of sulphur, and 0.5 per cent of ash. No binder is used, the natural tar and moisture present being sufficient for the cementing of the briquets. The annual output of the plant is approximately 10,000 short tons of briquets.

Western Fuel Co., Oakland, Cal.—The plant of this company depends for its raw material upon the screenings (practically all from Welsh anthracite) from the company's coal yards, and uses asphaltic pitch as a binder. The plant has a capacity of 60 tons a day of 10 hours, but is limited in its output by the supply of screenings available. The briquet mixture consists of 90 to 92 per cent of screenings and of 8 to 10 per cent of binder.

United Collieries Co., Seattle, Wash.—This plant, completed in 1911, produced about 10,000 tons of briquets in 1912, utilizing bituminous coal slack imported from Vancouver Island, British Columbia. The binder is patented, the patent being owned by individual members of the company. The plant, which has a capacity of 200 tons a day, was designed by the superintendent, N. L. Tooker, and was built to conform to the company's process. The conditions were particularly favorable for starting the plant in 1912, for on account of strikes at the mines the supply of coal was small and irregular, and the demand for briquets exceeded the output of the plant.

NEW DEVELOPMENTS.

Among the indications of the interest taken in the briquetting industry as promising future development are the following:

1. The organization of the Malcolmson Briquet Engineering Co., of St. Louis, Mo., for the purpose of designing, building, and equipping briquetting plants, but not for the purpose of engaging in the manufacture of briquets.

2. In contemplation, the construction of a plant for the manufacture of boulets by the Devillers or Belgian process at Grafton, W. Va., which shall utilize bituminous slack from the mines of the Grafton district.

3. In contemplation, the construction of a plant at Cambridge, Mass., by the Atlas Coal Briquet Co., with headquarters in Boston. It is reported that the contract has been closed for the construction and equipment of a plant similar in design and character of output to the one in Brooklyn, N. Y.

4. Under construction, the plant of the Northern Briquetting Co., at Minot, N. Dak., for the purpose of utilizing lignite, of which ample supplies are available. The plant is expected to be in operation in August, 1913.

5. In contemplation, the Pacific Coast Coal Co., Seattle, Wash., expects to have a plant completed by October, 1913. The character of the fuel and the binder to be used are not stated.

CANADA.

Through the courtesy of Mr. Virgil H. Hewes, manager of the Zwoyer Fuel Co., of New York City, the writer has received the following information regarding the operations of the briquetting plant located at Bankhead, Alberta: The plant itself has been taken over by the Canadian Pacific Co. and is operated under the department of natural resources of that corporation. In 1912 this plant made and sold 101,175 tons of briquets, nearly 100 per cent more than the largest output of any plant in the United States. Since the plant was started it has produced 433,200 tons and would have reached a total of 500,000 tons except for strikes, one of which, in 1909, lasted about three and a half months, and another, in 1911, closed the plant for six months. In the first two months of 1913 the Bankhead plant turned out 21,025 tons of briquets.

NATURAL GAS.

By B. Hill.

INTRODUCTION.

The natural-gas industry has become one of the leading industries of this country, and to the United States belongs the credit of making natural gas a commercial product. It is the best of fuels, being cleaner, more convenient, and more efficient for almost any purpose than any other fuel. Were it possible to transport natural gas as coal, petroleum, or other fuels now in use are transported, it would be the leading fuel of the world and its value would probably exceed that of any other commodity. As it is, enormous quantities are wasted annually, quantities too great even to be estimated, and it is with the greatest difficulty that interest can be aroused to the importance of conserving this valuable fuel and preventing the exhaustion of the fields. Although steps have been taken in some localities to prevent waste, it still goes on. The utilization of waste gas from the oil wells in different parts of the United States has been an important means of conserving this fuel, and the increasing number of plants erected and being erected for the extraction of gasoline from this "casing-head gas" is one of the most important features of the natural-gas industry in the year 1912. The statistics of the production of natural-gas gasoline in 1912 will be found in another part of this report.

The year 1912 was one of greatest prosperity to the natural-gas producer and has been remarkable for the making of high industrial records, the industrial and the fuel interests working hand in hand. The important features of the year in natural-gas circles were increased production, the extension of pipe lines to new communities, the consequent increased consumption of gas for both domestic and industrial purposes, and increased prices, as will appear from the figures given in this report. In the latter part of 1911 and throughout 1912 the price of petroleum continued to advance. This stimulus of higher prices made drilling more active in every district and resulted in the discovery of some new oil and gas pools, as well as in the extension of older fields, and so long as present prices prevail the search for oil and gas will continue, and the probability is that the year 1913 will show still greater results than 1912.

One feature of particular interest in the year 1912 was the completion of the pipe line which is to convey natural gas from the Buena Vista Hills, of Kern County, Cal., to consumers in the city of Los Angeles and the surrounding towns. This pipe line was built under great difficulties and at tremendous cost. It is expected that on the completion of the compressor which is being built in the Midway field this line will be put into operation.

An examination of the following table shows that the total estimated consumption of natural gas in the United States in 1912 was 562,203,452,000 cubic feet, valued at $84,563,957, an average price of 15.04 cents per thousand cubic feet, compared with 512,993,021,000 cubic feet, valued at $74,621,534, an average price of 14.55 cents, in 1911. It will be observed that the number of domestic consumers supplied with gas in the United States in 1912 was 1,621,557 and that the value of gas consumed for domestic purposes amounted to $50,960,883, while the number of industrial consumers was 15,936 and the value of gas consumed for industrial purposes was $33,603,074. On the assumption that 28,000 cubic feet of gas equals in heating power 1 ton of coal, the fuel displaced in 1912 was equivalent to approximately 20,000,000 tons of coal.

PRODUCTION AND CONSUMPTION.

The following table gives, by States, the total value of the natural gas produced in the entire country from 1885 to 1912, inclusive:

Approximate value of natural gas produced in the United States, 1885–1912, by States.

State.	1885	1886	1887	1888	1889	1890	1891
Pennsylvania	$4,500,000	$9,000,000	$13,749,500	$19,282,375	$11,593,989	$9,551,025	$7,834,016
New York	196,000	210,000	333,000	332,500	530,026	552,000	280,000
Ohio	100,000	400,000	1,000,000	1,500,000	5,215,669	4,684,300	3,076,325
West Virginia	40,000	60,000	120,000	120,000	12,000	5,400	35,000
Illinois	1,200	4,000			10,615	6,000	6,000
Indiana		300,000	600,000	1,320,000	2,075,702	2,302,500	3,942,500
Kansas		6,000			15,873	12,000	5,500
Missouri					35,687	10,500	1,500
California					12,680	33,000	30,000
Kentucky and Tennessee					2,580	30,000	38,993
Texas and Alabama					1,728		
Arkansas and Wyoming					375		250
Utah							
Colorado							
South Dakota							
Indian Territory and Oklahoma							
Louisiana							
Other	20,000	32,000	15,000	75,000	1,600,175	1,606,000	250,000
Total	4,857,200	10,012,000	15,817,500	22,629,875	21,107,099	18,792,725	15,500,084

State.	1892	1893	1894	1895	1896	1897	1898
Pennsylvania	$7,376,281	$6,488,000	$6,279,000	$5,852,000	$5,528,610	$6,242,543	$6,806,742
New York	216,000	210,000	249,000	241,530	256,000	200,076	229,078
Ohio	2,136,000	1,510,000	1,276,100	1,255,700	1,172,400	1,171,777	1,488,308
West Virginia	70,500	123,000	395,000	100,000	640,000	912,528	1,334,023
Illinois	12,988	14,000	15,000	7,500	6,375	5,000	2,498
Indiana	4,716,000	5,718,000	5,437,000	5,203,200	5,043,635	5,009,208	5,060,969
Kansas	40,795	50,000	86,600	112,400	124,750	105,700	174,640
Missouri	3,775	2,100	4,500	3,500	1,500	500	145
California	55,000	62,000	60,350	55,000	55,682	50,000	65,337
Kentucky and Tennessee	43,175	68,500	89,200	98,700	99,000	90,000	103,133
Texas and Alabama	100	50	50	20			765
Arkansas and Wyoming	100	100	100	100	60	40	
Utah		500	500	20,000	20,000	15,050	7,875
Colorado			12,000	7,000	4,500	4,000	3,300
South Dakota							
Indian Territory and Oklahoma							
Louisiana							
Other	200,000	100,000	50,000	50,000	50,000	20,000	20,000
Total	14,870,714	14,346,250	13,954,400	13,006,650	13,002,512	13,826,422	15,296,813

Approximate value of natural gas produced in the United States, 1885–1912, by States—Continued.

State.	1899	1900	1901	1902	1903	1904	1905
Pennsylvania	$8,337,210	$10,215,412	$12,688,161	$14,352,183	$16,182,834	$18,139,914	$19,197,336
New York	294,593	335,367	293,232	346,471	493,686	522,575	623,251
Ohio	1,866,271	2,178,234	2,147,215	2,355,458	4,479,040	5,315,564	5,721,462
West Virginia	2,335,864	2,959,032	3,954,472	5,390,181	6,882,359	8,114,249	10,075,804
Illinois	2,067	1,700	1,825	1,844	3,310	4,745	7,223
Indiana	6,680,370	7,254,539	6,954,566	7,081,344	6,098,364	4,342,409	3,094,134
Kansas	332,592	356,900	659,173	824,431	1,123,849	1,517,643	2,261,836
Missouri	290	547	1,328	2,154	7,070	6,285	7,390
California	86,891	79,083	67,602	120,648	104,521	114,195	133,696
Kentucky Tennessee	125,745	286,243	270,871	365,656	390,601	322,404	237,290 300
Texas Alabama	8,000	20,000	18,577	14,953	13,851	14,082	14,409
Arkansas and Wyoming	....	....	....	....	2,460	6,515	21,135
Colorado	1,480	1,800	1,800	1,900	14,140	14,300	20,752
South Dakota	3,500	9,817	7,255	10,280	10,775	12,215	15,200
Indian Territory and Oklahoma	....	....	....	360	1,000	49,665	130,137
Louisiana	....	....	....	....	....	....	....
Other	....	....	....	....	....	....	....
Total	20,074,873	23,698,674	27,066,077	30,867,863	35,807,860	38,496,760	41,562,855

State.	1906	1907	1908	1909	1910	1911	1912
Pennsylvania	$18,558,245	$18,844,156	$19,104,944	$20,475,207	$21,057,211	$18,520,796	$18,539,672
New York	672,795	766,157	959,280	1,222,666	1,678,720	1,418,767	2,343,379
Ohio	7,145,809	8,718,562	8,244,835	9,966,938	8,626,954	9,367,347	11,891,299
West Virginia	13,735,343	16,670,962	14,837,130	17,538,565	23,816,553	28,435,907	33,349,021
Illinois	87,211	143,577	446,077	644,401	613,642	687,726	616,467
Indiana	1,750,715	1,572,605	1,312,507	1,616,903	1,473,403	1,192,418	1,014,295
Kansas	4,010,986	6,198,583	7,691,587	8,293,846	7,755,367	4,854,534	4,336,635
Missouri	7,210	17,010	22,592	10,025	12,611	10,496	11,576
California	134,560	168,397	307,652	446,933	476,697	800,714	1,134,456
Texas Alabama Louisiana	150,695	178,276	236,837	453,253	956,683	1,014,945 (Texas) 858,145 (Alabama, Louisiana)	1,405,077 (Texas) 1,747,379 (Alabama, Louisiana)
Kentucky	287,501	380,176	424,271	485,192	456,293	407,689	497,909
Tennessee	300	300	350	350	300	300	375
Arkansas and Wyoming	34,500	126,582	164,930	226,925	301,151	295,858	309,816
Colorado	22,800	(included above)	(included above)	(included above)	(included above)	(included above)	(included above)
Oklahoma	259,862	417,221	860,159	1,806,193	3,490,704	6,731,770	7,334,599
South Dakota	15,400	19,500	24,400	16,164	31,999	16,984	30,412
North Dakota	....	235	2,480	3,025	7,010	5,738	(included above)
Oregon	....	100	250	50	....	....	....
Iowa	....	....	93	50	40	70	120
Michigan	....	....	....	255	820	1,330	1,470
Total	46,873,932	54,222,399	54,640,374	63,206,941	70,756,158	74,621,534	84,563,957

The following table shows the production and consumption of natural gas in 1911 and 1912, by States:

Quantity and value of natural gas produced and consumed in the United States in 1911 and 1912, by States.

1911.

State.	Produced.			Consumed.		
	Quantity, M cubic feet.	Cents per M cu. ft.	Value.	Quantity, M cubic feet.	Cents per M cu. ft.	Value.
West Virginia	206,890,576	13.74	$28,435,907	80,868,645	7.72	$6,240,152
Pennsylvania	108,869,296	17.01	18,520,796	159,104,376	15.05	23,940,001
Ohio	49,449,749	18.94	9,367,347	112,123,029	20.33	22,792,270
Oklahoma	67,275,608	10.01	6,731,770	28,213,871	7.42	2,092,603
Kansas	38,799,406	12.51	4,854,534	a 77,861,143	12.19	9,493,701
New York	5,239,915	27.07	1,418,767	14,894,303	28.71	4,276,324
Indiana	4,365,339	27.32	1,192,418	4,365,339	27.32	1,192,418
Texas	5,503,393	18.44	1,014,945	5,503,393	18.44	1,014,945
Louisiana, Alabama	9,786,041	8.77	858,145	b 9,786,041	8.77	858,145
California	6,389,820	12.53	800,714	6,389,820	12.53	800,714
Illinois	6,762,361	10.17	687,726	6,762,361	10.17	687,726
Kentucky	1,275,397	31.97	407,689	4,734,580	19.05	901,759
Arkansas, Colorado, Wyoming	2,293,662	12.90	295,858	2,293,662	12.90	295,858
South Dakota	25,547	66.48	16,984	25,547	66.48	16,984
Missouri	50,315	20.86	10,496	50,315	20.86	10,496
North Dakota	13,526	42.42	5,738	13,526	42.42	5,738
Michigan	1,730	76.88	1,330	1,730	76.88	1,330
Tennessee	1,200	25.00	300	1,200	25.00	300
Iowa	140	50.00	70	140	50.00	70
Total	512,993,021	14.55	74,621,534	512,993,021	14.55	74,621,534

a Includes gas piped from Kansas and consumed in Missouri; also gas piped from Oklahoma into Kansas and Missouri.
b Includes gas piped from Louisiana to Texas and from Louisiana to Arkansas.

1912.

State.	Produced. Quantity, M cubic feet.	Produced. Cents per M cu. ft.	Produced. Value.	Consumed. Quantity, M cubic feet.	Consumed. Cents per M cu. ft.	Consumed. Value.
West Virginia	239,088,068	13.95	$33,349,021	95,402,248	7.34	$7,001,331
Pennsylvania	112,149,855	16.53	18,539,672	173,656,003	15.25	26,486,302
Ohio	56,210,052	21.16	11,891,299	126,854,659	21.44	27,196,162
Oklahoma	73,799,319	10.04	7,406,528	41,549,403	7.58	3,149,376
Kansas	28,068,370	15.19	4,264,706	a 60,318,286	14.13	8,521,858
New York	8,625,979	27.17	2,343,379	16,927,598	28.75	4,866,821
Louisiana, Alabama	14,492,696	12.06	1,747,379	b 14,492,696	12.06	1,747,379
Texas	7,470,373	18.81	1,405,077	7,470,373	18.81	1,405,077
California	9,354,428	12.13	1,134,456	9,354,428	12.13	1,134,456
Indiana	3,618,077	28.03	1,014,295	3,618,077	28.03	1,014,295
Illinois	5,603,368	11.00	616,467	5,603,368	11.00	616,467
Kentucky	1,869,495	26.63	497,909	5,102,941	20.98	1,070,664
Arkansas, Colorado, Wyoming	1,742,379	17.78	309,816	1,742,379	17.78	309,816
South Dakota, North Dakota	54,320	55.99	30,412	54,320	55.99	30,412
Missouri	53,013	21.83	11,576	53,013	21.83	11,576
Michigan	1,920	76.56	1,470	1,920	76.56	1,470
Tennessee	1,500	25.00	375	1,500	25.00	375
Iowa	240	50.00	120	240	50.00	120
Total	562,203,452	15.04	84,563,957	562,203,452	15.04	84,563,957

a Includes gas piped from Kansas and consumed in Missouri; also gas piped from Oklahoma into Kansas and Missouri.
b Includes gas piped from Louisiana to Texas and from Louisiana to Arkansas.

In the following tables is given the distribution of natural gas consumed in 1911 and 1912, by States:

Distribution of natural gas consumed in the United States in 1911, by States.

State.	Number of producers.	Consumers.		Gas consumed.		
				Domestic.		
		Domestic.	Industrial.	Quantity, M cubic feet.	Cents per M cubic feet.	Value.
Pennsylvania	1,067	330,537	4,597	45,505,643	24.53	$11,164,168
Ohio	1,900	577,263	3,634	57,791,210	27.40	15,837,421
Kansas [a]	232	199,523	907	27,688,371	22.82	6,317,307
West Virginia [b]	340	87,438	1,566	13,870,321	18.12	2,513,689
New York	302	116,314	208	13,479,789	30.39	4,096,162
Oklahoma	204	44,854	1,507	5,816,723	16.88	981,976
Indiana [c]	1,094	31,576	143	3,512,633	29.92	1,050,947
Texas	29	22,972	303	1,590,858	39.73	631,986
Kentucky	74	41,201	70	2,193,859	30.57	670,648
Louisiana [d]	27	17,964	442	} 1,369,498	22.84	312,782
Alabama	7	105	4			
California	22	10,598	307	543,392	58.42	317,467
Illinois [e]	225	10,078	293	1,263,652	22.85	288,802
Arkansas	5	5,008	90			
Colorado	17	1,107	14	} 737,303	25.41	187,331
Wyoming	7	354	5			
South Dakota	34	393	9	18,480	70.80	13,084
Missouri	44	551	13	44,868	20.44	9,173
North Dakota	16	255	1	13,276	42.47	5,638
Michigan	20	16	1	930	100.00	930
Tennessee	4	1	....	1,200	25.00	300
Iowa	5	2	....	140	50.00	70
Total	5,675	1,498,110	14,114	175,442,146	25.31	44,399,881

State.	Gas consumed.					
	Industrial.			Total.		
	Quantity, M cubic feet.	Cents per M cubic feet.	Value.	Quantity, M cubic feet.	Cents per M cubic feet.	Value.
Pennsylvania	113,598,733	11.25	$12,775,833	159,104,376	15.05	$23,940,001
Ohio	54,331,819	12.80	6,954,849	112,123,029	20.33	22,792,270
Kansas [a]	50,172,772	6.33	3,176,394	77,861,143	12.19	9,493,701
West Virginia [b]	66,998,324	5.56	3,726,463	80,868,645	7.72	6,240,152
New York	1,414,514	12.74	180,162	14,894,303	28.71	4,276,324
Oklahoma	22,397,148	4.96	1,110,627	28,213,871	7.42	2,092,603
Indiana [c]	852,706	16.59	141,471	4,365,339	27.32	1,192,418
Texas	3,912,535	9.79	382,959	5,503,393	18.44	1,014,945
Kentucky	2,540,721	9.10	231,111	4,734,580	19.05	901,759
Louisiana [d] } Alabama	8,416,543	6.48	545,363	9,786,041	8.77	858,145
California	5,846,428	8.27	483,247	6,389,820	12.53	800,714
Illinois [e]	5,498,709	7.25	398,924	6,762,361	10.17	687,726
Arkansas						
Colorado }	1,556,359	6.97	108,527	2,293,662	12.90	295,858
Wyoming						
South Dakota	7,067	55.19	3,900	25,547	66.48	16,984
Missouri	5,447	24.29	1,323	50,315	20.86	10,496
North Dakota	250	40.00	100	13,526	42.42	5,738
Michigan	800	50.00	400	1,730	76.88	1,330
Tennessee	....	....	....	1,200	25.00	300
Iowa	....	....	....	140	50.00	70
Total	337,550,875	8.95	30,221,653	512,993,021	14.55	74,621,534

[a] Includes the consumption of gas piped from Kansas to Missouri and from Oklahoma to Kansas and Missouri.
[b] Includes the consumption of gas piped from West Virginia to Maryland.
[c] Includes the consumption of gas piped from Indiana to Chicago, Ill.
[d] Includes the consumption of gas piped to Texas from Louisiana and to Arkansas from Louisiana.
[e] Includes the consumption of gas piped from Illinois to Vincennes, Ind.

Distribution of natural gas consumed in the United States in 1912, by States.

State.	Number of producers.	Consumers.		Gas consumed.		
				Domestic.		
		Domestic.	Industrial.	Quantity, M cubic feet.	Cents per M cubic feet.	Value.
Ohio	2,031	641,724	4,414	67,150,744	28.92	$19,420,086
Pennsylvania	1,104	345,765	3,442	49,331,092	24.64	12,153,254
Kansas [a]	253	195,446	1,104	24,821,582	24.25	6,018,363
West Virginia [b]	406	94,273	1,953	16,180,778	18.11	2,930,628
New York	332	129,930	805	15,329,811	29.90	4,583,414
Oklahoma	242	47,017	1,651	6,500,062	19.83	1,288,894
Louisiana [c]	41	30,205	1,428	2,871,707	28.04	805,265
Alabama	9	152	4			
Texas	41	27,226	329	2,341,628	38.71	906,412
California	43	18,171	232	974,796	53.90	525,428
Kentucky	88	45,603	103	2,762,571	30.38	839,346
Indiana [d]	1,140	27,165	140	2,989,648	30.51	912,252
Illinois [e]	223	10,691	212	1,236,162	23.62	291,987
Arkansas	6	5,530	87	871,628	28.62	249,501
Colorado	16	1,211	12			
Wyoming	8	363	4			
South Dakota	32	403	3	44,420	56.31	25,012
North Dakota	13	162	....			
Missouri	45	500	11	45,413	20.98	9,526
Michigan	21	14	2	1,020	100.00	1,020
Tennessee	7	3	....	1,500	25.00	375
Iowa	5	3	....	240	50.00	120
Total	6,106	1,621,557	15,936	193,454,802	26.34	50,960,883

State.	Gas consumed.					
	Industrial.			Total.		
	Quantity, M cubic feet.	Cents per M cubic feet.	Value.	Quantity, M cubic feet.	Cents per M cubic feet.	Value.
Ohio	59,703,915	13.02	$7,776,076	126,854,659	21.44	$27,196,162
Pennsylvania	124,324,911	11.53	14,333,048	173,656,003	15.25	26,486,302
Kansas [a]	35,496,704	7.05	2,503,495	60,318,286	14.13	8,521,858
West Virginia [b]	79,221,470	5.14	4,070,703	95,402,248	7.34	7,001,331
New York	1,597,787	17.74	283,407	16,927,598	28.75	4,866,821
Oklahoma	35,049,341	5.31	1,860,482	41,549,403	7.58	3,149,376
Louisiana [c]	11,620,989	8.11	942,114	14,492,696	12.06	1,747,379
Alabama						
Texas	5,128,745	9.72	498,665	7,470,373	18.81	1,405,077
California	8,379,632	7.27	609,028	9,354,428	12.13	1,134,456
Kentucky	2,340,370	9.88	231,318	5,102,941	20.98	1,070,664
Indiana [d]	628,429	16.24	102,043	3,618,077	28.03	1,014,295
Illinois [e]	4,367,206	7.43	324,480	5,603,368	11.00	616,467
Arkansas	870,751	6.93	60,315	1,742,379	17.78	309,816
Colorado						
Wyoming						
South Dakota	9,900	54.55	5,400	54,320	55.99	30,412
North Dakota						
Missouri	7,600	26.97	2,050	53,013	21.83	11,576
Michigan	900	50.00	450	1,920	76.56	1,470
Tennessee	....	....	....	1,500	25.00	375
Iowa	....	....	....	240	50.00	120
Total	368,748,650	9.11	33,603,074	562,203,452	15.04	84,563,957

[a] Includes the consumption of gas piped from Kansas to Missouri and from Oklahoma to Kansas and Missouri.
[b] Includes the consumption of gas piped from West Virginia to Maryland.
[c] Includes the consumption of gas piped to Texas from Louisiana and to Arkansas from Louisiana.
[d] Includes the consumption of gas piped from Indiana to Chicago, Ill.
[e] Includes the consumption of gas piped from Illinois to Vincennes, Ind.

The following table gives the distribution of gas consumed for industrial purposes in 1911 and 1912, by States:

Distribution of gas consumed for industrial purposes in 1911 and 1912, by States.

1911.

State.	Manufacturing.			Other industrial (power).			Total industrial.		
	Quantity, M cubic feet.	Cents per M cubic feet.	Value.	Quantity, M cubic feet.	Cents per M cubic feet.	Value.	Quantity, M cubic feet.	Cents per M cubic feet.	Value.
Pennsylvania	103,227,580	11.03	$11,385,045	10,371,153	13.41	$1,390,788	113,598,733	11.25	$12,775,833
Ohio	43,150,631	12.72	5,489,390	11,181,188	13.11	1,465,459	54,331,819	12.80	6,954,849
West Virginia	50,130,046	5.39	2,701,511	16,868,278	6.08	1,024,952	66,998,324	5.56	3,726,463
Kansas	46,570,417	6.12	2,849,626	3,602,355	9.07	326,768	50,172,772	6.33	3,176,394
Oklahoma	14,433,264	4.07	587,398	7,963,884	6.57	523,229	22,397,148	4.96	1,110,627
Louisiana, Alabama	2,678,678	9.36	250,824	5,737,865	5.13	294,539	8,416,543	6.48	545,363
California				5,846,428	8.27	483,247	5,846,428	8.27	483,247
Illinois	1,388,743	8.89	123,449	4,109,966	6.70	275,475	5,498,709	7.25	398,924
Texas	(a)		(a)	3,912,535	9.79	382,959	3,912,535	9.79	382,959
Kentucky	1,794,551	7.51	134,768	746,170	12.91	96,343	2,540,721	9.10	231,111
New York	249,761	18.38	45,907	1,164,753	11.53	134,255	1,414,514	12.74	180,162
Indiana	281,377	16.89	47,513	571,329	16.45	93,958	852,706	16.59	141,471
Arkansas, Colorado, Wyoming	(a)		(a)	1,556,359	6.97	108,527	1,556,359	6.97	108,527
South Dakota				7,067	55.19	3,900	7,067	55.19	3,900
Missouri				5,447	24.29	1,323	5,447	24.29	1,323
Michigan				800	50.00	400	800	50.00	400
North Dakota				250	40.00	100	250	40.00	100
Total	263,905,048	8.95	23,615,431	73,645,827	8.97	6,606,222	337,550,875	8.95	30,221,653

a Included in other industrial.

1912.

State.	Industrial consumers.			Gas consumed. Manufacturing.		
	Manufacturing.	Other industrial (power).	Total.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
Pennsylvania	1,987	1,455	3,442	114,617,963	11.45	$13,127,440
Ohio	2,768	1,646	4,414	43,300,321	12.86	5,568,386
West Virginia	888	1,065	1,953	59,189,820	5.07	2,998,754
Kansas	959	145	1,104	32,353,405	6.94	2,246,186
Oklahoma	288	1,363	1,651	20,915,974	4.56	954,498
Louisiana, Alabama	550	882	1,432	2,992,216	8.38	250,803
California		232	232			
Texas	(a)	329	329	(a)		(a)
Illinois	26	186	212	948,415	10.00	95,088
New York	11	794	805	354,333	16.51	58,518
Kentucky	19	84	103	1,671,287	7.97	133,220
Indiana	20	120	140	223,547	18.19	40,675
Arkansas, Colorado, Wyoming	(a)	103	103	(a)		(a)
South Dakota, North Dakota		3	3			
Missouri		11	11			
Michigan		2	2			
Total	7,516	8,420	15,936	276,567,281	9.21	25,473,568

Distribution of gas consumed for industrial purposes in 1911 and 1912, by States—Con.

1912.

State.	Gas consumed. Other industrial (power). Quantity (M cubic feet).	Other industrial (power). Cents per M cubic feet.	Other industrial (power). Value.	Total industrial. Quantity (M cubic feet).	Total industrial. Cents per M cubic feet.	Total industrial. Value.
Pennsylvania	9,706,948	12.42	$1,205,608	124,324,911	11.53	$14,333,048
Ohio	16,403,594	13.46	2,207,690	59,703,915	13.02	7,776,076
West Virginia	20,031,650	5.35	1,071,949	79,221,470	5.14	4,070,703
Kansas	3,143,299	8.19	257,309	35,496,704	7.05	2,503,495
Oklahoma	14,133,367	6.41	905,984	35,049,341	5.31	1,860,482
Louisiana }	8,628,773	8.01	691,311	11,620,989	8.11	942,114
Alabama }						
California	8,379,632	7.27	609,028	8,379,632	7.27	609,028
Texas	5,128,745	9.72	498,665	5,128,745	9.72	498,665
Illinois	3,418,791	6.71	229,392	4,367,206	7.43	324,480
New York	1,243,454	18.09	224,889	1,597,787	17.74	283,407
Kentucky	669,083	14.66	98,098	2,340,370	9.88	231,318
Indiana	404,882	15.16	61,368	628,429	16.24	102,043
Arkansas }						
Colorado }	870,751	6.93	60,315	870,751	6.93	60,315
Wyoming }						
South Dakota }	9,900	54.55	5,400	9,900	54.55	5,400
North Dakota }						
Missouri	7,600	26.97	2,050	7,600	26.97	2,050
Michigan	900	50.00	450	900	50.00	450
Total	92,181,369	8.82	8,129,506	368,748,650	9.11	33,603,074

a Included in other industrial.

The following table gives the value of natural gas consumed in the United States from 1907 to 1912, inclusive, by States:

Value of natural gas consumed in the United States, 1907–1912, by States.

State.	1907	1908	1909	1910	1911	1912
Pennsylvania	$22,917,547	$20,678,161	$21,639,102	$23,934,691	$23,940,001	$26,486,302
Ohio	15,227,780	15,166,434	18,884,312	21,210,965	22,792,270	27,196,162
Kansas	[a] 6,208,862	[a] 7,691,587	[a] 8,356,076	[a] 9,335,027	[a] 9,493,701	[a] 8,521,858
West Virginia	[b] 3,757,977	[b] 4,020,282	[b] 5,183,054	[b] 5,617,910	[b] 6,240,152	[b] 7,001,331
New York	3,098,533	3,281,312	3,286,523	3,963,872	4,276,324	4,866,821
Oklahoma	406,942	860,159	1,743,963	1,911,044	2,092,603	3,149,376
Indiana	[c] 1,570,605	[c] 1,312,507	[c] 1,616,903	[c] 1,473,403	[c] 1,192,418	[c] 1,014,295
Texas }					1,014,945	1,405,077
Louisiana }	178,276	236,837	453,253	956,683	} [d] 858,145	[d] 1,747,379
Alabama }						
Kentucky	380,176	424,271	695,577	908,293	901,759	1,070,664
California	168,397	307,652	446,933	476,697	800,714	1,134,456
Illinois	143,577	[e] 446,077	[e] 644,401	[e] 613,642	[e] 687,726	[e] 616,467
Arkansas }						
Wyoming }	126,582	164,930	226,925	301,151	295,858	309,816
Colorado }						
Missouri	17,010	22,592	10,025	12,611	10,496	11,576
South Dakota	19,500	24,400	16,164	31,999	16,984	} 30,412
North Dakota	235	2,480	3,025	7,010	5,738	}
Michigan	....	....	255	820	1,330	1,470
Tennessee	300	350	350	300	300	375
Iowa	....	93	50	40	70	120
Oregon	100	250	50	....	....	....
Total	54,222,399	54,640,374	63,206,941	70,756,158	74,621,534	84,563,957

a Includes value of gas piped from Kansas to Missouri in 1907, 1908, and 1909, and from Kansas and Oklahoma to Missouri in 1910, 1911, and 1912.
b Includes value of gas piped from West Virginia to Maryland.
c A portion of this was consumed in Chicago, Ill.
d Includes value of gas piped from Louisiana to Texas and Arkansas.
e Includes value of gas produced in Illinois and consumed in Vincennes, Ind.

COMBINED VALUE OF NATURAL GAS AND PETROLEUM.

The following table gives the value of natural gas and of petroleum and their combined value in 1911 and 1912, by States, arranged in the order of the value of the combined production:

Value of the natural gas and petroleum produced in 1911 and 1912, and their combined value, by States.

1911.

State.	Value of natural gas.	Value of crude petroleum.	Value of natural gas and crude petroleum.
West Virginia	$28,435,907	$12,767,293	$41,203,200
California	800,714	38,719,080	39,519,794
Oklahoma	6,731,770	26,451,767	33,183,537
Pennsylvania	18,520,796	10,894,074	29,414,870
Illinois	687,726	19,734,339	20,422,065
Ohio	9,367,347	9,479,542	18,846,889
Texas	1,014,945	6,554,552	7,569,497
Louisiana }	858,145	5,668,814	6,526,959
Alabama }		.....	
Kansas	4,854,534	608,756	5,463,290
New York	1,418,767	1,248,950	2,667,717
Indiana	1,192,418	1,228,835	2,421,253
Kentucky	407,689	328,614	736,303
Arkansas }	295,858	.....	647,999
Colorado }		228,104	
Wyoming }		124,037	
Utah }	.....		
Missouri	10,496	7,995	19,821
Michigan	1,330		
South Dakota	16,984	.....	16,984
North Dakota	5,738	.....	5,738
Tennessee	300	.....	300
Iowa	70	.....	70
Total	74,621,534	134,044,752	208,666,286

1912.

State.	Value of natural gas.	Value of crude petroleum.	Value of natural gas and crude petroleum.
West Virginia	$33,349,021	$19,927,721	$53,276,742
Oklahoma	7,406,528	34,672,604	42,079,132
California	1,134,456	39,213,588	40,348,044
Pennsylvania	18,539,672	12,886,752	31,426,424
Illinois	616,467	24,332,605	24,949,072
Ohio	11,891,299	12,085,998	23,978,767
Michigan	1,470		
Texas	1,405,077	8,852,713	10,257,790
Louisiana }	1,747,379	7,023,827	8,771,206
Alabama }		.....	
Kansas	4,264,706	1,095,698	5,360,404
New York	2,343,379	1,401,880	3,745,259
Indiana	1,014,295	885,975	1,900,270
Utah }	.....	798,470	1,307,947
Wyoming }	309,816		
Colorado }		199,661	
Arkansas }			
Kentucky	497,909	424,842	922,751
South Dakota }	30,412	.....	30,412
North Dakota }			
Missouri	11,576	.....	11,576
Tennessee	375	.....	375
Iowa	120	.....	120
Total	84,563,957	163,802,334	248,366,291

WELL RECORD.

The following table gives the record of natural gas wells in 1912, by States:

Record of natural gas wells in 1912, by States.

State.	Productive Dec. 31, 1911.	Drilled in 1912.			Abandoned in 1912.	Productive Dec. 31, 1912.
		Gas.	Dry.	Total.		
Alabama	16	3	9	12		19
Arkansas	102	2	1	3	7	97
California	66	6	1	7	1	a 71
Colorado	8					8
Illinois	458	56	147	203	67	447
Indiana	2,744	96	39	135	293	2,547
Iowa	6					6
Kansas	2,033	435	200	635	404	2,064
Kentucky	255	22	27	49	17	260
Louisiana	116	50	20	70	11	155
Michigan	18	2		2	3	a 17
Missouri	62	7	3	10	6	63
New York	1,531	218	54	272	42	1,707
North Dakota	24					a 24
Ohio	4,999	637	289	926	440	5,196
Oklahoma	732	329	197	526	191	870
Pennsylvania	10,885	993	219	1,212	335	11,543
South Dakota	37				2	b 35
Tennessee	4	3		3	1	6
Texas	69	24	23	47	6	87
West Virginia	4,790	870	149	1,019	127	5,533
Wyoming	23	2	5	7	1	24
Total	28,978	3,755	1,383	5,138	1,954	30,779

a Include some artesian wells from which gas is used. b Artesian wells from which gas is used.

ACREAGE CONTROLLED BY NATURAL-GAS COMPANIES.

The following table shows the number of acres of land held by natural-gas companies in 1911 and 1912, and whether the acreage was owned in fee or leased:

Acreage controlled by natural-gas companies in 1911 and 1912, by States.

State.	1911				1912			
	In fee.	Leased.	Gas rights.	Total.	In fee.	Leased.	Gas rights.	Total.
Alabama	570	66,350		66,920	570	216,000		216,570
Arkansas	600	17,217		17,817	600	20,059		20,659
California	1,321	6,400		7,721	2,434	7,690		10,124
Colorado		195		195		195		195
Illinois	4,057	198,493	25,800	228,350	3,568	165,337	17,342	186,247
Indiana	100,348	178,396	10,152	288,896	120,020	173,979	8,692	302,691
Kansas	28,340	388,750	1,925	419,015	25,405	366,475	17,870	409,750
Kentucky	1,940	105,348	4,045	111,333	2,970	113,947		116,917
Louisiana	22,298	575,531	22,476	620,305	15,625	301,664		317,289
Missouri	4,636	1,410		6,046	4,077	1,660		5,737
New York	8,962	589,066	985	599,013	10,689	490,506	1,205	502,400
North Dakota		20,000		20,000		20,000		20,000
Ohio	27,245	1,506,723	109,260	1,643,228	14,834	1,711,552	29,781	1,756,167
Oklahoma	9,743	1,022,976	114,851	1,147,570	7,047	1,058,144	95,857	1,161,048
Pennsylvania	103,595	1,372,131	557,046	2,032,772	115,242	1,675,116	397,030	2,187,388
Tennessee	500			500	500			500
Texas	3,740	153,379	361,739	518,858	7,660	153,919	6,369	167,948
West Virginia	45,005	2,537,264	816,944	3,399,213	124,880	2,202,642	691,794	3,019,316
Wyoming	1,320	3,570		4,890	2,968	3,970		6,938
Total	364,220	8,743,199	2,025,223	11,132,642	459,089	8,682,855	1,265,940	10,407,884

NATURAL-GAS INDUSTRY BY STATES.

PENNSYLVANIA.

The natural-gas industry of Pennsylvania in 1912 surpassed that of any previous year from almost every point of view. Except in 1908, a year of business depression, the value of the gas consumed in Pennsylvania has continued to increase steadily until 1912, when the enormous total of 173,656,003,000 cubic feet of gas, valued at $26,486,302, an average of 15.25 cents per thousand cubic feet, was consumed. The consumption of gas in this State in 1911 was 159,104,376,000 cubic feet, valued at $23,940,001, an average of 15.05 cents per thousand cubic feet. Pennsylvania leads all other States in the quantity of gas consumed.

On referring to the table giving the distribution of natural gas consumed in the United States in 1912, by States, it will be observed that the gas consumed in Pennsylvania was largely used for manufacturing and other industrial purposes, the total quantity of the gas consumed for these purposes being 124,324,911,000 cubic feet, valued at $14,333,048, an average price of 11.53 cents per thousand cubic feet, compared with 113,598,733,000 cubic feet, valued at $12,775,833, an average price of 11.25 cents per thousand cubic feet, in 1911. Of the total industrial consumption of gas in 1912 there was consumed for manufacturing purposes 114,617,963,000 cubic feet, valued at $13,127,440, an average of 11.45 cents per thousand cubic feet, and for other industrial or power purposes 9,706,948,000 cubic feet, valued at $1,205,608, an average of 12.42 cents per thousand cubic feet.

In the industrial world the year 1912 was one of great prosperity, and natural gas is one of the fuels most needed and sought for. It is the ideal fuel for the manufacture of iron, steel, and glass, for which the State of Pennsylvania is noted, and the presence of this gas in the fields of this State has helped to make it the leading manufacturing State in the country. Since the introduction of natural gas into the industrial establishments of Pittsburgh in 1883 this district has continued to grow until it has become the greatest commercial center in the country. It is to be regretted that exact figures of the consumption of natural gas in the Pittsburgh district can not be given, but it is estimated that more fuel (including natural gas, coal, and coke) is consumed in this city and its immediate vicinity and more coal and coke are shipped into and through the Pittsburgh district than in any other district in the world.

The quantity and value of natural gas consumed for domestic purposes in Pennsylvania in 1912 was 49,331,092,000 cubic feet, valued at $12,153,254, an average price of 24.64 cents per thousand cubic feet; in 1911 the total domestic consumption was 45,505,643,000 cubic feet, valued at $11,164,168, an average price of 24.53 cents per thousand cubic feet.

In this connection it must be said that a large quantity of the gas consumed in Pennsylvania, a little less than one-third of the State's consumption in 1912, is piped into the State from the natural-gas fields of West Virginia. Some gas was piped from Pennsylvania into West Virginia, a smaller quantity to Ohio, and a considerable quantity was piped from Pennsylvania to supply consumers in New York State.

The report for Pennsylvania shows that the year 1912 exceeded all others in the quantity and value of gas produced. This was largely due to increased activity in the oil and gas fields of the State brought about by advancing prices for crude petroleum, the operators making every effort to find new producing territory and to extend the old fields, and also to the greater demand for gas, the result being the completion of more gas wells in Pennsylvania in 1912 than in any previous year and the extension of pipe lines to reach consumers not already supplied.

During 1912 a total of 1,212 wells were drilled by gas producers in Pennsylvania, of which 993 were productive of gas and 219 were dry holes. Many of the new wells drilled are high in pressure and large in volume and will take the place of the older wells which are gradually becoming exhausted. A total of 335 gas wells were abandoned in 1912, the number of productive gas wells at the close of the year being 11,543.

It is estimated that the total quantity of gas produced from wells in Pennsylvania and supplied for consumption in 1912 was 112,149,855,000 cubic feet, valued at $18,539,672, an average of 16.53 cents per thousand cubic feet.

There has been no change in the natural gas producing counties of Pennsylvania since the report for 1911. At the close of the year 1912 the total acreage held in fee and under lease by the gas producers of this State was 2,187,388 acres.

In the table showing the combined value of natural gas and crude petroleum in the United States in 1912, by States, it will be seen that Pennsylvania takes fourth place, as in 1911.

The number of plants installed in Pennsylvania for the extraction of gasoline from natural gas increased considerably during 1912. The statistics of this industry will be found in another part of this report.

In the following table is given a record of the natural-gas industry in Pennsylvania from 1897 to 1912, inclusive:

Record of the natural-gas industry in Pennsylvania, 1897–1912.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
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	7,300
1907	344	18,844,156	295,115	3,812	22,917,547	769	180	8,051
1908	[b]572	19,104,944	307,585	4,577	20,678,161	571	147	[c]8,831
1909	[b]777	20,475,207	294,781	5,377	21,639,102	756	166	[c]9,499
1910	[b]819	21,057,211	321,430	4,102	23,934,691	857	161	[c]10,337
1911	[b]1,067	18,520,796	330,537	4,597	23,940,001	832	224	[c]10,885
1912	[b]1,104	18,539,672	345,765	3,442	26,486,302	993	219	[c]11,543

[a] Number of fires supplied.
[b] Includes 216 producers having shallow wells in Erie County for their own domestic consumption in 1908, 311 producers in 1909, 345 producers in 1910, 399 in 1911, and 401 in 1912.
[c] Includes 350 shallow wells in Erie County in 1908, 429 in 1909, 429 in 1910, 476 in 1911, and 492 in 1912.

In the following table are given the depth and gas pressure of wells in Pennsylvania from 1907 to 1912, inclusive, by counties:

Depth and gas pressure of wells in Pennsylvania, 1907–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Allegheny	900–3,265	7– 400	1–350	10–600	10–600	10– 800	10– 500
Armstrong	702–3,450	6– 800	2–600	25–900	3–800	3– 435	5– 900
Beaver	700–2,000	4	....	4–600	4– 75	....	30– 70
Butler	700–2,900	15– 625	15–550	30–600	6–700	4– 800	2– 700
Clarion	600–3,000	3– 700	15–500	8–800	25–900	5– 900	1– 900
Elk	500–3,200	49– 960	50–940	50–990	50–990	40– 900	60– 840
Crawford Erie	600–1,200 300–1,600	10– 200	100	1– 85	0– 85	0– 100	2– 100
Fayette Cambria	900–2,772	100– 550	200–550	100–700	100–650	40– 600	35– 700
Forest	700–2,900	75– 250	85–160	15–145	10–850	6– 150	5– 800
Greene	680–3,600	80–1,200	70–350	50–500	40–400	40– 900	60– 575
Indiana	1,100–1,500	....	....	....	....	....	....
Jefferson	700–3,360	200– 500	325–760	10–635	100–700	60–1,200	90–1,000
McKean	750–3,000	20– 450	15–500	30–600	6–600	5– 850	1– 950
Mercer Lawrence	700–1,500	....	....	40	....	160– 250	190
Potter	750–2,200	40– 360	100–460	60–500	50–300	35– 500	10– 360
Tioga	700–1,400	350	300	250	300	13– 350	....
Venango	350–2,110	70– 150	40–400	20–250	10– 85	10– 500	15– 200
Warren	600–3,290	10– 60	14–250	20– 50	10–190	3– 200	10– 350
Washington	606–3,304	15– 100	5–400	12–500	5–800	5– 600	5– 550
Westmoreland	1,800–3,300	25	10– 30	50–180	10– 25	60– 250	15– 20

NEW YORK.

The year 1912 surpassed all previous years in the quantity and value of gas produced in New York. This was due to the further development of the gas fields of Erie County. Late in 1911 an excitement was created by the discovery of gas in the neighborhood of Orchard Park, where at a depth of 1,625 to 1,675 feet gas wells with a pressure of 250 to 625 pounds were brought in. Several companies were organized to exploit this territory, with most encouraging results. During the year 1912, out of a total of 78 wells completed in Erie County only 11 were dry holes. These gas wells vary in depth from 1,600 to 1,900 feet and have a rock pressure of 135 to 950 pounds. This production aided very materially to increase the gas production of the State in 1912.

The gas-producing counties of New York were the same in 1912 as in 1911. A total of 272 wells were drilled by gas producers in this State in 1912, of which 218 were productive and 54 were dry holes. There were 42 gas wells abandoned in 1912. The number of productive gas wells at the close of 1912 was 1,707.

The total quantity of gas produced in New York in 1912 is estimated at 8,625,979,000 cubic feet, valued at $2,343,379. On the other hand, the consumption of gas in New York in 1912 was 16,927,598,000 cubic feet, valued at $4,866,821, an average price of 28.75 cents per thousand cubic feet. It will be noted that the larger proportion of gas consuned in this State is consumed for domestic purposes. It is estimated that the total gas consumption for domestic purposes in 1912 was 15,329,811,000 cubic feet, valued at $4,583,414, an average price of 29.90 cents per thousand cubic feet, and that 1,597,787,000 cubic feet, valued at $283,407, was consumed for industrial purposes.

The greater portion of the gas consumed for industrial purposes in this State was used for power. The figures given in this report show that the consumption of gas in New York is on the increase. The difference between the value of the gas consumed in New York and the value of gas produced in New York, which in 1912 amounted to $2,523,442, represents the value received for gas piped into this State from Pennsylvania, upon whose gas fields consumers in New York are so largely dependent for their supply of gas. It will be seen that the number of domestic consumers supplied with gas in New York in 1912 was 129,930, as compared with 116,314 in 1911.

In the following table is given a record of the natural-gas industry in New York from 1897 to 1912, inclusive:

Record of natural-gas industry in New York, 1897–1912.

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	919
1907	208	766,157	83,805	155	3,098,533	61	13	1,049
1908	215	959,280	91,391	213	3,281,312	68	19	1,211
1909	282	1,222,666	92,958	570	3,286,523	86	18	1,340
1910	273	1,678,720	106,538	717	3,963,872	97	20	1,411
1911	302	1,418,767	116,314	208	4,276,324	167	53	1,531
1912	332	2,343,379	129,930	805	4,866,821	218	54	1,707

[a] Number of fires supplied.

In the following table are given the depth and gas pressure of wells in New York from 1907 to 1912, inclusive, by counties:

Depth and gas pressure of wells in New York, 1907–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Allegany	600–1,700	10–150	10–200	6–300	10–300	15–150	7–300
Cattaraugus	400–2,800	5–85	4–150	8–250	10–90	1–120	0–700
Chautauqua	150–2,500	1–800	1–800	0–800	1–700	0–700	0–[a]900
Erie	360–3,000	40–585	25–500	25–500	22–610	10–700	25–[a]950
Niagara	550	....	150	150	....	....	....
Genesee	1,150–1,870	300–580	600	600	500	500	500
Livingston	345–2,000	10	1–350	15–450	10–380	100–400	200–525
Monroe	500–1,300	....	....	....	....	....	50–400
Onondaga	1,000–3,000	100	100–350	....	300–500	300–600	3–300
Ontario Seneca	600–2,300 1,250–1,550	65–425	65–510	60–480	5–400	60–440	55–450
Oswego	700–1,700	....	....	3–200	20–200	11–200	8–75
Schuyler Yates	1,000–1,600 375–1,900	100–435	15–100	100–435	100–435	200–435	300–435
Steuben	279–1,100	....	25	....	50–100	....	75–200
Wyoming	1,500–2,000	140–200	100–200	200	50	125	110–140

[a] New well.

WEST VIRGINIA.

West Virginia takes the lead among the States in the quantity of gas produced and supplied for consumption in 1912, having held this place for the last four years, and it can be said that the gas production of this State could be largely increased, as many of its gas wells are closed in for future use or awaiting a market. The total quantity of natural gas produced in West Virginia in 1912 is estimated at 239,088,068,000 cubic feet, valued at $33,349,021, as compared with 206,890,576,000 cubic feet, valued at $28,435,907, in 1911. The quantity of gas piped out of West Virginia to supply consumers in the States of Pennsylvania, Ohio, and Kentucky in 1912 amounted to 143,685,820,000 cubic feet, for which was received $26,347,690 at the point of consumption; the quantity of gas piped out of this State in 1911 was 126,021,931,000 cubic feet, valued at $22,195,755. Of the total quantity of gas exported from West Virginia in 1912, there was piped to Pennsylvania about 73,000,000,000 cubic feet, to Ohio about 65,000,000,000 cubic feet, and the remainder to Kentucky; but before the close of the year 1913 it is expected that gas will be piped from the gas fields of Lewis and Harrison counties to supply consumers in several towns in Indiana. A pipe line is now under construction from the Sugar Grove field in Ohio to Indiana which connects with the line laid and in operation from West Virginia to Sugar Grove. Consequently there will be a greater demand for gas from the West Virginia fields in 1913 than ever before. Some of the prominent cities in which consumers are supplied with gas for domestic and other purposes from the fields of West Virginia are Cleveland, Toledo, Cincinnati, and Portsmouth in Ohio; Pittsburgh and vicinity in Pennsylvania; and Covington in Kentucky. An additional line is now being constructed from the West Virginia fields to northern Ohio, which will serve to increase the supply of gas for Cleveland and vicinity.

The principal gas-producing companies in West Virginia in 1912 were the Hope Natural Gas Co., United Fuel Gas Co., Carnegie Natural Gas Co., Manufacturers' Light & Heat Co., Columbia Gas & Electric Co., and the Philadelphia Co. of West Virginia.

Drilling was very active throughout the oil and gas fields of West Virginia in 1912 and considerable work was accomplished, resulting in the completion of 870 gas wells and 149 dry holes. At the close of the year there were 5,533 gas wells, and the producing territory extended over a much increased area. A new field was opened in Boone County, where a few good gas wells were completed with a daily capacity of from 2,000,000 to 2,500,000 cubic feet, but are closed in for want of a market. Considerable drilling was done in Harrison, Kanawha, Ritchie, Monongalia, Lewis, Lincoln, Tyler, and Marion counties. Gas completions are also reported in the following-named counties: Doddridge, Calhoun, Hancock, Wood, Clay, Roane, Upshur, Wayne, Mingo, Gilmer, Wetzel, Wirt, and Pleasants. Three gas wells were completed in Nicholas County, opening up a new field. These wells have not been put to use. Developments began late in 1911 in Logan County were continued in 1912 and at the close of the year a total of 7 gas wells had been completed, some with a daily capacity of 18,000,000 cubic feet, which are closed for lack of a market. One well completed in 1912 to a depth of 2,400 to 2,500 feet in Lewis County showed a rock pressure of 1,100 pounds, this being the highest pressure reported for any well in this State in 1912. Another well in the same county had a pressure of 900 pounds, while a few had pressures of 700 pounds. A well completed in Harrison County had a pressure of 800 pounds; 2 wells had pressures of 700 and 750 pounds, and several had pressures from 600 to 700 pounds. Tyler County completed 3 wells with pressures of 600, 700, and 750 pounds, respectively. Marion County had 2 wells with pressure of 800 pounds, and 2 with pressure of 500 and 600 pounds. Gas pressure of new wells in Kanawha County ranged from 275 to 600 pounds, in Lincoln County from 400 to 600 pounds. These figures show that West Virginia is likely to remain a great gas-producing State.

As a consumer of gas West Virginia stands third in quantity and fourth in value of the gas consumed in 1912. The total quantity of gas consumed in this State in 1912 was 95,402,248,000 cubic feet, valued at $7,001,331, as compared with 80,868,645,000 cubic feet, valued at $6,240,152, in 1911, a gain in both quantity and value. Of this total, there was consumed for domestic purposes 16,180,778,000 cubic feet, valued at $2,930,628, an average price of 18.11 cents per thousand cubic feet, and for industrial purposes 79,221,470,000 cubic feet, valued at $4,070,703, an average price of 5.14 cents per thousand cubic feet. It will be seen that nearly five times as much gas was consumed for industrial purposes as in domestic use.

As much of the gas produced in West Virginia is sold at a flat rate and much is also used for both domestic and industrial purposes without measurement, the quantity of the gas produced and consumed can only be given approximately.

The figures of consumption of gas in West Virginia include the quantity and value of gas piped out of this State to western Maryland where consumers in the following named towns were supplied with gas: Cumberland, Lonaconing, Frostburg, Luke, Oakland, Loch Lynn, Deer Park, Corinth, and Mountain Lake Park.

Of the total estimated consumption of gas in this State for industrial purposes in 1912, there was consumed for manufacturing purposes 59,189,820,000 cubic feet, valued at $2,998,754, an average price of 5.07 cents per thousand cubic feet; and the quantity of gas consumed for power and field purposes was 20,031,650,000 cubic feet, valued at $1,071,949, an average price of 5.35 cents per thousand cubic feet.

The gas consumed for manufacturing purposes was supplied to iron, glass, brick, pottery, aluminum, and chemical works, and to carbon-black factories, for all of which uses it can be purchased at a very low rate per thousand cubic feet.

The manufacture of carbon black from natural gas is an industry which is almost wholly confined to the State of West Virginia. At the close of 1912 there were 16 companies engaged in this business, gas used at these plants being produced in the following-named counties: Calhoun, Clay, Doddridge, Kanawha, Harrison, Lewis, Lincoln, Mingo, Roane, Ritchie, Wayne, and Wirt. The factories are usually located near the wells from which the gas is drawn. In most cases the operators of the factories are the owners of the gas wells. Some operators are also purchasers of large quantities of gas from wells in their neighborhood. The gas is mostly piped directly to the plants and used without measurement, consequently the quantity of gas consumed in this industry can only be given approximately. Enormous quantities of gas are consumed annually. It is said that by improved methods, which are in practice at some of the plants, only 1,000 cubic feet of gas are required to make 1 pound of carbon black, but at some of the plants 1,200 cubic feet or more are necessary. As it may be of interest to know how the gas is used at one of these factories, the following passage is quoted from the "Handbook of natural gas," by Henry P. Westcott:

Generally a lampblack factory consists of a row of low sheet-iron buildings in which are long rows of troughs. Under these troughs the gas is burned through common jet burners, the combustion taking place with an insufficient supply of air, resulting in a heavy deposit of unconsumed carbon, or soot, on the under side of the troughs. This soot, or carbon black, is then scraped off and packed in 12½-pound bags, which in turn are barreled for shipment. In this process no use is made of the heat energy of the gas, other than that required to separate the carbon from the hydrogen and other constituents.

It is estimated that the quantity of gas used during the year 1912 in the manufacture of carbon black in West Virginia was 25,430,749,000 cubic feet, valued at $559,572, an average of 2.2 cents per thousand cubic feet. The price of this gas ranged from 1½ to 3 cents per thousand cubic feet at the wells. These figures show that the industry is growing, as the quantity of gas used at the carbon-black works of this State in 1911 was estimated at 18,737,265,000 cubic feet, valued at $544,856.

It is believed by many that this is a wasteful and extravagant use to make of natural gas, which is such a luxurious and matchless fuel for family purposes, but as there is no market for the gas in the vicinity of many of the wells it is doubtful if the operators and owners of the wells would realize a greater profit by transporting it to a market after deducting the cost of the pipe lines and their maintenance.

Another industry which has become of considerable importance in West Virginia is the extraction of gasoline from the waste or "casing-head" gas from oil wells. Statistics of this industry will be found in another part of this report.

In the following table is given a record of the natural-gas industry in West Virginia from 1897 to 1912, inclusive:

Record of natural-gas industry in West Virginia, 1897–1912.

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	1,831
1907	105	16,670,962	53,807	1,000	[b] 3,757,977	377	59	2,169
1908	138	14,837,130	63,228	1,225	[b] 4,020,282	253	80	2,511
1909	183	17,538,565	70,853	1,907	[b] 5,183,054	642	65	3,074
1910	241	23,816,553	86,778	2,659	[b] 5,617,910	883	69	4,052
1911	340	28,435,907	87,438	1,566	[b] 6,240,152	870	117	4,790
1912	406	33,349,021	94,273	1,953	[b] 7,001,331	870	149	5,533

[a] Number of fires supplied. [b] Includes gas consumed in Maryland.

In the following table are given the depth and gas pressure of wells in West Virginia from 1907 to 1912, inclusive, by counties:

Depth and gas pressure of wells in West Virginia, 1907–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Boone	1,060–1,780	....	....	....	....	....	350– 520
Braxton	2,100–3,000	250–900	250–500	240– 525	125– 535	840	....
Clay	1,400–2,000					200– 400	300– 600
Taylor	1,453–2,800					80– 800	100– 600
Brooke	1,200–1,800	100	30–600	100– 600	100– 400	0– 50	0– 270
Cabell	900–2,325	300–625	230–650	200– 460	250– 540	250– 500	350– 400
Calhoun	824–4,000	200–600	25–400	60–1,400	18–1,500	35– 655	20– 760
Doddridge	1,400–3,000	180–620	70–580	100– 800	10– 760	100– 750	5– 700
Gilmer	1,280–3,181	....	....	250– 875	350– 630	640	130– 210
Hancock	700–1,400	15–300	1–220	10– 150	3– 100	1– 60	20– 150
Harrison	800–3,210	105–975	150–800	50– 900	50– 900	50–1,040	40– 900
Kanawha	1,500–2,585	....	....	500	480– 560	400– 500	250– 600
Lewis	1,127–3,000	250–900	275–750	200– 720	125– 800	60– 950	45–[a]1,100
Lincoln	900–2,720	500	585	250– 450	400– 500	400– 650	200– 600
Logan	1,200–1,300	....	....	....	....	....	550– 560
Marion	1,500–3,478	300–350	100–700	125– 580	50– 600	90–1,200	75– 805
Marshall	1,000–2,900	....	160–300	200– 300	10– 295	50– 300	6– 300
Mingo	1,250–2,100	....	....	....	....	300– 600	375– 550
Wayne							
Monongalia	1,350–3,500	140–450	40–400	85– 500	70– 450	60– 700	60– 825
Nicholas	1,200	....	....	....	....	40– 125	15– 350
Ohio	1,500–2,000	....	....	....	....		
Pocahontas	2,000–2,500	....	....	....	....		
Pleasants	900–2,150	50–300	200–350	100– 250	100– 150	150– 400	50– 300
Putnam	900–2,400	....	....	300– 800	300– 800	300– 800	....
Upshur	1,940–2,800	....	....			25– 740	480– 600
Ritchie	900–2,925	....	25–670	45– 670	20– 800	250– 275	20– 700
Roane	1,472–2,350	340	500–700	400– 500	275– 600		320– 465
Tyler	1,650–2,700	160–550	40–340	65– 300	35– 440	50– 100	50– 750
Wetzel	2,000–3,560	125–242	65–300	95– 250	70– 300	0– 200	50– 113
Wirt	500–1,875	20–530	30–500	40– 500	35– 500	10– 450	30– 500
Wood	1,030–1,800	....	40–150	250– 540	250– 540	160– 350	300– 520

[a] New well.

KENTUCKY.

The year 1912 was one of unusual activity in the natural-gas industry in Kentucky. During the year this State not only largely increased its production but also piped a considerable quantity of gas from the gas fields of West Virginia to supply the demands of consumers. Gas produced from wells of the Columbia Gas & Electric Co. in West Virginia is supplied to the Union Light, Heat & Power Co., of Covington, Ky., and to the Maysville Gas Co., of Maysville, Ky., the former company supplying gas to consumers in Covington, West Covington, Ludlow, Bellevue, Dayton, Newport, and Clifton, Ky., and the latter company supplying Maysville, Ky. The United Fuel Gas Co. also piped a large quantity of gas from its wells in West Virginia to augment its gas production from Kentucky wells, and supplied consumers in Ashland, Inez, Kinner, Catlettsburg, Warfield, Pollard, Russell, Buchanan, Louisa, and Kavanaugh, Ky. The Central Kentucky Natural Gas Co., with gas wells in Menifee and Powell counties, Ky., also piped some gas from wells in West Virginia and supplied consumers in Lexington, Winchester, Mount Sterling, and Rothwell, Ky.

During 1912 considerable drilling was done in an effort to find gas in Boyd County. The Means & Russell Iron Co., of Ashland, Ky., put down a well as an experiment on land adjoining its brick yard at

Bellefonte, near Ashland, and got a well with a capacity of from 400,000 to 500,000 cubic feet of gas at a depth of 1,710 feet in the shale. The pressure is holding up and the gas is sufficient to run their small brick plant. About 27 wells in all were drilled in and around Ashland, and although 3 or 4 produced considerable gas at a depth of 500 feet, all but 2 had been exhausted at the close of 1912.

The Menifee County field is the source of the greatest gas supply of this State at the present time. A recently issued report on this important gas field, prepared by M. J. Munn,[1] of the United States Geological Survey, says:

> Gas was discovered in the Menifee field in March, 1904, in a well of the New Domain Oil & Gas Co., about 4 miles from Rothwell. The gas was found at a depth of 452 to 478 feet in the "Corniferous" limestone (Boyle limestone of Foerste) just below the black Ohio (Chattanooga) shale. This well developed a closed pressure of about 79 pounds to the square inch and an initial daily capacity of 460,000 cubic feet. The total number of wells drilled in the field up to June 1, 1911, was 115. These range from less than 350 feet to about 800 feet in depth, to the top of the gas-bearing limestone. The majority of the wells are between 400 and 600 feet deep, the difference in depth being due largely to the unevenness of the surface of the country. Of these wells, 90 were gas wells and 25 dry holes. On June 1, 1911, only three of the gas wells had been abandoned. The greatest daily production of the field is not known, but on June 1, 1912, it was reported by the Central Kentucky Natural Gas Co. to be approximately 25,000,000 cubic feet, the gas having a closed pressure of about 60 pounds to the square inch. The field as outlined at that time was about 8½ miles long and 4½ miles wide in maximum dimensions, the total area covered being about 24 square miles. Only small "shows" of oil have been reported from a few of the wells in this field.

A gas field of some importance has been developed in Morgan County; two gas wells were completed and others were drilling in 1912, the total number of gas wells in this county at the close of the year being seven. Consumers in West Liberty, Hazel Green, and Caney are supplied with gas from these wells, and preparations are being made to supply other towns. New operators in this field are the Elk Oil & Gas Co. and the Kentucky Block Cannel Coal Co.

In the latter part of 1912 the Monticello Gas Co. was organized and is arranging to pipe gas from the Wayne County field to supply consumers in Monticello, which is 4 miles distant from the wells.

The total value of the gas produced in Kentucky in 1912 was $497,909, which exceeded the value for 1911 by $90,220 and was $12,717 greater than the value for 1909, which was $485,192. As will be seen from the report, the greater portion of the gas consumed was supplied for domestic purposes in 1912, and amounted to 2,762,571,000 cubic feet, valued at $839,346, an average price of 30.38 cents per thousand cubic feet. The total quantity of gas consumed for industrial purposes in this State in 1912 was 2,340,370,000 cubic feet, valued at $231,318, or an average price of 9.88 cents per thousand cubic feet. The total quantity of gas consumed in Kentucky in 1912 was 5,102,941,000 cubic feet, valued at $1,070,664, an average of 20.98 cents per thousand cubic feet, as against 4,734,-580,000 cubic feet, valued at $901,759, an average price of 19.05 cents per thousand cubic feet, in 1911.

The number of gas wells completed by gas producers in this State in 1912 was 49, of which 22 were productive and 27 were dry holes. The number of gas wells abandoned in 1912 was 17. The total number of gas wells at the close of the year was 260.

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[1] Bull. U. S. Geol. Survey No. 531-A, 1913, p. 3.

In the following table is given a record of the natural gas industry in Kentucky from 1906 to 1912, inclusive:

Record of natural gas industry in Kentucky, 1906–1912.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1906	45	$287,501	17,216	18	$287,501	......	......	166
1907	38	380,176	19,279	239	380,176	31	14	179
1908	38	424,271	21,778	42	424,271	19	23	218
1909	38	485,192	25,639	137	695,577	26	7	212
1910	47	456,293	27,961	112	908,293	23	12	241
1911	74	407,689	41,201	70	901,759	19	8	255
1912	88	497,909	45,603	103	1,070,664	22	27	260

ALABAMA.

The principal gas-producing section of Alabama in 1912 was the Fayette County field, where gas has been found in paying quantities. The developed part of this field is about 2,500 feet long by 1,000 feet wide. Although considerable drilling has been done in this field, resulting in the completion of five productive gas wells up to the close of 1912, the field does not appear to be fully developed. The gas is found at a depth of 1,412 to 1,616 feet, the initial volume of the wells being from 250,000 to 4,500,000 cubic feet daily, and the pressure from 350 to 465 pounds. The gas from this field is supplied to consumers in the town of Fayette.

Another gas field in this State, which is being developed, is near Jasper in Walker County, where three good wells have been completed at a depth of 1,800 feet and a probable rock pressure of 600 pounds. The gas from these wells will be supplied to consumers in the town of Jasper, which early in 1913 was being piped. Other wells are being drilled in this field.

The New York-Alabama Oil Co., with wells in Madison County, continued to supply gas to a few consumers in the town of West Huntsville in 1912.

A gas well completed in 1911 in Winston County supplied gas to make steam to drill another well, which proved unproductive, in 1912.

At the close of 1912 there were 19 productive gas wells in this State as compared with 16 at the close of 1911. Twelve wells were drilled in 1912, of which 9 were dry holes. No gas wells were abandoned in 1912.

The statistics of gas production in this State are combined with those of Louisiana.

TENNESSEE.

No gas field of any importance has as yet been developed in Tennessee. During 1912 two small gas wells were drilled in Franklin County to a depth of 310 and 500 feet, respectively, from each of which a small quantity of gas was consumed for domestic purposes.

One gas well in this county has been in service for 10 years for domestic use and has a present pressure of about 50 pounds. In Perry County a well yet incomplete produces a little gas at 127 feet. In White County, near Sparta, are two gas wells at a depth of 400 to 700 feet, with considerable pressure, neither of which is utilized. The field has not been developed.

OHIO.

The natural-gas industry in Ohio was in a flourishing condition during 1912. In the value of gas consumed by States Ohio takes first place. The natural-gas consumption in 1912 greatly exceeded in quantity and value that of any preceding year, amounting to 126,854,659,000 cubic feet, valued at $27,196,162, an average of 21.44 cents per thousand cubic feet, as compared with 112,123,029,000 cubic feet, valued at $22,792,270, an average of 20.33 cents per thousand cubic feet, in 1911.

Reference to the table showing the gas consumed in the United States in 1912, by States, will show that the great gain over 1911 was in the gas utilized for domestic purposes. The consumption of gas for domestic purposes in 1912 was 67,150,744,000 cubic feet, valued at $19,420,086, an average of 28.92 cents per thousand cubic feet, as compared with 57,791,210,000 cubic feet, valued at $15,837,421, an average of 27.40 cents per thousand cubic feet, in 1911. The increase in the number of domestic consumers was from 577,263 in 1911 to 641,724 in 1912.

Although Ohio depends upon the gas fields of West Virginia for the larger part of its gas supply, some 65,000,000,000 cubic feet of gas having been transported to this State from West Virginia in 1912, the year 1912 was one of great activity in the State and resulted in the completion of many excellent wells of great volume and pressure, which served to increase the production from 49,449,749,000 cubic feet, valued at $9,367,347, in 1911 to 56,210,052,000 cubic feet, valued at $11,891,299, in 1912. Some of the prominent cities in Ohio which receive their gas supply almost wholly from West Virginia are Cincinnati, Cleveland, Toledo, and Portsmouth. Additional pipe lines are under construction, and the receipts of gas from West Virginia will be increased.

The Logan Natural Gas & Fuel Co. is constructing a transportation line from Sugar Grove, Fairfield County, Ohio, to Muncie, Ind., a distance of approximately 160 miles. The line from Sugar Grove to a point about 3 miles north of Dayton, Ohio, is 18 inches in diameter. From that point to Muncie, the line is 16 inches in diameter. From Muncie branch lines of 10 and 12 inches in diameter are being laid to Anderson and Fairmont to connect with smaller sized lines supplying Hartford City, Marion, Kokomo, Elwood, Alexandria, Gas City, Tipton, Shelbyville, Greenfield, and other points in central Indiana. It is also about to begin the construction of a 10-inch line from the 16-inch trunk line to supply Richmond, Ind., and at a point farther west, on the 16-inch line, an 8-inch line will be laid to supply New Castle. The construction of the 18-inch and 16-inch trunk lines was commenced about May 20, 1913, and it is expected will be completed and ready to deliver gas not later than

September 15. The source of supply for this service will be gas obtained from Harrison and Lewis counties, W. Va., the lines from those fields being laid and in operation to Sugar Grove, at which point the Indiana lines have been connected.

The central Ohio district, which has been the chief source of the gas produced in the State itself, was actively drilled over in 1912, as well as the territory northward to Lake Erie, embracing the Sugar Grove field, which includes Fairfield and Hocking counties; the Homer field, which includes Knox and Licking counties; and the Ashland-Lorain field, which includes Ashland, Medina, Richland, Lorain, and Wayne counties. Many productive wells have been completed in Ashland County, and it is proposed to supply consumers in Indiana with gas from this field. A test of the pressure of certain wells in the central Ohio district shows a decline, as will be seen from the following statement: In the Sugar Grove field the average pressure decreased from 125 pounds in 1910 to 92 pounds in 1911 and to 74 pounds in 1912; in the Homer field the average pressure decreased from 207 pounds in 1910 to 180 pounds in 1911 and to 157 pounds in 1912; in the Ashland-Lorain field the average pressure increased from 663 pounds in 1910 to 770 pounds in 1911 and then decreased to 593 pounds in 1912.

It is interesting to note some of the new developments in Ohio in 1912. In the city of Cleveland, Cuyahoga County, several gas wells drilled to a depth of from 2,704 to 2,900 feet, have a rock pressure of from 300 to 800 pounds and are supplying gas for manufacturing and power purposes. In Lorain County gas wells have been completed to a depth of from 2,150 to 2,200 feet, with a rock pressure of from 840 to 900 pounds, gas being used commercially. At Canfield, Mahoning County, have been completed three gas wells at a depth of 650 or 700 feet, gas being supplied to consumers in that town. In Summit County a gas well was completed at a depth of 3,550 feet, with rock pressure of 980 to 1,020 pounds, which has not been put to use. In Wayne County, at a depth of 3,200 feet, a gas well was completed, with 800 pounds rock pressure. In Medina County, at a depth of 2,900 feet, two wells were completed, with approximate rock pressure of 1,100 pounds; both are closed in. In Jefferson County a gas well was drilled to a depth of 1,650 to 1,700 feet, with rock pressure of from 800 to 890 pounds; this well is also closed in.

During the year 1912 a total of 926 wells were drilled by gas producers in Ohio, of which 637 were productive of gas and 289 were dry holes. The number of gas wells abandoned in 1912 was 440. At the close of the year there were 5,196 productive gas wells in this State.

The acreage held in fee and under lease by gas producers in Ohio at the close of 1912 was 1,756,167 acres, as compared with 1,643,228 acres in 1911 and with 1,423,351 acres in 1910.

During the year 1912 the number of plants installed in Ohio for the extraction of gasoline from natural gas was increased, there being also a considerable gain in the quantity of gasoline produced, as compared with 1911. The statistics of this industry will be found in another part of this report.

In the following table is given a record of the natural-gas industry in Ohio from 1897 to 1912, inclusive:

Record of natural-gas industry in Ohio, 1897–1912.

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	b 1,977
1907	468	8,718,562	380,489	5,476	15,227,780	431	90	2,942
1908	c 970	8,244,835	427,276	3,621	15,166,434	398	124	d 3,691
1909	c 1,534	9,966,938	450,973	5,260	18,884,312	548	149	d 4,260
1910	c 1,630	8,626,954	475,505	3,187	21,210,965	466	202	d 4,717
1911	c 1,900	9,367,347	577,263	3,634	22,792,270	450	191	d 4,999
1912	c 2,031	11,891,299	641,724	4,414	27,196,162	637	289	d 5,196

a Number of fires supplied.
b Exclusive of complete report of shallow wells.
c Includes 735 producers in Ashtabula, Erie, Huron, Lake, Lorain, and Cuyahoga Counties having shallow wells for their own domestic purposes in 1908, 1,239 in 1909, 1,289 in 1910, 1,476 in 1911, and 1,579 in 1912.
d Includes 901 shallow wells located in Ashtabula, Erie, Huron, Lake, Lorain, and Cuyahoga Counties in 1908, 1,568 in 1909, 1,541 in 1910, 1,757 in 1911, and 1,773 in 1912.

In the following table are given the depth and gas pressure of wells in Ohio from 1907 to 1912, inclusive, by counties:

Depth and gas pressure of wells in Ohio, 1907–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Allen	1,200–1,300	200	....	....	....	....	....
Ashland	2,500–2,800	....	....	....	663	670	250– 650
Ashtabula	400–2,200	....	3– 300	5– 300	5–300	0– 275	0– 410
Athens	440–1,500	100	30– 250	160– 280	25–350	25– 350	10– 350
Auglaize	1,110–1,300	5– 250	5– 225	....	12– 30	2– 90	5– 110
Belmont	778–1,970	200– 275	5– 100	200– 300	60–600	40– 150	20– 50
Carroll	500–1,434	200– 375	200– 350	165– 300	185–350	90– 300	100– 150
Clinton	715–	....	....	....	....	160– 190	160
Columbiana	575–1,000	70– 240	30– 275	50– 287	55–240	25– 240	25– 350
Cuyahoga	337–2,900	....	90	2– 100	2– 80	0– 97	0– a 800
Darke	850–1,300	75– 103	30	5– 25	15–185	2– 250	2– 300
Erie	350– 650	....	....	....	....	20– 40	18– 40
Fairfield	263–2,695	40– 130	5– 150	60– 500	50–280	40– 500	40– 350
Guernsey	700–1,500	400	300– 450	80– 400	50–300	} 350– 400	250
Muskingum	800–3,350	400– 425	350– 400	1,000–1,100	....		
Hancock	880–1,800	85	3– 5	2– 70	2– 50	0– 200	2– 400
Hardin	1,200–1,600	....	16– 150	25– 40	20–300	25– 300	75– 300
Harrison	600–1,630	40– 200	5– 125	5– 400	30–345	10– 110	10– 150
Hocking	750–3,300	....	....	800– 850	....	....	....
Huron	400– 800	....	....	....	....	10– 25	0– 40
Holmes	600–1,160	215	180– 205	225	....	135– 220	100– 170
Jefferson	600–2,026	240	150– 495	40– 230	40–250	0– 400	12– a890
Knox	590–3,200	110– 400	140– 900	25– 400	80–390	50– 250	15– 250
Lake	360–1,700	....	100	1– 100	1–135	0– 165	0– 185
Licking	2,000–2,900	200– 750	100– 730	100– 750	80–600	60– 700	80– 400
Logan	1,360–1,500	40	....	130– 280	....	....	20– 180
Lorain	338–2,590	....	0– 120	0– 840	0–500	0– a 1,150	0– a 900
Lucas	1,156–1,550	1– 90	1– 80	8– 30	4– 11	5– 100	7– 30

a New well.

Depth and gas pressure of wells in Ohio, 1907–1912, by counties—Continued.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Mahoning	650– 700	....	....	....	....	....	*a* 160
Medina	198–3,000	....	20– 75	10– 40	3– 30	5– 875	4–*a* 1,100
Mercer	1,020–1,400	2– 40	2– 250	4– 210	1–150	3– 120	1– 100
Monroe	650–2,400	400	200– 500	25– 500	60–400	100– 400	8– 200
Morgan	240–1,650	15– 500	20– 450	10– 400	20–450	20– 450	20– 80
Noble	484–2,000	....	550	150– 700	100–500	200– 650	100– 620
Ottawa	1,250–1,600	50– 420	20– 400	100– 350	200–450	85– 450	40– 450
Perry	650–3,448	350– 700	75– 85	50– 900	40–740	50– 250	150– 800
Richland	1,950–2,800	1,100	500–1,000	450	250–400	150– 300	200– 250
Sandusky	450–1,400	30– 75	20– 200	40– 160	5–175	5– 165	5– 160
Seneca	370–1,760	15– 140	2– 150	50– 175	25–100	25– 140	20– 110
Summit	900–3,550	....	....	....	....	160	*a*980– 1,020
Trumbull	370– 388	....	75	....		....	....
Tuscarawas	850–1,200	....	....	....	325–385	260– 325	180– 350
Van Wert	1,200–1,285	....	175	35	40	40	40
Vinton and Jackson	520– 800	300	275– 325	250	....	....	....
Warren	275–1,000	....	40– 50	....	....	....	....
Wayne	3,200	....	....	....	....	....	*a* 800
Washington	500–2,600	75– 350	15– 550	15– 450	15–500	15– 500	15– 600
Wood	1,175–1,500	20	....	....	20– 40	10– 15	10– 12

a New well.

INDIANA.

The report shows a reduction in the gas production in Indiana in 1912 as compared with 1911. Although considerable work was carried on by the gas companies of this State in several localities and a few fair gas wells were completed, no gas field of special importance was developed, the producing fields remaining practically the same as in 1911.

The total consumption of gas in Indiana in 1912 is estimated at 3,618,077,000 cubic feet, valued at $1,014,295, an average price of 28.03 cents per thousand cubic feet, as compared with 4,365,339,000 cubic feet, valued at $1,192,418, an average price of 27.32 cents per thousand cubic feet, in 1911. These figures show a slight gain in average price.

There are but few gas companies doing business in this State as compared with former days. More wells are being exhausted as time goes on and are being abandoned annually, and of those remaining the volume and pressure has declined until their entire production is now almost exclusively used for domestic purposes. Of the gas consumed in this State in 1912, the consumption for domestic purposes was 2,989,648,000 cubic feet, valued at $912,252, an average price of 30.51 cents per thousand cubic feet; and for industrial purposes it was 628,429,000 cubic feet, valued at $102,043, an average price of 16.24 cents per thousand cubic feet.

Many gas wells in Indiana, which are exhausted or have ceased to be of value to the gas companies and are abandoned by them, are purchased for a small sum by the farmers on whose lands they are located and may possibly serve them for domestic purposes for a few years. Each of these persons is counted a producer, and although the production of gas is decreasing the number of producers is increasing.

As much of the gas used in Indiana is consumed at a flat rate or without measurement, the figures of consumption of gas are only approximate.

It is reported that many small oil wells in Indiana were abandoned in 1912 on account of lack of gas to operate them. Their product had declined so low that it was not found profitable to operate them notwithstanding the increase in price of crude petroleum.

A pipe line is now under construction from Sugar Grove, Ohio, to Muncie, Ind., with branch lines extending to other towns, and there is a probability that many of the places in Indiana, which in former years were supplied with an abundance of gas from wells in Indiana, will be supplied with gas from the Ohio and West Virginia gas fields before the expiration of the year 1913.

The number of productive gas wells completed in Indiana in 1912 was 96 and the number of dry holes was 39. During the year 293 gas wells were abandoned and the number of productive gas wells at the close of the year was 2,547.

In the following table is given a record of the natural-gas industry in Indiana from 1897 to 1912, inclusive:

Record of natural-gas industry in Indiana, 1897–1912.

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	b 5,833,370	838	109	3,909
1900	670	7,254,539	a 181,751	2,751	b 6,412,307	861	156	4,546
1901	656	6,954,566	a 153,869	2,570	b 6,276,119	985	208	4,572
1902	929	7,081,344	101,481	3,282	b 6,710,080	1,331	205	5,820
1903	924	6,098,364	90,118	1,020	b 5,915,367	895	242	5,514
1904	846	4,342,409	84,862	390	b 4,282,409	706	153	4,684
1905	740	3,094,134	63,194	231	b 3,056,634	252	74	3,650
1906	578	1,750,715	47,368	156	b 1,750,755	159	46	3,523
1907	687	1,572,605	46,210	218	b 1,570,605	185	56	3,386
1908	823	1,312,507	42,054	216	b 1,312,507	187	41	3,223
1909	1,010	1,616,903	40,565	369	b 1,616,903	190	70	2,938
1910	1,027	1,473,403	36,054	282	b 1,473,403	69	33	2,955
1911	1,094	1,192,418	31,576	143	b 1,192,418	110	32	2,744
1912	1,140	1,014,295	27,165	140	b 1,014,295	96	39	2,547

a Number of fires supplied. b Includes value of gas consumed in Chicago, Ill.

In the following table are given the depth and gas pressure of wells in Indiana from 1907 to 1912, inclusive, by counties:

Depth and gas pressure of wells in Indiana, 1907–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Adams	1,000–1,050			250			100
Bartholomew	864– 990	5– 150	100–150	50–175	50–250	150–175	75–125
Blackford	850–1,100	1– 65	2– 60	1– 25	1– 10	0– 30	0– 12
Clark	128– 244		10– 27				27
Daviess, Martin	400– 600	8– 25	5–50	0– 20	0– 60	9–160	7–150
Decatur	700–1,200	15– 335	10–335	0–325	0–315	0–325	5–330
Delaware	728–1,500	1– 40	1– 75	1– 55	0– 70	0– 75	0– 60
Grant	830–1,200	a 0–b 240	45	2– 45	2– 50	0–180	2–180

a Run on vacuum. b New.

Depth and gas pressure of wells in Indiana, 1907–1912—Continued.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Hamilton	800–1,200	10– 175	10–190	5–185	15–180	15–225	8–235
Hancock	700–1,100	5– 140	5–250	0–100	0–100	3–280	5– 80
Harrison	320– 764	60	40			60–110	112
Henry	800–1,100	15– 120	5–270	5–100	0– 90	0– 80	0–100
Howard	800–1,100	25– 250	3–240	0–200	0–220	20–250	10–180
Jay	900–1,600	160	60	0– 50	0– 40	0–110	0–220
Jefferson	1,360		8– 10			10	
Madison	800–1,200	1– 200	1–150	0–200	0–190	0–180	1–175
Miami	900–1,000	20– 60	20–100	0– 10	0– 40		
Marion, Ripley	880–1,050	60– 190		35	40	180–285	150–250
Pike	1,000–1,400		250–525	300–550	125–500	100–480	60–300
Randolph	900–1,300	5– 260	1–220	0–175	0–180	2–300	4–140
Rush	700–1,400	25– 350	10–350	9–375	20–325	0–300	12–300
Shelby	650–1,020	45– 350	25–330	10–310	1–375	1–300	10–366
Spencer	1,025						410
Sullivan	698– 780	295	295	250	200	50–100	40–110
Tipton	750–1,100	40– 200	10–180	18–180	10–230	15–190	3–180
Wayne	800–1,150	50– 80	50–250	20–300	50–240	25–150	25– 70

ILLINOIS.

Little can be added to what has already been said in previous reports concerning the gas-producing fields of Illinois, which remained the same in 1912 as in 1911. The wells which produce gas commercially in this State are located in Bond, Clark, Crawford, Lawrence, Cumberland, McLean, and Macoupin counties. The figures given in this report show that the larger portion of the gas consumed in the State is utilized for power purposes and mostly for drilling and operating in the oil and gas fields. As this gas is not measured and as prices are charged as in oil fields in other States at so much per day for each gas engine operated or to contractors at so much per day for gas used for drilling, it is readily seen that only approximate figures of the quantity of gas consumed can be given.

The total quantity and value of the gas consumed in this State for domestic purposes in 1912 was 1,236,162,000 cubic feet, valued at $291,987, an average price of 23.62 cents per thousand cubic feet. As against 1911, the quantity of gas consumed has declined, while the price received for the gas has advanced, the average price in 1911 having been 22.85 cents per thousand cubic feet.

The total quantity and value of the gas consumed for industrial purposes in 1912 is estimated at 4,367,206,000 cubic feet, valued at $324,480, an average price of 7.43 cents per thousand cubic feet. As compared with 1911, these figures show a reduction in both total quantity and value, but a slightly higher average price per thousand cubic feet.

The total quantity and value of gas consumed in this State in 1912 was 5,603,368,000 cubic feet, valued at $616,467, an average price of 11 cents per thousand cubic feet, as compared with 6,762,361,000 cubic feet, valued at $687,726, an average price of 10.17 cents, in 1911.

In addition to the commercial gas wells of this State, there are a number of shallow wells located in Bureau, Champaign, Dewitt, Edgar, Lee, Pike, Logan, Morgan, and McHenry counties, which produce scarcely more than enough gas for one family. At the close of 1912 there were 210 of these wells owned by 179 individuals. They furnished gas for 174 domestic consumers and 5 gas engines, the aggregate value of the gas utilized during the year being estimated at $15,492.

There were in Illinois at the close of 1912 a total of 447 productive gas wells, of which 56 were completed in 1912. The number of gas wells abandoned in this State in 1912 was 67.

In this connection it may be of interest to state that during the year 1912 a few plants installed for the purpose of extracting gasoline from "casing-head gas" in the oil fields of this State were in successful operation, the statistics of which will be found in another part of this report.

In the following table is given a record of the natural-gas industry in Illinois from 1906 to 1912, inclusive:

Record of natural-gas industry in Illinois, 1906–1912.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1906	66	$87,211	1,429	2	$87,211	......	......	200
1907	128	143,577	2,126	61	143,577	94	41	283
1908	185	446,077	a 7,377	a 204	a 446,077	121	42	400
1909	194	644,401	a 8,458	a 518	a 644,401	56	11	423
1910	207	613,642	a 10,109	a 261	a 613,642	64	31	458
1911	225	687,726	a 10,078	a 293	a 687,726	69	78	458
1912	223	616,467	a 10,691	a 212	a 616,467	56	147	447

a Includes number of consumers and value of gas consumed in Vincennes, Ind.

In the following table are given the depth and gas pressure of wells in Illinois from 1908 to 1912, inclusive, by counties:

Depth and gas pressure of wells in Illinois, 1908–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1908	1909	1910	1911	1912
Bond Lawrence	900–1,900	500–600	200–580	200–750	100–350	40–410
Bureau	98– 357	0– 30	0– 23	0– 23	0– 42	0– 80
Champaign	80– 140	....	....	15– 32	15– 30	0– 20
Clark	250– 610	65–100	38–100	35– 45	10– 60	15–105
Crawford	500–1,550	25–400	45–275	20–225	10–150	20–200
Cumberland	500– 575	15– 35	40	....	....	....
Dewitt	94– 127	....	....	25– 50	20– 50	0– 50
Edgar	260– 600	....	....	75–127	50– 90	75–130
Lee	126– 280	....	....	18– 28	19– 28	12– 28
Logan	84– 90	....	....	....	....	....
McHenry McLean Macoupin	160– 372	....	....	....	10– 22	....
Morgan	260– 400	....	....	....	0–100	0–100
Pike	96– 350	3– 10	3– 7	4– 10	1– 20	0– 10

KANSAS.

An examination of the following table shows that the total value of natural gas consumed in Kansas continued to increase until the year 1911, when the maximum of $9,493,701 was reached. Although this State occupies third place in the value of gas consumed in the United States in 1912, as in 1911, the report shows a decrease in both quantity and value of gas consumed. This was due not only to decreased production of gas within the State, but to the decrease in quantity of gas piped into the State. Reference to the table showing the production of natural gas in the United States in 1912, by States, will show that the production of natural gas in Kansas declined from 38,799,406,000 cubic feet, valued at $4,854,534, in 1911 to 28,068,370,000 cubic feet, valued at $4,264,706, in 1912, or 10,731,036,000 cubic feet in quantity and $589,828 in value. As has already been stated in previous reports, the States of Kansas and Missouri depend largely upon the gas fields of Oklahoma for their supply of gas. The difference between the quantity and value of gas produced and consumed in Kansas shows the quantity and value of gas piped into the State from Oklahoma. It will be seen from a comparison of figures that the quantity and value of gas piped from Oklahoma in 1911 was 39,061,737,000 cubic feet, valued at $4,639,167, and in 1912 it was 32,249,916,000 cubic feet, valued at $4,257,152, this being the value received for the gas at the point of consumption—a decrease of 6,811,821,000 cubic feet in quantity and of $382,015 in value. The total quantity of gas consumed in Kansas in 1912 was 60,318,286,000 cubic feet, valued at $8,521,858, as compared with 77,861,143,000 cubic feet, valued at $9,493,701 in 1911, a reduction of 17,542,857,000 cubic feet in quantity and of $971,843 in value. The average price received for this gas per thousand cubic feet advanced from 12.19 cents in 1911 to 14.13 cents in 1912.

The table giving the distribution of natural gas consumed in the United States, by States, shows that there was a reduction in quantity and value of gas consumed for both domestic and industrial purposes in Kansas and Missouri in 1912 as against 1911. However, there was a slight gain in the average price received per thousand cubic feet for gas utilized for each purpose.

The quantity and value of gas consumed for domestic purposes in Kansas and Missouri in 1912 was 24,821,582,000 cubic feet, valued at $6,018,363, an average price of 24.25 cents per thousand cubic feet; in 1911 it was 27,688,371,000 cubic feet, valued at $6,317,307, an average price of 22.82 cents per thousand cubic feet.

The quantity and value of the gas consumed for manufacturing and other industrial purposes in these States was 35,496,704,000 cubic feet in 1912, valued at $2,503,495, an average price of 7.05 cents per thousand cubic feet, as compared with 50,172,772,000 cubic feet, valued at $3,176,394, an average price of 6.33 cents per thousand cubic feet in 1911.

The decline of the gas fields of Kansas and the consequent shortage of gas are greatly felt by the operators of cement and zinc plants, who for so many years have been largely supplied with this matchless fuel and are now beginning to look to other sources for a supply of fuel. When the quantity of gas required to operate a cement or zinc plant is taken into consideration, the requirements of these plants in Kansas may be appreciated. Henry P. Westcott says in his Handbook of natural gas:

> The amount of gas required to make one barrel of cement, in plants of more than 1,000 barrels daily capacity, is 3,000 cubic feet. For the burning only of one barrel of cement in kilns, 1,750 cubic feet of gas is required. The amount of gas required in a smelter to burn one block of 640 retorts for 24 hours is between 600,000 and 700,000 cubic feet of gas, dependent on the kind of ore smelted. In plants of three blocks or more, it is generally figured 1,000,000 cubic feet of gas is required for each block, which figures include roasting, pottery, and boiler use.

Both coal and oil are used at cement plants in this State, and it is estimated that a total of 7,140,009,000 cubic feet of gas (produced from wells in Kansas and Oklahoma), valued at $437,042, an average price of 6.12 cents per thousand cubic feet, was also consumed at these cement plants in 1912. This is a considerable reduction as compared with 1911, when it was estimated that the consumption of gas at these plants was 13,272,417,000 cubic feet, valued at $729,911, an average price of 5.5 cents per thousand cubic feet. The names of operators of cement plants at which gas was used in 1912 are as follows: Ash Grove Lime & Portland Cement Co., Chanute Cement Co., Iola Portland Cement Co., Lumbermen's Cement & Brick Co., United Kansas Portland Cement Co., and Western States Portland Cement Co. Some of these plants are being remodeled for the installation of coal-burning systems.

It is estimated that zinc smelters in Kansas consumed a total of 12,474,938,000 cubic feet of gas in 1912, valued at $666,892, an average price of 5.35 cents per thousand cubic feet, as compared with 13,186,505,000 cubic feet, valued at $543,301, an average price of 4.12 cents per thousand cubic feet in 1911. These plants received a large portion of their supply from the Oklahoma gas fields. The following-named operators were using gas at their plants in 1912: American Zinc, Lead & Smelting Co., Chanute Zinc Co., Edgar Zinc Co., Granby Mining & Smelting Co., Kansas Zinc Co., Prime Western Spelter Co., United Zinc & Chemical Co.

Natural gas is also largely used in Kansas for the manufacture of brick and glass. It is estimated that the total consumption of gas for brick manufacture in 1912 was 2,768,874,000 cubic feet, valued at $171,644, and that glass plants consumed 922,142,000 cubic feet, valued at $57,047.

Drilling was very active in Kansas in 1912. During the year 635 wells were completed, of which 435 were gas producers, the total number of productive gas wells at the close of the year being 2,064. The number of gas wells abandoned in 1912 was 404. A small gas field was discovered in Ellsworth County in 1912. In the town of Ellsworth, or within a mile of this town, about 10 wells were drilled, 4 of which were productive at the close of the year. These wells range in depth from 950 to 1,130 feet and from 80,000 to 120,000 cubic feet in capacity.

Several very good gas wells were developed in 1912 in Montgomery and Wilson counties, the pressure ranging from 95 to 380 pounds. A pipe line is being laid to the Bolton field, Montgomery County, which will supply gas to factories in Independence.

In the following table is given a record of the natural-gas industry in Kansas from 1897 to 1912, inclusive:

Record of natural-gas industry in Kansas, 1897–1912.

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	79.270	990	[b]4,023,566	331	99	1,495
1907	196	6,198,583	149,327	1,605	[b]6,208,862	361	163	1,760
1908	212	7,691,587	168,855	1,162	[b]7,691,587	403	208	1,917
1909	199	8,293,846	182,657	1,160	[b]8,356,076	452	214	2,138
1910	204	7,755,367	186,333	1,412	[c]9,335,027	392	195	2,149
1911	232	4,854,534	199,523	907	[c]9,493,701	301	152	2,033
1912	253	4,264,706	195,446	1,104	[c]8,521,858	435	200	2,064

[a] Number of fires supplied.
[b] Includes gas taken from Kansas and consumed in Missouri.
[c] Includes gas taken from Kansas to Missouri; also gas piped from Oklahoma to Kansas and Missouri.

In the following table are given the depth and gas pressure of wells in Kansas from 1907 to 1912, inclusive, by counties:

Depth and gas pressure of wells in Kansas, 1907–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.					
		1907	1908	1909	1910	1911	1912
Allen	600–1,300	10–300	5–300	5–300	15–350	5–351	10–300
Anderson	230–770	43–200	65–237	65–200	40–150	60–225	30–240
Bourbon	200–710	50	50	75	35–45	40	40
Chase	80–1,100	48–100	6–150	17–300	10–350	1–400	7–80
Crawford Cowley	150–1,500	25–150	20–26	55–80	4–65	20–40	15–50
Chautauqua	300–1,300	50–280	50–260	60–500	40–500	25–250	50–300
Douglas Johnson	130–870	60–230	5–170	40–180	10–100	30–120	10–280
Ellsworth	950–1,130						125–270
Elk	500–1,400	10–300	100–215	40–200	100–225	100–225	100
Butler Greenwood Woodson	350–1,485	75–450	40–640	40–500	40–550	65–450	60–[a]525
Labette	350–1,000	80–200	80–208	60–125	50–160	25–235	23–185
Linn	85–750	9–175	10–175	10–150	12–130	22–110	6–70
Franklin Miami	160–865	20–225	20–260	20–200	75–210	50–220	3–260
Montgomery	258–1,600	25–530	40–530	10–350	3–295	5–350	2–[a]515
Neosho	490–1,200	40–225	50–250	25–350	35–300	20–287	28–250
Wilson	250–1,300	70–395	50–395	25–400	12–400	20–380	15–380
Wyandotte	271–700	175	160–198	150–250	50–200	40–250	40–125

[a] New wells.

MISSOURI.

The natural-gas industry in Missouri was practically the same in 1912 as in 1911. It is of little importance, the wells from which the gas is produced being shallow and small in volume. They range in depth from about 100 to 550 feet. The gas is produced from wells in Bates, Cass, and Jackson counties. The only towns supplied with gas from wells within the State are Rich Hill, Belton, and Martin City. Much of the gas produced is consumed for domestic purposes by the owners of the wells upon whose lands they are located.

Most of the gas produced in this State in 1912 was consumed for domestic purposes, the number of consumers supplied being 500. A small quantity of gas was used for power in the operation of engines. The total value of gas produced in Missouri and consumed in 1912 was $11,576, as compared with $10,496 in 1911.

The number of gas wells in this State at the close of 1912 was 63. During the year 7 gas wells and 3 dry holes were drilled and 6 gas wells were abandoned.

OKLAHOMA.

The year 1912 was the most prosperous in the history of the natural-gas industry in Oklahoma. The frequent advances in the price of crude petroleum, which began at the close of 1911 and continued throughout 1912, gave an impetus to drilling not before experienced in this State and resulted in the extension of oil territory and the discovery of some gas pools of considerable importance. In the opening of the Cushing oil field, in Creek County, several good gas wells, with a rock pressure varying from 250 to 850 pounds, were completed. The towns of Mounds and Sapulpa are being supplied with gas from the wells in Creek County. Several gas wells were completed in Kay County, which will add to the supply of gas to consumers in Blackwell, Braman, Ponca City, and vicinity, which are supplied from this field. A few good gas wells were completed in Marshall and McIntosh counties in 1912, but for want of a market have been closed in. A new gas field was developed in Stephens County, the gas from which will be piped to supply consumers in Duncan and Marlow. Osage and Pawnee counties report a number of gas completions. Henryetta, Coalton, Dewar, Beggs, Okmulgee, and Morris are supplied with gas from the Okmulgee County gas fields. A large proportion of the gas produced from wells in Nowata and Washington counties is piped to Kansas and Missouri. Other gas-producing counties are Rogers, Tulsa, and Wagoner, all of which contributed to increase the supply of gas produced in 1912.

The total production of gas in Oklahoma in 1912 was 73,799,319,000 cubic feet, valued at $7,406,528, or 10.04 cents per thousand cubic feet, as compared with 67,275,608,000 cubic feet, valued at $6,731,770, or 10.01 cents per thousand cubic feet, in 1911.

The report shows not only an increase in the quantity and value of the gas produced, but a considerable increase in the quantity and value of gas consumed within the State. The total value of gas consumed in Oklahoma in 1912 was 41,549,403,000 cubic feet, valued at $3,149,376, or 7.58 cents per thousand cubic feet, as compared with 28,213,871,000 cubic feet, valued at $2,092,603, or 7.42 cents per thousand cubic feet, in 1911.

It will be seen that less gas was exported to Kansas and Missouri in 1912 than in 1911, showing conclusively the increasing market for the gas at home. As large quantities of gas are consumed in this State for both domestic and industrial purposes at a flat rate, no meters being used, it is impossible to give, except approximately, the quantity of gas consumed. A glance at the following table shows that the number of domestic consumers increased from 44,854 in 1911 to 47,017 in 1912, and that the gain in quantity and value of gas consumed for domestic purposes increased from 5,816,723,000 cubic feet, valued at $981,976 in 1911, to 6,500,062,000 cubic feet, valued at $1,288,894, in 1912.

The estimated quantity and value of the gas consumed for manufacturing purposes in Oklahoma in 1912 was 20,915,974,000 cubic feet, valued at $954,498, or 4.56 cents per thousand cubic feet. This gas was consumed in large quantities for zinc smelting, for cement manufacture, for burning brick, and for the manufacture of carbon black. The quantity and value of the gas consumed for other industrial purposes in 1912, including that used for power, for the operation of gas engines, and for fuel under boilers, in the oil fields and elsewhere, was estimated at 14,133,367,000 cubic feet, valued at $905,984, or 6.41 cents per thousand cubic feet.

The total estimated quantity and value of gas consumed in Oklahoma for industrial purposes was 35,049,341,000 cubic feet, valued at $1,860,482, in 1912, as compared with 22,397,148,000 cubic feet, valued at $1,110,627, in 1911.

Much of the gas produced from the oil wells of Oklahoma, for which there is no use or sale, is wasted. In the counties of Creek, Nowata, Muskogee, and Washington, where this "casing-head" gas is found rich in gasoline, several plants have been installed for the extraction of gasoline from the surplus gas from the oil wells. This has become quite an industry, there being a ready sale for the product. At the close of 1912 there were 12 gasoline plants in operation, as compared with 9 at the close of 1911. The statistics of this industry will be found in another part of this report.

The total number of wells completed by gas producers in the State of Oklahoma in 1912 was 526, of which 329 were productive and 197 were dry holes. The number of gas wells abandoned in 1912 was 191. The number of productive gas wells in this State at the close of 1912 was 870.

In the following table is given a record of the natural-gas industry in Oklahoma from 1906 to 1912, inclusive:

Record of natural-gas industry in Oklahoma, 1906–1912.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers.		Value.	Drilled.		Productive Dec. 31.
			Domestic.	Industrial.		Gas.	Dry.	
1906	50	$259,862	8,391	202	$247,282	81	33	239
1907	107	417,221	11,038	277	406,942	99	41	344
1908	115	860,159	17,567	356	860,159	73	40	374
1909	131	1,806,193	32,907	1,527	1,743,963	97	35	454
1910	168	3,490,704	38,617	1,557	1,911,044	93	58	509
1911	204	6,731,770	44,854	1,507	2,092,603	303	143	732
1912	242	7,406,528	47,017	1,651	3,149,376	329	197	870

In the following table are given the depth and pressure of gas wells in Oklahoma from 1908 to 1912, inclusive, by counties:

Depth and gas pressure of wells in Oklahoma, 1908–1912, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1908	1909	1910	1911	1912
Hughes	1,000–1,900	....	....	....	....	200
Carter	590–1,840					
Cherokee	600– 650	190–200	50–350	60–100	48–150	....
Comanche	380– 400					
Craig	500					
Latimer	1,575	....	....	....	40–470	....
Sequoyah	1,200					
Creek	400–2,500	60–900	50–900	40–450	20–700	40–850
Kay	436–1,530	75–481	60–385	60–375	40–390	165–365
Kiowa	350– 825	50–150	....	35	10– 50	....
Le Flore	1,300–2,200	....	....	350	300–355	350–355
McIntosh	1,300–1,900	....	....	....	....	150–600
Marshall	525					
Muskogee	1,000–1,910	470–650	130–160	50–500	18–225	15–350
Nowata	450–1,700	100–450	120–500	70–100	60–450	25–150
Okmulgee	760–2,600	300–800	150–700	150–800	100–700	300
Osage	900–2,010	300–850	300–850	200–650	150–650	200–780
Pawnee	1,200–2,560	200–400	160–260	150–200	200–450	40–800
Rogers	380–1,250	110–320	50–550	125–530	90–480	40–525
Stephens	850– 885	....	....	....	....	300–325
Tulsa	580–2,000	50–700	50–700	50–650	80–400	50–625
Wagoner	750–1,700	350–600	210–600	90–120	100–300	....
Washington	425–2,260	40–700	60–800	80–740	15–620	10–250

LOUISIANA.

Louisiana is conceded to contain the greatest gas fields yet discovered in this country, the chief natural-gas field being located in Caddo Parish. The report shows a marked increase in the quantity and value of gas produced from wells in this State and consumed in 1912, the increase in the value of the product being more than double that of 1911. In the early months of the year drilling was not very active, but upon the completion by the city of Shreveport of a gas well within the city limits, considerable excitement was created. Development work began and continued throughout the year, and it is estimated that during the months of November and December, 1912, and January, 1913, not less than 120,000,000 cubic feet of new gas was brought in.

The city of Shreveport, which owns 100 acres of land used for fairgrounds, drilled its first well for salt water to supply a natatorium, when gas was found with a pressure of 450 pounds. This well got beyond control and was "killed" and abandoned. Another well was drilled, this time with a view to getting gas and not salt water. This well proved a success. It has a depth of about 1,000 feet and a capacity of 1,500,000 to 2,000,000 cubic feet of gas daily. The well is closed in except when being used during the annual fair to illuminate the fair grounds and for pumping water to supply the grounds. The Purified Petroleum Products Co. completed a gas well about 3 miles north of the city of Shreveport. Other companies which completed good wells were: Shreveport Ice & Brewing Co., Shreveport Natural Gas Co., Commercial Gas & Oil Co., Cross Lake Oil & Gas Co., and McCann & Harper.

The principal gas producers supplying consumers with gas drawn from wells in Caddo Parish are the Arkansas Natural Gas Co. and the Southwestern Gas & Electric Co. The last-named company succeeded to the business of the Shreveport Gas, Electric Light & Power Co. and the Caddo Gas & Oil Co. in the latter part of 1912. The Arkansas Natural Gas Co. has extended its pipe lines farther into Arkansas, and at the close of 1912 was supplying gas to the following-named cities and towns in that State: Hope, Garland, Emmet, Prescott, Boughton, Beirne, Gurdon, Arkadelphia, Gum Springs, Malvern, Donaldson, Gifford, Perla, Beaton, Bauxite, Mabelvale, Bryant, Sheridan, Pine Bluff, Little Rock, Argenta, Pulaski Heights, and Hot Springs. The following-named cities and towns were supplied with gas from wells in the Caddo field by the Southwestern Gas & Electric Co. and other gas companies in 1912: Mooringsport, Blanchard, Caddo, Rodesso, Oil City, Vivian, Bloomburg, Hosston, Ida, Dixie, Belcher, and Shreveport, in Louisiana; Atlanta, Queen City, Marshall, Texarkana, and Cass, in Texas; Ravana and Texarkana, in Arkansas.

It is believed that more gas is wasted in the oil and gas fields of Louisiana than in any other State. It is reported that the pressure of shallow wells in the field about Shreveport is steadily diminishing, although the pressure is very strong in the wells in Shreveport. The rock pressure of certain wells in August, 1912, was 150 pounds and by February, 1913, it had declined to 110 pounds. The exhaustion of the Vivian-Hosston gas field—depth of wells from 900 to 1,060 feet—has been going on for the last three years. The volume or capacity of wells when first drilled was from 40,000,000 to 75,000,000 cubic feet and now it is almost gone; the rock pressure of the wells when first drilled was 465 pounds, now it is about 88 pounds. Gas has been wasted through little oil wells.

Another field in Louisiana which has producing gas wells is located in De Soto Parish, from which the town of Mansfield is supplied, the wells showing no decrease in pressure up to the present time. In Lafourche Parish are a few small gas wells whose product is used to operate gas engines. Efforts were made to develop an oil or gas field in Rapides Parish in 1912. One well is now drilling at a depth of 1,200 feet. Another well drilled for oil or gas was stopped when salt water was reached at a depth of 2,700 feet. In pumping the salt water sufficient gas is obtained to run all pumps required to pump fresh and salt water for a natatorium located at the well. One well was drilled in Terrebonne Parish to a depth of 1,768 feet with a probable rock pressure of 650 pounds and initial open flow capacity of 1,800,000 cubic feet. Gas was used under a drilling boiler and became exhausted after about three weeks' use.

The total value of the gas produced in Louisiana and Alabama in 1912 was $1,747,379, as compared with $858,145 in 1911. The total value of gas supplied for domestic purposes was $805,265 and for industrial purposes $942,114. Gas supplied for industrial or power purposes was used for glass manufacture, at oil refineries, breweries, ice plants, cotton gins, and for drilling and operating in the oil and gas fields.

During 1912 a total of 50 gas wells and 20 dry holes were drilled in Louisiana. The number of gas wells abandoned was 11 and the number of productive gas wells at the close of the year was 155.

TEXAS.

The year 1912 was the best in the history of the natural-gas industry of Texas and the Clay County field was the greatest source of gas supply, the Lone Star Gas Co. being the principal producer. This company does not distribute gas to consumers direct, but supplies its gas to the North Texas Gas Co., the Fort Worth Gas Co., the Dallas Gas Co., and the County Gas Co., which supply consumers. The following-named places were supplied with gas from the Clay County gas field in 1912: Alvord, Arlington, Bellevue, Bowie, Bridgeport, Byers, Dallas, Dalworth, Decatur, Denton, Eagle Ford, Fort Worth, Grand Prairie, Henrietta, Irving, Petrolia, Rhome, Sunset, Wichita Falls.

During 1912 a total of 13 wells were drilled in Clay County, of which 8 were gas producers, the number of gas wells at the close of the year being 29. Although stray gas sands are occasionally struck at 1,250 to 1,500 feet, the best wells in this field range from 1,550 to 1,750 feet. The pressure varies from 600 to 742 pounds, the highest original rock pressure of wells in this field. The average pressure on January 1, 1912, was 659 pounds and on December 31, 1912, it was 626 pounds. One well in this field not in use during 1912 never fell below 730 pounds and for five months stood at 740 pounds. A test of gas from a number of wells in the field made by S. H. Worrell, chemist for the Bureau of Economic Geology and Technology, University of Texas, shows 700 British thermal units.

Second in importance to the Clay County gas field is the gas field in Webb County, from whose wells gas is being supplied to consumers in the town of Laredo by the Border Gas Co., which receives its supply from the Producers Oil Co. Another gas field of importance is found in Shackelford County, from whose wells gas is being supplied to consumers in the town of Moran by the Pioneer Natural Gas Co., and to the town of Albany by the Albany Natural Gas Co., both of these companies receiving their supply of gas from the Texas Co. operating in this field.

Other fields in which developments were in progress in 1912 are as follows: In Angelina County a well was drilled to a depth of 312 feet, with a showing of oil and gas; work was discontinued and the well not finished. On Holloway Mountain, Brown County, a gas well was drilled to a depth of 306 feet, which furnished more than enough gas to operate an engine; another well drilled in this locality to a depth of 310 feet also furnished gas to run an engine. Two gas wells were drilled in Wichita County, gas being used for field purposes. In Gonzales County a gas well was completed at 468 feet, with 150 pounds pressure, product to be used in field work. There has been completed in Limestone County three good, dry gas wells, having an estimated combined capacity of 40,000,000 cubic feet. In prospecting for oil in Maverick County considerable gas was found in one well at depths of 725, 975, and 1,041 feet; in a second well only one gas stratum, at 941 feet, was discovered, this well not being drilled deeper. The first well at a depth of 725 feet has about 50 pounds pressure, and gas has been used from it for drilling. Two wells were drilling in McCulloch County at the close of 1912; four wells completed in this county in 1912 were abandoned. In Falls County an experimental well was drilled to a depth of 760 feet, with considerable showing of oil and gas; at a depth of about 160 feet it caved and shut out prospective findings. Coleman County was a field of activity in 1912, but up to the close of the year only two gas wells had been completed, the product of which was used for fuel in the field.

Considerable gas produced in the oil fields of Navarro and Harris counties is consumed for field purposes. Consumers in Corsicana are supplied with gas from Navarro County wells.

In Atascosa County several artesian wells have been drilled, which produce a small quantity of gas with the water. From a few of these wells gas is being used by the owners of the wells for illumination and heat.

The total quantity of gas produced from wells in Texas in 1912 amounted to 7,470,373,000 cubic feet, valued at $1,405,077, an average price of 18.81 cents, as compared with 5,503,393,000 cubic feet, valued at $1,014,945, an average price of 18.44 cents, in 1911. This is a gain in value of $390,132. The greater portion of the value for 1912 was received for gas supplied for domestic purposes, which aggregated $906,412, or nearly double the value of the gas consumed for manufacturing and power purposes, which was $498,665. Some gas is used in Texas for brick manufacture. For power purposes it is utilized in operating gas engines and boilers at waterworks, ice plants, cotton gins, and also largely in field work.

The total number of gas wells in this State was 87 at the close of 1912, of which 24 were drilled in 1912. The number of dry holes drilled was 23, and the number of gas wells abandoned was 6.

In the following table is given a record of the natural-gas industry in Texas from 1909 to 1912, inclusive:

Record of natural-gas industry in Texas, 1909–1912.

Year.	Number of producers.	Number of consumers.		Total value of gas produced.	Wells.		
					Drilled.		Productive Dec. 31.
		Domestic.	Industrial.		Gas.	Dry.	
1909	17	2,322	52	$127,008	7	6	38
1910	19	14,719	133	447,275	22	5	52
1911	29	22,972	303	1,014,945	19	14	69
1912	41	27,226	329	1,405,077	24	23	87

CALIFORNIA.

The year 1912 was the greatest in the history of the natural-gas industry of California. The estimated value of the gas consumed in 1912 was $1,134,456, as compared with $800,714 in 1911, an increase of $333,742. This increase was not brought about by the discovery of new fields, but by an increased production and consumption of gas from districts already reported, particularly the Midway field, which came into prominence as a gas producer in 1910–11, and which is the most important and productive gas field in California at the present time. It is located in Kern County, the source of production being the Buena Vista Hills, near Taft. Large volumes of gas accompany the oil gushers in this field, and several wells are exclusively gas producers. Some of these wells have a capacity of 50,000,000 cubic feet or more per day. Although natural gas has been produced and utilized for many years in California, it was not until the opening of this field in 1910 that this State began to assume importance as a gas producer. The field is now well developed and gives promise of an ample supply of gas. Believing this supply sufficient to justify the expenditure of building a pipe line from this field to Los Angeles to suppy gas to consumers in that and other towns in southern California, the Midway Gas Co. began in April, 1912, the construction of such a line.

The Midway Gas Co. has its initial station in sec. 8, T. 32 S., R. 24 E., Mount Diablo base and meridian, in Kern County. The pipe line extends southeasterly in a direct line to Tejon Pass; thence southerly through Tejon Pass and Antelope Valley to the junction of Castaic and Santa Clara rivers, in Ventura County; thence easterly to Newhall; and thence southeasterly, following the public highway, paralleling the Southern Pacific Railroad to San Fernando; thence along the public highway, still paralleling the Southern Pacific Railroad, to Burbank, Glendale, and Los Angeles. The line has been extended through Los Angeles by the way of Inglewood and Hawthorne to the coast. This pipe line is about 117 miles long, consisting of 12-inch plain end pipe, and is jointed by the Hammond coupler. An initial pressure of 450 pounds per square inch and a delivery pressure of 30 pounds should give a capacity of 24,000,000 cubic feet of gas per day rated on a 4-ounce base. The average consumption of Los Angeles is approximately 17,000,000 cubic feet of gas a day, though the peak load for 1912 was 36,000,000 cubic feet. To enable the present natural-gas system to take care of this peak load the Midway Gas Co. is installing a compressor plant in the Midway district. This will be ready for operation in the latter part of 1913. Up to the present time (August, 1913) gas has not been distributed in the city of Los Angeles except in small quantities for fuel in the gas works, but it is reported that small quantities of gas are being used in some of the beach towns for domestic purposes and also for manufacturing and power plants.

The building of this pipe line to conserve and supply natural gas to consumers in southern California has been undertaken under great difficulties and at enormous expense. The enterprise ought to be appreciated by the consumers to the fullest extent.

There were at the close of 1912 a total of 15 gas wells in the Midway gas field, 4 of which were completed during the year, and 3 wells were in process of drilling. These wells have a rock pressure of 65 to 960 pounds and a depth of 1,600 to 2,600 feet.

The gas wells in this field are controlled by the Standard Oil Co. and the Honolulu Consolidated Oil Co., the product of the wells in 1912 being sold to the California Natural Gas Co., which supplies gas to consumers for industrial or power purposes and to domestic consumers in Bakersfield, Taft, Maricopa, and Fellows through distributing companies.

Reference to the table giving the distribution of gas consumed in the United States by States in 1912 will show that the number of domestic consumers supplied in California was 18,171, as compared with 10,598 in 1911, and that the quantity and value of the gas consumed for domestic purposes increased from 543,392,000 cubic feet, valued at $317,467, in 1911, to 974,796,000 cubic feet, valued at $525,428, in 1912. This gas was supplied to domestic consumers in the following-named towns: Bakersfield, Taft, Fellows, Maricopa, Sacramento, Stockton, Santa Maria, Guadalupe, Betteravia, Suisun City, Fairfield, Cement, Oxnard, Ventura, and Santa Paula.

Large quantities of gas are consumed in the oil fields of this State for drilling and operating, and gas consumed for these purposes can only be estimated. From returns received it is estimated that the total quantity and value of the gas consumed in California for power purposes was 8,379,632,000 cubic feet, valued at $609,028, an average price of 7.27 cents per thousand cubic feet.

A considerable quantity of gas produced from the oil wells of this State goes to waste annually, there being no means of disposing of it. Much of this gas is very rich in gasoline, and during 1912 several plants for the extraction of gasoline from natural gas were erected and were in successful operation, the statistics of which will be found in another part of this report.

The number of gas wells in this State at the close of 1912 was 71, as compared with 66 at the beginning of the year, 6 productive wells and 1 dry hole having been completed and 1 gas well abandoned during the year.

ARKANSAS.

The natural-gas industry in Arkansas has changed but little since the last report. As compared with 1911 there has been an increase in the quantity and value of the gas supplied for domestic purposes, and the industrial consumption has fallen off slightly. A considerable quantity of gas is consumed for brick manufacture. The number of domestic consumers increased from 5,008 in 1911 to 5,530 in 1912. The towns supplied in 1912 with gas produced in Arkansas were Fort Smith, Van Buren, Mansfield, and Huntington.

The natural-gas field is located in Sebastian and Scott counties, where 97 gas wells had been completed up to the close of the year, 2 of which were drilled in 1912. It is reported that the gas wells show a slow, gradual reduction in rock pressure, but some of them hold their pressure remarkably well. The rock pressure of a few wells which have been in active service since 1902 have a pressure of 100 to 210 pounds, while other wells which had an average initial rock pressure of 210 pounds now have an average pressure of 55 pounds. Gas in the field is produced from the gas-bearing sand which is found between 1,200 and 1,400 feet and between 2,000 and 2,400 feet. The gas is clean and dry.

The statistics of the natural-gas industry of Arkansas are included with those of Colorado and Wyoming.

The report on the natural-gas industry in Louisiana shows that many cities and towns in Arkansas are supplied with gas from the Caddo field, the quantity and value of this gas consumption being included with the statistics of Louisiana.

COLORADO.

The principal gas-producing field of Colorado is located near Boulder, in Boulder County. Consumers in the town of Boulder are supplied with gas from a gas well in this field. The oil wells in the

Boulder oil field produce considerable gas which is used for field purposes. Excess gas from wells in this field, which is very rich in gasoline, is used for the production of gasoline, the statistics of which will be found in another part of this report. Gas from oil wells in the Florence oil field, Fremont County, is also used for field purposes by the operators. Gas from 2 wells in Las Animas County and from 1 well in Mesa County is consumed for domestic purposes by the owners of the ranches on which they are located.

On the ranch of Alfons Myers, 1 mile from De Beque, Mesa County, where an effort is being made to develop an oil field, a well was struck while drilling for oil, which at a depth of 1,535 feet produces a very strong flow of gas and water, which spouts to a height of 150 to 200 feet at intervals of 74 hours for 6 or 7 hours. During these intervals it spouts every 28 minutes to a height of 30 to 40 feet. The gas burns all through the water to a height of 300 feet sometimes, and at night presents a rare and beautiful spectacle. Owing to the enormous pressure of the gas no attempt has been made to control this well. A small quantity of gas flows from most of the few small oil wells in this field, from one of which it is used for illumination and as a domestic fuel.

During 1912 a total of 1,211 domestic consumers were supplied with gas from wells in this State as compared with 1,107 in 1911. The number of gas wells at the close of 1912 was 8.

The statistics of the natural-gas industry in Colorado are included with those of Arkansas and Wyoming.

IOWA.

The gas production of Iowa, which came from four shallow wells in Louisa County, is very insignificant, gas produced from two wells being sufficient only for cooking and illumination in one farmhouse, and two houses being supplied with gas from two other wells for illumination only. The total value of the gas consumed in 1912 was placed at $120.

In Guthrie County a showing of gas has been found in two wells at a depth of 75 feet and 125 feet, respectively.

MICHIGAN.

The natural-gas industry of Michigan is of little importance. Thus far no deep dry gas wells have been drilled. The gas consumed in 1912 came mostly from very shallow wells, not exceeding 220 feet in depth, which produced both water and gas. Enough gas is collected from most of the wells to supply one family with fuel. A small quantity of gas is used from the oil wells of this State for field purposes. The gas consumed in 1912 was produced in the following named counties: Benzie, Macomb, Oakland, St. Clair, Saginaw, Washtenaw, and Wayne.

The total value of the gas consumed in 1912 was estimated at $1,470. The number of wells from which gas was produced at the close of 1912 was 17.

NORTH DAKOTA.

The condition of the natural-gas industry in North Dakota in 1912 was practically the same as in 1911, no gas wells having been reported as drilled during the year. The only towns in which consumers have been supplied with gas in this State are Lansford and Westhope, the source of supply being from wells in Bottineau County. In Lamoure County a few families were using gas which was produced from artesian wells. A small quantity of gas was being utilized for domestic purposes from three wells in Renville County.

The statistics of natural gas consumption in this State are included with those of South Dakota.

SOUTH DAKOTA.

The natural-gas industry of South Dakota is confined to the counties of Hughes, Lyman, Stanley, Sully, Potter, and Walworth, where the gas is produced entirely from artesian wells. During 1912 sufficient gas was obtained from these wells to supply 403 domestic and 3 industrial consumers. The city of Pierre supplied gas for domestic purposes, and also consumed gas for power at the electric light and water plants of the city. Fort Pierre also supplied gas for domestic use and power for its waterworks. Gas is used for domestic and other purposes by the owners of ranches on which the wells are located.

An interesting use for gas in this State is to aid in irrigation. At the United States Indian School, near Pierre, there is an artesian well that produces a large flow of water and natural gas. It was proposed to utilize the flow from this well for irrigating the gardens and fields attached to the school; a pumping plant was installed, and this plant is operated by a gas engine, which is supplied with gas furnished by the artesian well.

The number of artesian wells in this State from which gas was used at the close of 1912 was 35. From reports received the pressure of gas from these wells is not generally very strong, say from 30 to 60 pounds. During the year 1912 two wells were abandoned.

The total value of the natural gas consumed in South Dakota in 1912 was greater than that of 1911.

The statistics of the natural-gas industry in South Dakota are included with those of North Dakota, the combined value of the gas consumed in these States in 1912 exceeding that of 1911.

WYOMING.

Wyoming is not only increasing its production of oil but also of gas. The most important gas field is located in Bighorn County, where in 1911 a gas well with a present estimated daily capacity of 7,000,000 cubic feet and rock pressure of 655 pounds was drilled at a depth of 1,575 feet. It is interesting to note that gas from this well was supplied to domestic consumers in the town of Byron about December of 1912, the town owning the distributing line. Gas from this well is also used for field work. It is said the gas pressure of this well is increasing. Another well is in process of drilling in the same field. Gas from other wells in the same county is being supplied to consumers in the towns of Basin and Graybull.

In Converse County are located a few gas wells from which a small quantity of gas was used in 1912. In Uinta County gas from oil wells is consumed for field work. The number of gas wells in this

State at close of 1912 was 24. The statistics of the natural-gas industry in Wyoming are included with those of Arkansas and Colorado.

IMPORTS.

The imports of natural gas for consumption during the last six years have been as follows:

Value of natural gas imported for consumption, 1907–1912.

1907	$32,107	1910	None reported.
1908	22,003	1911	Do.
1909	6,060	1912	Do.

No exports of natural gas from 1907 to 1912 inclusive were reported.

NATURAL GAS IN FOREIGN COUNTRIES.

CANADA.

The preliminary report on the mineral production of Canada for 1912, published by the department of mines, states:

While the production of petroleum has been declining, the output and use of natural gas has been steadily increasing. The southern portion of Ontario has for many years been the principal source of gas, but the Albert County field in New Brunswick is now an important producer, while large developments are taking place in Alberta with such a rapid increase in output of gas that this Province may soon take first place as a producer.

The total production of natural gas in Canada in 1912 was approximately 15,286,803,000 cubic feet, valued at $2,362,700, and includes 12,529,463,000 cubic feet in Ontario, valued at $2,036,245, and 2,583,437,000 cubic feet in Alberta, valued at $289,906. New Brunswick production was 173,903,000 cubic feet. The production in 1911 was reported at 11,644,000,000 cubic feet, valued at $1,917,678, including 10,864,000,000 cubic feet in Ontario, valued at $1,807,513, and 780,000,000 cubic feet in Alberta, valued at $110,165. These values represent as closely as can be ascertained the value received by the owners or operators of the wells for gas produced and sold or used. The values do not represent what consumers have to pay, since in many cases the gas is resold once or twice by pipe-line companies before reaching the consumer.

The following table gives the value of natural gas produced in Canada each year since 1902, by Provinces:

Value of natural gas produced in Canada, by Provinces, 1902–1912.

Year.	Alberta.	Ontario.	Total Canada.
1902		$195,992	$195,992
1903	[a] $5,675	196,535	202,210
1904	[a] 74,852	253,524	328,376
1905	[a] 63,085	316,476	379,561
1906	[a] 50,077	533,446	583,523
1907	[a] 68,533	746,499	815,032
1908	[a] 24,044	988,616	1,012,660
1909	61,722	1,145,307	1,207,029
1910	75,168	1,271,303	1,346,471
1911	110,165	1,807,513	1,917,678
1912	[a] 326,455	2,036,245	2,362,700

[a] Alberta and other.

The following table gives the statistics of natural gas production in the Province of Ontario, Canada, since 1902:

Statistics of natural-gas production in the Province of Ontario, Canada, 1902–1912.

Year.	Wells bored in the year.		Producing wells.	Miles of gas pipe.	Workmen employed.	Gas production.		Wages for labor.
	Productive.	Non-productive.				Quantity. (cubic feet).	Value.	
1902			169	369	107		$195,992	$55,618
1903			210	312	138		196,535	79,945
1904			176	231			253,524	53,674
1905			273	462½	130		316,476	88,865
1906			332	550	108	2,534,200,000	533,446	64,968
1907			582	810	191	4,155,900,000	746,499	110,832
1908			656	850	152	4,483,000,000	988,616	106,786
1909			744	987	171	5,388,000,000	1,145,307	103,672
1910			828	982	186	7,263,427,000	1,271,303	118,785
1911	268	38	1,179	1,296	287	10,863,871,000	1,807,513	183,663
1912	178	41	1,247	1,448	277	12,529,463,000	2,036,245	184,351

GALICIA.

Notable oil-gas strike.—A strike of oil-gas has been made at Kalusz, in east Galicia. At the depth of 600 meters a strong flow of natural gas was encountered, which Dr. Zuber thinks is a favorable indication of deeper-lying oil sand. The Kalusz Petroleum Gesellschaft was founded with Dr. Zuber at the head of it, the object being to deepen the bore hole to 1,000 meters and develop the oil resources, if any. At a depth of 870 meters strong gas was struck. The rush was so violent that the water in the bore hole, sand, and stones were hurled over the derrick top. At first the volume of the gas escaping was measured as 200,000 cubic feet per hour. After some weeks a second gage showed a volume of 160,000 cubic feet per hour. Boring was continued, and at 890 meters a bituminous shale was met with which was recognized as the menilite, so closely associated, as all Galician oil operators are aware, with the petroleum formations of that country. The boring is proceeding.

HOLLAND.

Consul Frank W. Mahin, of Amsterdam, says:

Natural gas exists in various parts of this consular district. In the Vondel Park in Amsterdam it is manifest in bubbles on the small, shallow lakes and in similar places elsewhere, and can be lighted by a certain process, but no practical use is made of it. However, near Alkmaar, northwest of Amsterdam, the gas is abundant enough to be made useful. It appears there on polders (drained marshy land below sea level), and on two of them gas plants have been installed at farmhouses. The installation comprises a well, into which water from the soil filters, with a gas generator placed therein, this extracting the gaseous properties from the water and conducting them to a reservoir containing a supply for the house. The gas thus obtained provides all the wants for cooking, heating, and lighting in the house or any other part of the farmyard. After the plant is once installed, which is at a small expense, the cost is absolutely nothing, and the quality of the gas is said to be particularly good. It is a great convenience and an economical benefit to the farmers using it.

HUNGARY.

An abstract from the Montanistische Rundschau, prepared by Dr. W. Petrascheck, gives the following information concerning the Transsylvanian natural-gas fields of Hungary:

The history of the evolution of the natural-gas industry in Transylvania is briefly as follows: In the course of borings for potassium salts near Kissarmas emanations of methane gas were first met with at a relatively short distance from the surface. In going deeper the odor steadily increased until at a depth of 302 meters violent eruptions were experienced, so that the boring had to be discontinued. Instead of a potash deposit, a gas well had been opened up, which turned out to be one of the most productive in the world. It yielded daily 860,000 cubic meters methane gas of 99 per cent. The Hungarian Government, fully alive to the importance of the discovery, acquired the land on which the well is situated, and having by act of Parliament made a State monopoly of the natural-gas industry, at once took energetic measures for the purpose of developing it as much as possible. A general geological survey of the district was arranged, and, as it was soon recognized that as carriers of gas reservoirs the anticlines are of special importance, it was decided to have the course of the various anticlinal chains in Transylvania explored by a well-equipped staff of geologists and engineers. The report of this survey, in part, was published sometime ago, but many new and important facts have been discovered since then, and the general knowledge of the gas occurrences has been greatly increased. It has now been fully proved that the seat of the gases is in the Miocene salt formation, consisting of the same kind of marl which also carries gases in upper Austria, Galicia, Moravia, and Silesia. The gas collects and accumulates in the anticlines, but the rich gas reservoirs are confined to the cupola-shaped excresences of the anticlinal lines (the domes), while the synclines dipping from the anticlinal axis were, down to a great depth, found to be poor in gas. In their structure the anticlinal folds are similar to those in the Roumanian petroleum zone, while the gas occurrences resemble in all points the gas and oil deposits of Louisiana, United States, except that in the latter country it is chalk and not marl which forms the salt, gas, and oil-carrying domes. If the natural laws governing the Transsylvanian gas deposits had been recognized, the bores could be placed with an almost absolute certainty of striking gas. Up to the present the following important wells have been opened up:

Designation of borehole.	Depth in meters.	Daily yield in cubic meters.
Kissarmas No. II	302	860,000
Kissarmas No. X	68	55,000
Kissarmas No. XI	80	65,000
Kissarmas No. XII	225	204,000
Kissarmas No. XIII	108	70,000
Kissarmas No. XX	119	105,000
	129	160,000
Kissarmas No. XXI	220	76,000
Mediasch	102	18,000
Magyar-Saros	153	196,000
Baaben	140	55,000
Samsond No. XVI	72	6,000
	215	170,000
Kishalus No. XXV	117	86,000

Other bores, part of which are still in course of being sunk, have yielded smaller quantities.

The large total of the daily yield secured up to now assumes even greater importance when it is borne in mind that by sinking the bores to greater depth considerably increased quantities would in the majority of cases be obtained, for the gas occurs in sand strata embedded in marl, and a number of bores, notably Kissarmas II, have proved that often a long series of gas sands extend into a very considerable depth, so that the deeper a bore is carried down the greater will be the number of gas reservoirs tapped by it. Some of the bores enumerated above would have been driven deeper, but it is rather difficult to cut off the gases, which are rising under high pressure, at the right moment. The packers used in the United States for that purpose have not proved suitable in Transylvania, and so long as the gas can neither be promptly turned off nor usefully employed it is, of course, better not to open overmuch of it. Several bores have, therefore, been discontinued as soon as the occurrence of a deposit had been proved. They need only be deepened if more gas should be required.

Of great importance in computing the quantitative strength of the gas reserves available on the Transylvanian fields is the experience gained at Kissarmas. During two years the large well there gave off every day 860,000 cubic meters of gas. Now that the well has been shut in and no gas can escape, the registration manometer shows a constant pressure of 27 atmospheres, which did not change when at a distance of only 600 meters well No. XII, with a daily yield of 204,000 cubic meters, had been opened up. Even at a period when, as a consequence of some seismic disturbances, a violent gas eruption tore up a crater in the near neighborhood of the well, the pressure did not alter. This shows that only the gas sands closely surrounding the well supply it with gas, while all sands outside that comparatively narrow circle are as yet unaffected.

From the geological investigations it appears that the anticlinal line on which Kissarmas is situated extends over a distance of 85 kilometers. On this line the occurrence of several other domes has been proved. In some of them the bores enumerated above have been put down, while others bear conclusive external evidence of the occurrence of gas reservoirs in their interior. By the above-mentioned geological survey it has been proved that in addition to the Kissarmas anticline there are within the Transylvanian gas zone at least 18 more anticlinal folds of similar extent and formation, so that there can be scarcely any reasonable doubt that the country carries a sufficient number of gas reserves to give the natural-gas industry which is now to be developed there a very long life.

In order to make the economic value of these fields more easily appreciable, it may be useful to compare the heating capacity of the Transylvanian gas with that of coal. A cubic meter of the former has a heating value of 8,000 calories. Now, assuming that of the total quantity of gas at present opened up by the bores only 1,500,000 cubic meters were efficient (certainly a conservative estimate), that quantity would in heating value be equal to 184 wagons of coal. That may not be very much, but it must be borne in mind that the heating value of gas can be much more completely and efficiently utilized than that of coal. Furthermore, it must be understood that for the economic future of Hungary the Transylvanian gas fields are of particular value, for Hungary possesses very extensive and quantitatively rich coal fields, but the quality of the product is decidedly inferior. Good gas coal, or coking coal, fit for industrial purposes has not yet been discovered there. A good gas coal gives 35 cubic meters gas per 100 kilograms; 1,500,000 efficient cubic meters of natural gas would, therefore, be equivalent to 428 wagons of gas coal, and the natural gas could, of course, be supplied at a much lower price than coal gas.

The distances between the several fields in Transylvania are not very great, and when one has ceased to yield, a neighboring one might, without difficulty or great expense, be made to serve the same purposes. At present the richest, because the best developed, field is that of Kissarmas. Its distance from Budapest is 450 kilometers—by no means too much for transmission of the gas by a pipe line. No doubt there is a great future before the Transylvanian natural-gas industry.

ITALY.

The Rivista Minerario gives the production and value of natural gas in Italy from 1903 to 1912, as follows:

Production and value of natural gas in Italy, 1903–1912.

Year.	Quantity (cubic meters).	Value.
1903	2,255,596	$15,024
1904	2,551,396	16,715
1905	3,092,000	19,310
1906	5,723,469	32,394
1907	5,710,000	32,279
1908	6,737,500	33,809
1909	8,268,000	42,287
1910	8,840,000	73,301
1911	9,021,000	74,174
1912	(a)	(a)

a Not available.

JAPAN.

The banks of Lake Suwa are said to contain a large amount of natural gas, and the use of this supply for various purposes has been greatly extended with the advance of knowledge among the people there. The present consumers number more than 100, and certain villages there have been developing this industry systematically since 1911 with good results. The present output comes from four wells.

MEXICO.

As stated in the last report, natural gas is found associated with the oil and is being developed to a considerable extent in Mexico. Successful attempts have been made to control and utilize the gas escaping from oil wells. Prof. I. C. White, State geologist of West Virginia, who has returned from Mexico after making an examination of a great oil well near Tampico, says:

> The greatest oil well in the world, struck near Tampico September 17, 1910, besides producing 22,000 barrels of oil daily has also been producing from 10,000,000 to 12,000,000 cubic feet of gas daily. This gas is very poisonous and contains a great deal of hydrogen sulphide and other compounds of sulphur. It is charged so heavily that when the atmospheric pressure is low the gas settles down in the low places and has asphyxiated several people. It has to be handled carefully. This gas has been led up onto a volcanic mound and is being separated from the oil and burned in 12 jets of a million feet each. An effort is now being made to utilize this waste gas, and a pipe line 75 miles in length is being laid from Tampico to the well. The gas will be used in all the pumping stations, and the surplus will be burned in the city of Tampico. A gasoline plant is also being installed. First, the gasoline will be taken off, and then, with pumps and compressing stations, they will drive the gas to Tampico and to their pumping stations along the line, but as the oil is heavy, they can only pump it about 14 miles; they are therefore required to have several pumping stations.

PERU.

The natural resources of Peru have not been thoroughly tested, but it is reported that a few tests for oil and gas have been made in a section of land along the shores of Lake Titicaca, between Peru and Bolivia, where was found oil and a quantity of a noninflammable gas; with the gas was soda water. Above these the oil strata lay. One person writes concerning this field that his company has never drilled to a great depth and that he knows, therefore, but little concerning the gas in the district. Concerning the oil, however, he gives a favorable report, explaining that this oil has a paraffin base and is of good quality.

In the northern fields of Peru, near Payta, a great deal of oil and gas territory has not been opened. So far the fields are very small, and although the wells have some gas there is only gas sufficient for the operation of the leases, such as running gas engines, furnishing lights, and similar small demands.

UNITED KINGDOM.

The annual report of the British home office gives the statistics of the production and value of natural gas in the United Kingdom for the years 1902 to 1912 as follows:

Production and value of natural gas at Heathfield,[a] England, 1902–1912.

Year.	Quantity.	Value.
	Cubic feet.	
1902	150,000	$146
1903	972,460	944
1904	774,800	754
1905	(b)	(c)
1906	(b)	(c)
1907	(b)	(c)
1908	(b)	(c)
1909	236,800	(c)
1910	262,000	(c)
1911	221,400	(c)
1912	(d)	(c)

a Heathfield in Sussex County.
b None reported. The railway station at Heathfield, however, is lighted with it, but the quantity is not ascertained.
c Not stated.
d Not available.

GASOLINE FROM NATURAL GAS.

PRODUCTION.

The methods of extracting gasoline from natural gas are described in this report for the year 1911 and need not be repeated here.

Although gasoline has been produced in a small way in the oil fields of Pennsylvania for as many as 12 years, it was not until within the last few years that steps were taken to produce it on a larger scale by making use of the enormous quantities of waste or "casing-head" gas from the oil wells of the country. The low price of gasoline in the year 1911 was a great hindrance to the progress of this industry, but during the year 1912 the price continued to advance, and it will be seen from this report that the natural-gas gasoline industry is assuming large proportions and is likely to expand until it will become a very important adjunct of the natural-gas business. The use of "casing-head" gas for the production of gasoline is one of the most important means of conserving the natural-gas supplies.

All natural gases are not adapted to the manufacture of gasoline. Some gases are "dry" and contain very little if any gasoline; other or "wet" or "casing-head" gases may not contain sufficient gasoline to make it profitable to use them. A chemical analysis will show the expected yield of gasoline from a particular gas and will determine the probable quantity of gasoline to be obtained from any plant equipment, but the installation of a small experimental plant is a better test. This subject has been fully discussed in reports issued by the Bureau of Mines.

The following tables show that the total number of gasoline plants in operation in the United States increased from 176 in 1911 to 250 in 1912, and that the daily capacity almost doubled. These figures include not only the regularly established compressor plants but also those which use the simple method called the "gas-pump" or vacuum process.

It will be seen that the natural-gas gasoline industry was confined to 8 States[1] in both 1911 and 1912. West Virginia takes first place in the quantity of gasoline produced in 1911 and 1912; Pennsylvania, which was third in 1911, takes second place in 1912; Ohio, although showing considerable gain in 1912 over 1911, drops to third place in 1912; Oklahoma and California are next in order in both years and are followed by Colorado and Illinois, which exchange places in 1912; New York is eighth on the list.

The total production of gasoline from gas in 1912 was 12,081,179 gallons, valued at $1,157,476, as compared with 7,425,839 gallons, valued at $531,704, in 1911. The average price increased from 7.16 cents per gallon in 1911 to 9.6 cents per gallon in 1912, a gain of 2.44 cents per gallon.

The estimated quantity of gas used in the extraction of 12,081,179 gallons of gasoline in 1912 was 4,687,796,329 cubic feet, an average yield of 2.6 gallons of gasoline per thousand cubic feet of gas used.

Various uses are made of the residue or "exhaust" gas, which is the gas left after the gasoline has been extracted. In some places it is sold to gas companies and run through their lines to consumers for domestic and industrial purposes; in other places it is used to drive gas engines and the gasoline plant of the operator; but it is most commonly returned to the original producer for field purposes. In some few places it is entirely wasted.

In the following tables are given statistics of the production of gasoline from natural gas in the United States in the years 1911 and 1912, by States:

Production of gasoline from natural gas in the United States in 1911, by States.

State.	Number of operators.	Plants.		Gasoline produced.			Gas used.		Average yield in gasoline.
		Number.	Daily capacity.	Quantity.	Value.	Price per gallon.	Estimated quantity.	Value.	
			Gallons.	*Gallons.*		*Cents.*	*Cubic feet.*		*Gallons.*
West Virginia	47	72	16,819	3,660,165	$262,661	7.18	1,252,900,600	$76,074	2.92
Ohio	26	39	6,454	1,678,985	118,161	7.04	469,672,000	37,574	3.57
Pennsylvania	43	50	5,669	1,467,043	109,649	7.47	526,152,663	52,615	2.79
Oklahoma	8	8	4,800	388,058	20,975	5.40	144,629,000	4,378	2.68
California, Colorado, Illinois, New York	7	7	3,358	231,588	20,258	8.75	82,343,000	6,320	2.81
Total	131	176	37,100	7,425,839	531,704	7.16	2,475,697,263	176,961	3.00

[1] The only gasoline produced in Kentucky came from natural condensation in the pipes.

Production of gasoline from natural gas in the United States in 1912, by States.

State.	Number of operators.	Plants.		Gasoline produced.			Gas used.		Average yield in gasoline.
		Number in operation.	Daily capacity.	Quantity.	Value.	Price per gallon.	Estimated quantity.	Value.	
			Gallons.	*Gallons.*		*Cents.*	*Cubic feet.*		*Gallons.*
West Virginia....	66	97	22,366	5,318,136	$513,116	9.6	1,972,882,212	$163,749	2.8
Pennsylvania.....	69	83	10,524	2,041,109	217,016	10.6	722,730,117	62,010	2.8
Ohio..............	25	43	7,791	1,718,719	173,421	10.1	576,123,700	46,090	2.98
Oklahoma.........	11	13	11,910	1,575,644	99,626	6.3	701,044,300	24,901	2.25
California.........	7	7	6,669	1,040,695	112,502	10.8	600,743,000	25,573	1.7
Illinois............	4	4							
Colorado..........	2	2	2,008	386,876	41,795	10.8	114,273,000	9,662	3.4
New York.........	1	1							
Kentucky.........	1	(a)							
Total.......	186	250	61,268	12,081,179	1,157,476	9.6	4,687,796,329	331,985	2.6

a Drips.

WEST VIRGINIA.

An examination of the following table shows that the gasoline-producing counties of West Virginia were the same in 1912 as in 1911 and that the greatest number of plants in operation was in Tyler County, with Pleasants next in order, followed by Ritchie, Wood, and Brooke. It is not possible to give the production of gasoline by counties, but Tyler County was the greatest producer in 1912. The "casing head" gases of this State are mostly very rich in gasoline, and as there is an enormous production of gas from the oil wells the probability is that the gasoline production will continue to increase.

In the following table is given the yield of natural gas in gasoline in West Virginia in the years 1911 and 1912, by counties:

Yield of natural gas in gasoline in West Virginia in 1911 and 1912.

County.					Yield of gas in gasoline per thousand cubic feet.		Average gravity of gasoline as produced and before blending.	
Location of plant.	Number of operators.		Number of plants in operation.					
	1911	1912	1911	1912	1911	1912	1911	1912
					Gallons.	*Gallons.*	*° Baumé.*	*° Baumé.*
Brooke..............	4	5	5	7	1.5–8.0	2.0– 4.0	87 –94	85–95
Calhoun.............	1	1	1	1				
Hancock.............	1	2	1	3				
Harrison.............	1	1	2	1	1.0–5.0	0.7– 4.0	83.2–92	82–90
Marion..............	1	1	1	1				
Marshall.............	1	1	1	1				
Pleasants............	10	16	13	18	2.0–2.5	1.0– 4.0	75 –91	70–92
Ritchie..............	5	14	7	14	1.5–4.6	1.0– 4.0	83.2–96	78–96
Tyler................	16	14	34	40	1.5–9.0	1.9–11.0	79 –95	80–92
Wetzel..............	2	2	2	2	1.5–3.0	1.5– 2.75	80 –89	80–88
Wirt.................	1	1	1	1				
Wood................	4	8	4	8	1.0–4.5	2.0– 4.0	87 –89	82–95
Total..........	47	66	72	97	a 2.92	a 2.8	....	....

a Average.

PENNSYLVANIA.

Pennsylvania, which is the pioneer State in the production of natural-gas gasoline, was second in quantity of gasoline produced in 1912, having produced 2,041,109 gallons, or 40,822 barrels of 50 gallons each, as compared with 1,467,043 gallons, or 29,341 barrels, in 1911. The average price received for gasoline in this State increased from 7.47 cents per gallon in 1911 to 10.6 cents in 1912, a gain of 3.13 cents.

The greatest number of plants in operation in 1912 were in Butler and Warren counties, with about the same gasoline production from each county, these two counties producing above three-fifths of the total production of the State in 1912.

The average yield of gasoline per thousand cubic feet of gas used in this State was the same in 1911 and 1912, being 2.8 gallons.

In the following table is given the yield of natural gas in gasoline in Pennsylvania in the years 1911 and 1912, by counties:

Yield of natural gas in gasoline in Pennsylvania in 1911 and 1912.

County.					Yield of gas in gasoline per thousand cubic feet.		Average gravity of gasoline as produced and before blending.	
Location of plant.	Number of operators.		Number of plants in operation.					
	1911	1912	1911	1912	1911	1912	1911	1912
					Gallons.	*Gallons.*	*° Baumé.*	*° Baumé.*
Allegheny	2	4	4	9	2.4-6.0	1.5-6.0	86- 87	82- 87
Armstrong	1	1	1	1	2.0	2.0	86- 88	86- 88
Butler	16	29	19	36	1.0-6.0	1.0-7.0	75- 93	74- 95
Forest	1	1	1	1	2.0-2.5	2.0-2.5	86- 88	86- 90
McKean	2	5	2	5	2.0-4.0	2.5-4.0	86- 88	85- 90
Potter	....	1	....	1	....	1.0	....	86
Venango	1	2	1	2	3.0-6.0	3.0	75- 90	[a] 58- 88
Warren	19	25	20	26	1.0-3.0	2.0-7.0	76-100	74-105
Washington	1	1	2	2	6.0	6.0	87	87
Total	43	69	50	83	[b] 2.8	[b] 2.8	....	....

[a] Drips. [b] Average.

OHIO.

The gasoline production from natural gas in Ohio increased from 1,678,985 gallons, valued at $118,161, in 1911 to 1,718,719 gallons, valued at $173,421, in 1912. The average price received for this gasoline advanced from 7.04 cents a gallon in 1911 to 10.1 cents a gallon in 1912, a gain of 3.06 cents.

The greatest number of gasoline plants in operation in this State in 1912 were located in Monroe and Washington counties, the gas produced from the oil wells of these counties being reported as very rich and well adapted for the manufacture of gasoline.

In the following table is given the yield of natural gas in gasoline in Ohio in the years 1911 and 1912, by counties:

Yield of natural gas in gasoline in Ohio in 1911 and 1912.

County.					Yield of gas in gasoline per thousand cubic feet.		Average gravity of gasoline as produced and before blending.	
Location of plant.	Number of operators.		Number of plants in operation.					
	1911	1912	1911	1912	1911	1912	1911	1912
					Gallons.	*Gallons.*	*° Baumé.*	*° Baumé.*
Athens	1	(a)	1	(a)	5.0	(a)	....	(a)
Columbiana	2	2	2	2	3.0-5.0	3.0- 7.0	88-91	85-94
Fairfield	1	1	1	1	2.0	1.5- 2.5	85-88	85-88
Jefferson	1	1	1	1				
Monroe	7	10	17	26	0.5-9.0	0.5-10.0	70-95	78-90
Morgan	2	2	3	3	2.0-2.5	2.0- 2.5	80-88	80-88
Washington	12	9	14	10	1.0-9.0	1.5- 9.0	80-95	80-92
Total	26	25	39	43	[b] 3.57	[b] 2.98	....	....

[a] Idle. [b] Average.

OKLAHOMA.

The report shows a remarkable increase in the production of natural-gas gasoline in Oklahoma in 1912, as compared with 1911. There was a gain of 5 in the number of plants in operation, and the total quantity of gasoline produced in 1912 amounted to 1,575,644 gallons, valued at $99,626, as against 388,058 gallons, in 1911, valued at $20,975. The average price received for gasoline per gallon increased from 5.4 cents in 1911 to 6.3 cents in 1912. The advance in the price of gasoline per gallon in Oklahoma in 1912, as compared with 1911, was less than in any other State.

The gasoline plants of this State are located in Creek, Nowata, Muskogee, and Washington counties. The "casing-head" gas produced from the oil wells of Glenn pool, Creek County, is reported rich in gasoline, and this county led in the quantity of gasoline produced in 1912, and the probability is that it will further increase its production in 1913.

The daily capacity of 13 plants in operation in this State in 1912 was 11,910 gallons.

The average yield of gas in gasoline in Oklahoma in 1912 was 2.25 gallons per thousand cubic feet, the yield ranging from 1⅝ gallons to 4 gallons per thousand cubic feet.

CALIFORNIA.

The State of California, which had but 1 gasoline plant in operation in 1911 for the extraction of gasoline from natural gas, the plant of the Pacific Gasoline Co., had at the close of 1912 a total of 7 plants in successful operation, as follows: Pacific Gasoline Co., 1 plant in Brea Canyon, Orange County; Pinal-Dome Oil Co., 1 plant in Santa Maria district, Santa Barbara County; Puente Oil Co., 1 plant at Puente, Los Angeles County; Purity Gasoline Co., 2 plants in Santa Maria district, Santa Barbara County; Union Oil Co., 1 plant in Santa

Maria district, Santa Barbara County; and Western Gasoline Co,. 1 plant in Santa Maria district, Santa Barbara County. Two plants in California were idle all the year; that is, 1 plant of the Honolulu Consolidated Oil Co. in Kern County (which has never operated but experimentally) and 1 plant of Pinal-Dome Oil Co. in Santa Barbara County. The gasoline production of this State was very large in 1912, but several of the plants only operated a portion of the year. One plant operated but four months, another two months, one five months, one six months, and one began August 1, 1912, and continued throughout the year. With all the plants in operation the production could be very materially increased.

The total production of gasoline from natural gas in California in 1912 amounted to 1,040,695 gallons, valued at $112,502, an average price of 10.8 per gallon, which is the highest average price recorded.

The average yield of gas in gasoline per thousand cubic feet of gas used in 1912 was 1.7 gallons per thousand cubic feet, the range being from 1 to 3 gallons per thousand cubic feet.

It is expected that the production of gasoline from natural gas in California will continue to increase, as this State produces large quantities of gas from its oil wells in the Santa Maria field, as well as in Orange County, the gas being very rich in gasoline. It is thus seen that California is just beginning to realize the importance of her natural-gas resources and that the conservation of this valuable fuel should be undertaken. The production of gasoline from the surplus gas in the oil fields of southern California is one of the most important steps in this direction. It is reported that the gas from wells in the Midway field is of two kinds—dry gas, free from gasoline, at a depth of about 1,600 feet, and wet gas, charged with gasoline, at a depth of about 2,200 feet, the wet gas containing, it is said, about 2 gallons of gasoline per thousand cubic feet. No gasoline plants are in operation in the Midway field.

ILLINOIS.

Illinois was the sixth State in point of production of natural-gas gasoline in 1912. The returns received showed a marked increase in production, which was nearly three and a half times greater than in 1911. At the close of 1912 there were 4 plants in operation, 3 located in Crawford County and 1 in Lawrence County. The price received for gasoline per gallon in 1912 ranged from 10 to 15 cents. The yield of gas in gasoline per thousand cubic feet of gas used in 1912 varied from 1½ to 5 gallons per thousand cubic feet of gas used.

COLORADO.

There was little change in the condition of the natural-gas gasoline industry in Colorado in 1912 as compared with 1911, there being but two plants in operation, the same as in the previous year.

NEW YORK.

So far as could be learned there is but one plant in this State installed for the production of gasoline from natural gas, although the gas is rich in gasoline, testing about 3 gallons per thousand cubic feet. Considerable gas is produced from oil wells in Allegany and Cattaraugus counties.

GASOLINE EXPORTS AND IMPORTS.

The quantity of gasoline exported from the United States from July 1, 1912, to December 31, 1912, amounted to 38,070,949 gallons, valued at $4,671,815, and the quantity of gasoline and naphtha imported to the United States during the same period of time was 570 gallons, valued at $118.

ANALYSES OF NATURAL AND MANUFACTURED GASES.

The following table gives for comparison the general composition of coal gas, water gas, and producer gas from bituminous coals. The weights in pounds, the specific gravity, and the usual number of heat units per thousand cubic feet of the various gases are given according to the usually accepted values.

Analyses, weight, and heating quality, per 1,000 cubic feet, and specific gravity, of natural and manufactured gases.

Constituent.	Average of coal gas.	Average of water gas.	Average of producer gas from bituminous coal.
	Per cent.	*Per cent.*	*Pec cent.*
Marsh gas (CH_4)	40.00	2.00	2.05
Other hydrocarbons	4.00	.00	.04
Nitrogen	2.05	2.00	56.26
Carbonic acid (CO_2)	.45	4.00	2.60
Carbonic oxide (CO)	6.00	45.50	27.00
Hydrogen	46.00	45.00	12.00
Hydrogen sulphide	.00	.00	.00
Oxygen	1.50	1.50	.05
Total	100.00	100.00	100.00

Average gases.	Pounds in 1,000 cubic feet.[a]	Specific gravity, air being 1.	British thermal units per 1,000 cubic feet.[b]
Natural gas:			
Pennsylvania and West Virginia	47.50	0.624	1,145,000
Ohio and Indiana	48.50	.637	1,095,000
Kansas	49.00	.645	1,100,000
Coal gas	33.00	.435	755,000
Water gas	45.60	.600	350,000
Producer gas from bituminous coal	75.00	.985	155,000

[a] 1,000 cubic feet of air at an atmospheric pressure of 14.7 pounds and at a temperature of 62° F. weighs 76.1 pounds and is a mechanical mixture of 23 parts of oxygen and 77 parts of nitrogen by weight.
[b] A British thermal unit is the heat necessary to raise the temperature of 1 pound of pure water at 39° F. 1°.

LIST OF CITIES AND TOWNS SUPPLIED WITH NATURAL GAS.

The following list contains the names of cities and towns in the United States which were either wholly or in part supplied with natural gas in the year 1912:

ALABAMA.

Fayette. Jasper (1913). West Huntsville.

ARKANSAS.

Argenta.
Arkadelphia.
Bauxite.
Benton.
Bierne.
Boughton.
Bryant.
Donaldson.
Emmet.
Fort Smith.
Garland.
Gifford.
Gum Springs.
Gurdon.
Hope.
Hot Springs.
Huntington.
Little Rock.
Mabelvale.
Malvern.
Mansfield.
Perla.
Pine Bluff.
Prescott.
Pulaski Heights.
Ravana.
Sheridan.
Texarkana.
Van Buren.

CALIFORNIA.

Bakersfield.
Betteravia.
Cement.
Fairfield.
Fellows.
Guadalupe.
Maricopa.
Orcutt.
Oxnard.
Sacramento.
Sauta Maria.
Santa Paula.
Stockton.
Suisun City.
Taft.
Ventura.

COLORADO.

Boulder.

ILLINOIS.

Annapolis.
Birds.
Bridgeport.
Carlinville.
Casey.
Duncanville.
East Chicago.
Eaton.
Flat Rock.
Greenville.
Heyworth.
Hutsonville.
Jacksonville.
Lawrenceville.
Marshall.
Martinsville.
New Hebron.
Oblong.
Olney.
Palestine.
Pinkstaff.
Porterville.
Robinson.
Stoy.
Sumner.

INDIANA.

Adams.
Albany.
Alexandria.
Anderson.
Arcadia.
Atlanta.
Batesville.
Cambridge.
Carmel.
Carthage.
Charlottesville.
Chesterfield.
Cicero.
Connersville.
Converse.
Cowan.
Daleville.
Downeyville.
Dublin.
Dunkirk.
Dunreith.
Eaton.
Falmouth.
Farmland.
Fortville.
Fountaintown.
Frankton.
Freeport.
Geneva.
Gentryville.
Germantown.
Gowdy.
Greenfield.
Greensburg.
Gwynneville.
Hagerstown.
Herbst.
Homer.
Honey Creek.
Hope.
Hortonville.
Kennard.
Knightstown.
Kokomo.
La Fontaine.
Letts.
Lewisville.
Loogootee.
McCordsville.
Manilla.
Markleville.
Maxwell.
Mays.
Middletown.
Mier.
Milford.
Millgrove.
Millhousen.
Milroy.
Milton.
Modoc.
Mohawk.
Montpelier.
Morristown.
Mount Auburn.
Mount Summit.
Muncie.
Newcastle.
New Lisbon.
New Point.
Noblesville.
Oaklandon.
Oakville.
Ovid.
Pendleton.
Pennville.
Portland.
Princeton.
Raleigh.
Raysville.
Redkey.
Ridgeville.
Rushville.
St. Paul.
Sandusky.
Sardinia.
Sharpsville.
Shelbyville.
Sheridan.
Shirley.
Spiceland.
Springport.
Straughn.
Sullivan.
Sweetsers.
Tipton.
Union City.
Vincennes.
Waldron.
Westport.
Williamstown.
Winchester.
Windfall.
Winslow.

KANSAS.

Altamont.
Altoona.
Arkansas City.
Atchison.
Augusta.
Baldwin City.
Bartlett.
Bassett.
Baxter Springs.
Benedict.
Bonner Springs.
Bronson.
Buffalo.
Burlington.
Caney.
Carlyle.

KANSAS—continued.

Chanute.
Chautauqua Springs.
Cherokee.
Cherryvale.
Chetopa.
Coffeyville.
Colony.
Columbus.
Cottonwood Falls.
Coyville.
Deerfield.
Earleton.
Edgerton.
Edna.
Edwardsville.
Eldorado.
Elk City.
Elk Falls.
Elmdale.
Elsmore.
Empire City.
Emporia.
Erie.
Eudora.
Eureka.
Fairhaven.
Fall River.
Fort Scott.
Fredonia.
Galena.
Gardner.
Garnett.
Gas.
Greeley.
Havana.
Hepler.
Howard.
Hutchinson.
Independence.
Iola.
Jefferson.
Kansas City.
La Harpe.
Lawrence.
Leavenworth.
Lenexa.
Liberty.
Merriam.
Moline.
Moran.
Mound City.
Mound Valley.
Neodesha.
New Albany.
Newton.
Niotaze.
Olathe.
Osawatomie.
Oswego.
Ottawa.
Paola.
Parsons.
Peru.
Pittsburg.
Pleasanton.
Princeton.
Rantoul.
Richmond.
Roper.
Rose.
Savonburg.
Scammon.
Scipio.
Sedan.
Shawnee.
Spring Hill.
Stanley.
Strong.
Sycamore.
Tonganoxie.
Topeka.
Turner.
Tyro.
Vilas.
Weir.
Welda.
Wellington.
Wellsville.
Wichita.
Winfield.
Yates Center.

KENTUCKY.

Ashland.
Barbourville.
Bellevue.
Buchanan.
Burning Springs.
Caney.
Catlettsburg.
Central City.
Clifton.
Cloverport.
Cold Spring.
Covington.
Dayton.
Dunmor.
Hazel Green.
Inez.
Kenner.
Kavanaugh.
Lewisburg.
Lexington.
Louisa.
Louisville.
Ludlow.
Maysville.
Mount Sterling.
Newport.
Pollard.
Rothwell.
Russell.
Russellville.
Warfield.
West Covington.
West Liberty.
West Point.
Winchester.

LOUISIANA.

Belcher.
Blanchard.
Bloomburg.
Caddo.
Dixie.
Hosston.
Ida.
Mansfield.
Mooringsport.
Oil City.
Rodessa.
Shreveport.
Vivian.

MARYLAND.

Corinth.
Cumberland.
Deer Park.
Frostburg.
Loch Lynn.
Lonaconing.
Luke.
Mountain Lake Park.
Oakland.

MISSOURI.

Belton.
Carl Junction.
Carterville.
Carthage.
Joplin.
Kansas City.
Martin City.
Nevada.
Oronogo.
Rich Hill.
St. Joseph.
Webb City.
Weston

NEW YORK.

Addison.
Akron.
Alden.
Alexander.
Alfred.
Alfred Station.
Allentown.
Almond.
Ambush.
Andover.
Angola.
Armor.
Attica.
Baldwinsville.
Batavia.
Belfast.
Belmont.
Blasdell.
Bolivar.
Bowmansville.
Brant.
Bristol.
Bristol Center.
Brocton.
Buffalo.
Caledonia.
Canisteo.
Cattaraugus.

NEW YORK—continued.

Ceres.
Chipmonk.
Churchville.
Clarence.
Clarence Center.
Collins.
Collins Center.
Corfu.
Corning.
Crittenden.
Cuba.
Deer Creek.
Depew.
Dunkirk.
East Aurora.
East Bloomfield.
East Hamburg.
Ebenezer.
Elma.
Elmira.
Farnham.
Forestville.
Fredonia.
Friendship.
Gangloff.
Gardenville.
Geneseo.
Getzville.
Gorham.
Gowanda.
Greenwood.
Hamburg.
Hanover.
Holcomb.
Holland.
Honeoye Falls.
Hornell.
Independence.
Irving.
Jamestown.
Jewettville.
Lacona.
Lackawanna.
Lancaster.
Le Roy.
Lima.
Limestone.
Millgrove.
Naples.
North Collins.
North Tonawanda.
Obi.
Olean.
Orchard Park.
Pavilion.
Perry.
Petrolia.
Phoenix.
Pomfret.
Portland.
Portville.
Pulaski.
Reserve.
Richburg.
Ripley.
Rushville.
Salamanca.
Sandy Creek.
Scio.
Sheridan.
Silver Creek.
Southport.
Springville.
Stanards.
Tonawanda.
Town Line.
Versailles.
Warsaw.
Watkins.
Webb Mills.
Wellsville.
West Bloomfield.
West Clarksville.
Westfield.
West Seneca.
Wheatland.
Williamsville.
Wyoming.
Zoar.

NORTH DAKOTA.

Lansford.
Westhope.

OHIO.

Academia.
Adelphi.
Akron.
Alexandria.
Alliance.
Amanda.
Amboy.
Amesville.
Amherst.
Amsterdam.
Andover.
Antioch.
Appleton.
Arcanum.
Arlington.
Ashland.
Ashtabula.
Athens.
Austinburg.
Avery.
Bairdstown.
Baltimore.
Bangs.
Barberton.
Barlow.
Barnesville.
Bartlett.
Basil.
Batesville.
Beach City.
Beallsville.
Beem City.
Bellaire.
Belle Valley.
Belleville.
Bellevue.
Belmont.
Beloit.
Belpre.
Bergholz.
Berlin Heights.
Bethany.
Bethesda.
Bettsville.
Beverly.
Bexley.
Birmingham.
Bladensburg.
Bloomdale.
Bloomingburg.
Bowerston.
Bowling Green.
Bratenahl.
Bremen.
Bridgeport.
Brilliant.
Brink Haven.
Buckeye City.
Buckeye Lake.
Buchtel.
Buckingham.
Bucyrus.
Buffalo.
Bullett Park.
Burbank.
Butler.
Byesville.
Cadiz.
Caldwell.
Cambridge.
Canal Dover.
Canal Winchester.
Canfield.
Canton.
Cardington.
Carey.
Carroll.
Carrollton.
Cedarville.
Celina.
Centerburg.
Chauncey.
Chesterhill.
Chicago.
Chillicothe.
Chippewa Lake.
Cincinnati.
Circleville.
Clarington.
Claysville.
Clearport.
Cleveland.
Cleveland Heights.
Clintonville.
Clyde.
Coal Grove.
Coal Run.
Coalton.
Cochransville.
Coldwater.
Columbiana.
Columbus.
Conneaut.
Corning.
Coshocton.
Covington.
Crestline.
Creston.
Cridersville.
Crooksville.
Croton.
Cuyahoga Falls.
Cygnet.
Dakes.
Danville.
Dayton.
Deavertown.
Delaware.
Dennison.
Derwent.
Dexter City.
Doylestown.
Dresden.
Dudley.
East Cleveland.
East Fultonham.
East Liverpool.
East Palestine.
Edison.
Elba.
Elmore.
Elyria.
Empire.
Enterprise.
Euclid.
Findlay.
Florence.
Flushing.
Fly.
Forest.

OHIO—continued.

Fort Recovery.
Fostoria.
Franklin.
Frazeysburg.
Fredericktown.
Fremont.
French Creek (Avon).
Fulda.
Fultonham.
Gahanna.
Galena.
Galion.
Gallipolis.
Gambier.
Geneva.
Genoa.
Germantown.
Gibsonburg.
Girard.
Glenroy.
Glouster.
Grandview.
Granville.
Grogan.
Groveport.
Guysville.
Hallsville.
Hamden.
Hamilton.
Hanging Rock.
Hannibal.
Hanover.
Hanoverton.
Harlem Springs.
Harpster.
Harriettsville.
Hayesville.
Hebron.
Hemlock.
Homer.
Homeworth.
Hooker.
Hopedale.
Horns Mills.
Howard.
Hubbard.
Huntsville.
Ironton.
Jackson.
Jackson Center.
Jacksontown.
Jacksonville.
Jefferson.
Jeromesville.
Jerusalem.
Jewett.
Johnstown.
Jolly.
Junction City.
Kansas.
Kent.
Kilgore.
Kilbuck.
Kingston.
Kingsville.
Kirkersville.
Lakeside.
Lakewood.
Lancaster.
Laurelville.
Leesville.
Leetonia.
Leonard.
Leroy.
Lewisville.
Lexington.
Lima.
Linden.
Lisbon.
Litchfield.
Lockville.
Lodi.
Logan.
London.
Lorain.
Loudonville.
Lowell.
Lowellville.
Lower Salem.
McArthur.
McConnellsville.
Macksburg.
Malaga.
Malta.
Mansfield.
Maria Stein.
Marietta.
Marion.
Martinsburg.
Martins Ferry.
Massillon.
Maumee.
Medina.
Mendon.
Miamisburg.
Middleport.
Middletown.
Milan.
Millersburg.
Millersport.
Millers Run.
Millwood.
Milo.
Miltonsburg.
Mineral City.
Mingo.
Minster.
Monroe.
Monroeville.
Montezuma.
Morral.
Morristown.
Mount Gilead.
Mount Liberty.
Mount Sterling.
Mount Vernon.
Moxahala.
Murray.
Nashport.
Nelsonville.
Neptune.
Nevada.
New Albany.
New Alexandria.
Newark.
New Athens.
New Berlin.
New Boston.
New Bremen.
Newburgh.
New Carlisle.
New Castle.
Newcomerstown.
New Hagerstown.
New Knoxville.
New Lexington.
New Matamoras.
New Middletown.
New Philadelphia.
Newport.
New Riegel.
New Straitsville.
Niles.
North Amherst.
North Baltimore.
North Georgetown.
North Hampton.
Norwalk.
Nottingham.
Oakharbor.
Orrville.
Osgood.
Outville.
Ozark.
Pataskala.
Pennsville.
Perrysburg.
Perrysville.
Petersburg.
Pickerington.
Piqua.
Pleasant City.
Pleasantville.
Plymouth.
Point Pleasant.
Poland.
Polk.
Pomeroy.
Portage.
Portsmouth.
Quaker City.
Ravenna.
Rendville.
Reno.
Rex Mills.
Reynoldsville.
Richmond.
Rockbridge.
Rock Creek.
Rockyridge.
Roseville.
Roxbury.
Rural.
Rushville.
St. Clairsville.
St. Henry.
St. Louisville.
St. Marys.
Salem.
Salineville.
Sandusky.
Sarahsville.
Sardis.
Scio.
Sciotoville.
Sebring.
Senecaville.
Seville.
Shadyside.
Sharon.
Shawnee.
Shelby.
Sherodsville.
Shreve.
Sidney.
Simons.
Somerset.
Somerton.
South Charleston.
South Olive.
South Zanesville.
Spencer.
Spencerville.
Springfield.
Stafford.
Sterling.
Steubenville.
Stewart.
Stoutsville.
Strasburg.
Struthers.
Sugar Creek.
Sugar Grove.
Summerfield.
Sunbury.
Sycamore.
Tarlton.
Texas.
Thornville.
Thurston.
Tiffin.
Tippecanoe City.
Tiro.
Toledo.
Toronto.
Tremont City.
Trimble.
Trinway.
Troy.
Uhrichsville.
Upper Sandusky.
Urbana.
Utica.
Vanburen.
Vincent.
Wadsworth.
Wapakoneta.
Warner.
Warren.

OHIO—continued.

Warsaw.
Washington Court House.
Washingtonville.
Waterford.
Watertown.
Waterville.
Wellston.
Wellsville.
West Bedford.
West Carrollton.
Westerville.
West Jefferson.
West Millgrove.
West Rushville.
West Salem.
Wheelersburg.
Whipple.
Wilberforce.
Williamsport.
Woodsfield.
Wooster.
Worthington.
Xenia.
Zanesville.
Zenz City.

OKLAHOMA.

Arcadia.
Ardmore.
Avant.
Bartlesville.
Beggs.
Bigheart.
Bixby.
Blackwell.
Bluejacket.
Braman.
Bristow.
Broken Arrow.
Cameron.
Chandler.
Chelsea.
Choteau.
Claremore.
Cleveland.
Coalton.
Collinsville.
Copan.
Coweta.
Davenport.
Dawson.
Delaware.
Depew.
Dewar.
Dewey.
Drumright.
Dustin.
Edmond.
Gotebo.
Guthrie.
Hallett.
Haskell.
Hattonville.
Henryetta.
Inola.
Jenks.
Kellyville.
Kiefer.
Kildare.
Lenapah.
Luther.
Meeker.
Miami.
Midlothian.
Morris.
Mounds.
Muskogee.
Newkirk.
Ochelata.
Oglesby.
Oklahoma.
Okmulgee.
Oologah.
Osage.
Owasso.
Pawhuska.
Ponca.
Porter.
Poteau.
Pryor.
Ramona.
Red Fork.
Sapulpa.
Shawnee.
Skiatook.
South Coffeyville.
Stroud.
Tonkawa.
Tulsa.
Turley.
Vinita.
Wagoner.
Wainwright.
Wann.
Welch.
Wellston.

PENNSYLVANIA.

Aliquippa.
Alverton.
Ambridge.
Apollo.
Arnold.
Austin.
Avalon.
Baden.
Barnes.
Beallsville.
Beaver.
Beaver Falls.
Belle Vernon.
Bellevue.
Bingham.
Blairs Corners.
Blairsville.
Bloomster.
Bluff.
Bolivar.
Bradford.
Brady's Bend.
Branchton.
Brockport.
Brockwayville.
Brookville.
Brownsville.
Bruin.
Bryant.
Buffalo.
Bullion.
Bully Hill.
Burgettstown.
Butler.
Cabot.
California.
Callensburg.
Callery.
Campbelltown.
Candor.
Canonsburg.
Carnegie.
Carnot.
Carrick.
Carrolltown.
Castle Shannon.
Cecil.
Ceres.
Charleroi.
Chicora.
Clairton.
Clarendon.
Clarendon Boro.
Clarington.
Clarion.
Claysville.
Clermont.
Clintonville.
Cochranton.
Colegrove.
Coleville.
Colona.
Connellsville.
Conoquenessing.
Conway.
Cooksburg.
Cooperstown.
Coraopolis.
Corry.
Corsica.
Coryville.
Coudersport.
Courtney.
Craigsville.
Crosby.
Curllsville.
Darlington.
Davistown.
Dawson.
Dayton.
Derrick City.
Derry.
Donora.
Dubois.
Duke Center.
Dunbar.
Dunkard.
East Brady.
East Hickory.
Easton.
East Sharon.
East Springfield.
Edgeworth.
Edinburg.
Eidenau.
Elbon.
Eldersville.
Eldred.
Elizabeth.
Elkland.
Ellwood City.
Emlenton.
Emporium.
Emsworth.
Endeavor.
Enon Valley.
Enterprise.
Erie.
Evans City.
Fairmount City.
Fairview.
Falls Creek.
Fayette City.
Finleyville.
Florence.
Ford City.
Fosters Mills.
Foxburg.
Franklin.
Fredonia.
Freedom.
Freeport.
Frogtown.
Fryburg.

PENNSYLVANIA—continued.

Galeton.
Garland.
Gastonville.
Geneva Hill.
Gibsonton.
Gill Hall.
Gilmore.
Girard.
Glade Run.
Glassport.
Glenfield.
Glenhazel.
Glen Osborne.
Grand Valley.
Great Belt.
Greenfield.
Greensburg.
Greenville.
Grove City.
Hadley.
Halsey.
Harmony.
Harpers Corners.
Harrisville.
Hawthorn.
Hazel Hurst.
Heidelburg.
Herman.
Hickory.
Highland.
Hillsville.
Holbrook.
Homer.
Homer City.
Hopwood.
Houston.
Hydetown.
Imperial.
Indiana.
Industry.
Ingomar.
Instanter.
Irvineton.
Irwin.
James City.
Jamestown.
Jeannette.
Jefferson.
Johnetta.
Johnsonburg.
Johnstown.
Jollytown.
Kane.
Kane Boro.
Karns City.
Kaylor.
Keisters.
Kellettsville.
Khedive.
Kinzua.
Kittanning.
Knoxville.
Kushequa.
Lamont.
Larabee.
Latrobe.
Leechburg.
Leeper.
Leetsdale.
Lickingville.
Ligonier.
Limestone.
Lucinda.
McClellandtown.
McDonald.
McKees Rocks.
McKinley.
Manor.
Manorville.
Marble.
Marianna.
Marienville.
Mars.
Marvindale.
Marwood.
Masontown.
Mayburg.
Meadow Lands.
Meadville.
Mercer.
Middle Fork.
Midland.
Millers Eddy.
Millport.
Monaca.
Monessen.
Monongahela.
Monterey.
Mount Alton.
Mount Jewett.
Mount Morris.
Mount Oliver.
Mount Pleasant.
Myonia.
Natrona.
Nedskey.
New Bethlehem.
New Brighton.
New Castle.
New Florence.
New Kensington.
New Mayville.
New Salem.
New Sheffield.
New Stanton.
Newton.
New Wilmington.
Noblestown.
North Blackville.
North Girard.
Norwich.
Oakdale.
Oakland.
Oak Ridge.
Oil City.
Ormsby.
Osgood.
Oswayo.
Otto.
Parkers Landing.
Petersville.
Petroleum Center.
Petrolia.
Philipston.
Pittsburgh.
Pittsfield.
Pleasantville.
Plummer.
Point Marion.
Polk.
Pollock.
Port Allegany.
Porter.
Poseytown.
Primrose.
Punxsutawney.
Queenstown.
Ratigan.
Red Rock.
Reidsburg.
Renfrew.
Reno.
Reynoldsville.
Ridgway.
Rimer.
Rimersburg.
Rixford.
Rochester.
Rockland.
Rogersville.
Rolfe.
Roscoe.
Roseville.
Roulette.
Rouseville.
Rural Valley.
Rynd Farm.
St. Marys.
St. Petersburg.
Salina.
Salem.
Sandy Lake.
Saxonburg.
Scottdale.
Semples.
Seneca.
Sewickley.
Sharon.
Sharpsville.
Shawmut.
Sheffield.
Shinglehouse.
Shinglehouse Boro.
Sligo.
Slippery Rock.
Smethport.
Snowden.
South Brownsville.
South Heights.
South Sharon.
Stoneboro.
Straight.
Strattonville.
Sturgeon.
Sugar Creek.
Summerville.
Tarentum.
Tarrs.
Taylorstown.
Tidal.
Tidioute.
Tiona.
Tionesta.
Titusville.
Townville.
Turtle Creek.
Tylersburg.
Uniontown.
Utica.
Vanderbilt.
Vandergrift.
Vanport.
Venetia.
Venus.
Volant.
Walkers Mills.
Warren.
Warren Boro.
Washington.
Waters.
Waynesburg.
West Alexander.
West Elizabeth.
Westfield.
West Freedom.
West Hickory.
Westline.
West Middlesex.
West Middletown.
West Monongahela.
West Newton.
West Sunbury.
West Winfield.
Wetmore.
Wheatland.
Wick.
Widnoon.
Wilcox.
Wilkinsburg.
Wilson.
Woodlawn.
Worthington.
Youngsville.
Youngwood.
Zelienople.

SOUTH DAKOTA.

Fort Pierre.
Pierre.

TEXAS.

Albany.
Alvord.
Arlington.
Atlanta.
Bellevue.
Bowie.
Bridgeport.
Byers.
Cass.
Corsicana.
Crowther.
Dallas.
Dalworth.
Decatur.
Denton.
Eagle Ford.
Fort Worth.
Grand Prairie.
Henrietta.
Irving.
Laredo.
Marshall.
Moran.
Petrolia.
Queen City.
Rhome.
Sunset.
Texarkana.
Wichita Falls.

WEST VIRGINIA.

Adamston.
Alma.
Arvilla.
Barboursville.
Barrackville.
Belington.
Belmont.
Bens Run.
Benwood.
Benson.
Beraman.
Big Isaac.
Big Springs.
Blacksville.
Blueville.
Boothsville.
Branchland.
Bridgeport.
Briscoe.
Bristol.
Broad Oaks.
Brookville.
Buckhannon.
Buffalo.
Burdett.
Burning Springs.
Burnsville.
Burton.
Cairo.
Cameron.
Cedargrove.
Center Point.
Ceredo.
Charleston.
Chelyan.
Chester.
Clarington.
Clarksburg.
Clendenin.
Coalburg.
Colfax.
Colliers.
Creston.
Crown Hill.
Culloden.
Davis.
Daybrook.
Deanville.
Eastbank.
Edgewood.
Elizabeth.
Elkins.
Ellenboro.
Elm Grove.
Elm Run.
Enterprise.
Erie.
Eureka.
Fairmont.
Fairview.
Farmington.
Farnum.
Finch.
Flat Woods.
Flemington.
Follansbee.
Fort Gay.
Friendly.
Fulton.
Gandeeville.
Gassaway.
Glen Dale.
Glen Easton.
Glenova.
Glenville.
Glovergap.
Goose Creek.
Grafton.
Grantsville.
Griffithsville.
Hamlin.
Handley.
Hansford.
Harrisville.
Haymond Heights.
Haywood.
Heaters.
Hundred.
Huntington.
Hurricane.
Jacksonburg.
Jacksonville.
Janelew.
Jarvisville.
Kenova.
Kermit.
Keyser.
Lima.
Littleton.
Lost Creek.
Loudenville.
Loveland.
Lumberport.
McMechen.
Mahone.
Mannington.
Meadowbrook.
Metz.
Middlebourne.
Miletus.
Milton.
Monongah.
Montgomery.
Monticello Add.
Morgantown.
Moundsville.
Mount Clare.
Mount Zion.
Murphytown.
Myra.
New Cumberland.
New Martinsville.
Ogdin.
Ona.
Paden City.
Palestine.
Parkersburg.
Parsons.
Patterson.
Pennsboro.
Petroleum.
Philippi.
Piedmont.
Pine Grove.
Pleasant Valley.
Poca.
Pratt.
Proctor.
Pruntytown.
Pullman.
Ravenswood.
Reedy.
Ripley.
Rockford.
Rowlesburg.
St. Albans.
St. Marys.
Salem.
Sandyville.
Schultz.
Sedalia.
Seth.
Sherrard.
Shiloh.
Shinnston.
Shirley.
Shrewsbury.
Simpson.
Sistersville.
Smithburg.
Smithfield.
Smithville.
South Buckhannon
Spencer.
Star City.
Sutton.
Tanner.
Terra Alta.
Thornton.
Wallace.
Walton.
Ward.
Warwood.
Waverly.
Wayne.
Wellsburg.
West Fork.
Weston.
West Union.
Wheeling.
Wileyville.
Williamstown.
Wilsonburg.
Woodlawn.
Woodville.
Worthington.
Wyatt.

WYOMING.

Basin.
Byron.
Greybull.

PETROLEUM.

By David T. Day.

INTRODUCTION.

GENERAL CONDITION.

The production of 1911 was equaled and passed in 1912 when the total in barrels[1] reached 222,113,218 (or 29,615,096 metric tons) compared with 220,449,391 barrels in 1911. Higher prices were the rule in 1912, except in California, and even in that State there was no considerable decline. The average price per barrel in 1912 was nearly 74 cents as against nearly 61 cents in 1911. The total value therefore increased markedly, reaching $163,802,334, or 22.20 per cent above the value for the previous year.

In order to appreciate the magnitude of the present oil production it should be noted that it required 24 years after the beginning of the industry in 1859 to produce as much oil as one year's present output; and the output of only the last 8 years equals all produced before. The output of the United States in 1912 was greater than that of all other countries by 72 per cent, being 63.25 per cent of the world's product.

In order that the official statistics here presented may be intelligently compared with those published by other authorities, it should be noted that the production given for the year includes pipe-line runs, plus independent railroad shipments, plus oil piped direct to refineries, and the crude oil consumed as fuel in oil production. The production does not include stocks in the field which have not been sold.

The greatest increase in quantity was in California where the total advanced from 81,134,391 barrels to 86,450,767 barrels, a gain in that State alone of 5,316,376 barrels, or 6.55 per cent. Wyoming showed a remarkable gain from 186,695 barrels to 1,572,306 barrels, or 742 per cent, due to the increased activity of the Mid-West Oil Co. and the Wyoming Oil Fields Co. Operations in north Texas also more than offset the usual decline in the Gulf region and resulted in a significant gain for the State.

INCREASED EXPORTS.

The volume of crude oil and of the usual products exported from the United States increased, owing to foreign conditions being much more favorable to American exporters. Meanwhile importation of gasoline from the East Indies was a favorable element in relieving the growing demand for this product on the Pacific coast.

[1] Barrel contains 42 United States gallons.

DECREASED STOCKS.

The improved export conditions and the increased capacity of the refiners to take care of the great yield of crude oil resulted in a marked decline in stocks in all fields except California, and even there the storage of petroleum was checked by expanded consumption.

The total stocks of all crude oils aggregated 137,000,000 barrels at the beginning of 1912; by the close of the year this total had declined to 123,000,000 barrels, or a decrease of about 10 per cent. The principal decline was in the fields east of the Rocky Mountains. On January 1, 1912, these stocks aggregated 94,000,000 barrels; they declined during the year to 79,000,000 barrels, or a decrease of about 16 per cent.

This decline at once brought out a noteworthy stimulation of prices all over the East, thus increasing the activity in drilling. Its effect was marked; so much so that the natural decline of the older fields was partly checked. Even Ohio showed a slight increase in production in 1912, the first time in 12 years.

THE OIL OUTLOOK.

Present conditions of production indicate a somewhat increased production during the current year, 1913. This increase will come chiefly in California and in other States from the stimulus of higher prices, especially in the Mid-Continent field. The production of California will undoubtedly become a more significant element in the general petroleum industry with the opening of the Panama Canal, until, at least, the consumption in California outstrips production. It is not improbable that the flow of fuel oil through the pipe line alongside the Panama Canal may eventually be reversed, because fuel oil is so essential to the industrial development of the west coast, and because it may become possible, in the very near future, to supply very large quantities of low-priced oil from the Mexican fields. Importations from that country of low-grade oils are already tending to offset the exports from the United States of high-grade products. The imports of gasoline from the Far East being considered, it is probable that the net amount of gasoline exported will rapidly decline, while the exports of lamp oils and lubricants will increase. The great economic change in oil consumption affected by the development of gasoline engines calls attention to the possibility of other great variations in consumption of petroleum products. Lubricating oils can only show a gradual extension with the increased use of power of all kinds. Similarly the use of kerosene in lamps is not likely to show the sudden development observed in the gasoline trade. Nevertheless, the great discrepancy must be noted between the per capita consumption of illuminating oil in various countries. It might be expected that the advent of gas and electricity would check the use of lamps. The contrary is the case. But the change is slight compared to the great and significant difference in the per capita consumption of oil for light in various countries. In spite of the development of gas and electricity in the United States, this country leads in consumption of oil for light, using about 25 gallons of kerosene per capita per year. Other countries range in this consumption as low as to a tenth of this quantity. Besides the efforts to increase the use of artificial light as an outlet for oil, the effort to disseminate literature of all kinds in all countries will tend to increase the per capita use of oil; for example, China, with its great population, is in the class of very small consumption, and a slight increase there in literacy may rival the automobile in improving the oil market.

ACKNOWLEDGMENTS.

As stated in the last report of this series, the statistical portion of this report is the result of cooperative work between the Government and the petroleum producers, the transportation companies, especially the pipe-line companies, and the consumers. This cooperative work has been entirely voluntary, without any obligatory legislation whatever being invoked on the part of the Government. The amount of service thus rendered has involved many weeks of work by the statistical officers of large corporations and by others among the 14,000 contributors, and it is here gratefully acknowledged, as is also the skilled work of the petroleum accountants in the Survey.

As heretofore, the result has been obtained under two independent systems of statistics. Under one system returns are made direct to the Survey by the pipe lines as to the quantity of oil collected from the field, this information being supplemented by returns from railroads and refineries as to oil which was collected but did not go through pipe lines. Under the other system the returns are from the producers of petroleum as to the quantity produced and marketed plus the quantity used in the field.

By this means two totals are obtained, and when these two totals agree closely the substantial correctness of the report is assured. An interesting result, which is hereby demonstrated, is the remarkable accuracy of the pipe-line statistics.

In the States of Kansas, Michigan, Missouri, Oklahoma, Pennsylvania, and Texas, the statistics from the producers have been collected in cooperation with the State geologists, and appreciation is hereby expressed for the arduous labor carried on by these officers in order to make the reports complete at the earliest possible date. The general information furnished would have been impossible without the complete and expensive system of correspondence maintained by the petroleum press, especially the Oil City Derrick, whose field reports have been accepted as authoritative; the Independence Daily Reporter; the Oil and Gas Journal, of Tulsa, Okla., whose field reports are accepted for Texas and Louisiana; the Oil, Paint, and Drug Reporter; the Petroleum Gazette; Oildom; the California Derrick; the California Oil World; the Oil Age; Petroleum; the Moniteur du Pétrole Roumain; the Petroleum Review, of London; the Petroleum, of Berlin; and the Petroleum World, of London.

The statistics of foreign countries have been obtained chiefly by direct correspondence with the officials of the Governments concerned, as well as by the aid of many private authorities.

The statistical work and compilation of tables has been under the charge of Miss Anne B. Coons, statistician, whose work of revision of the statistics of runs, deliveries, and stocks is especially acknowledged.

PRODUCTION.

The statement of the production of petroleum in 1911 and 1912 is given in detail by States in the tables which follow:

Total quantity and value of petroleum produced in the United States and the average price per barrel in 1911 and 1912, by States, in barrels.

State.	1911			1912		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
California	81,134,391	$38,719,080	$0.477	86,450,767	$39,213,588	$0.454
Colorado	226,926	228,104	1.005	206,052	199,661	.973
Illinois	31,317,038	19,734,339	.630	28,601,308	24,332,605	.851
Indiana	1,695,289	1,228,835	.740	970,009	885,975	.913
Kansas	1,278,819	608,756	.476	1,592,796	1,095,698	.688
Kentucky	472,458	328,614	.696	484,368	424,842	.877
Louisiana	10,720,420	5,668,814	.529	9,263,439	7,023,827	.758
Michigan, Missouri	7,995	7,995	1.000	(a)	(a)	....
New York	952,515	1,248,950	1.311	874,128	1,401,880	1.604
Ohio	8,817,112	9,479,542	1.075	b 8,969,007	b 12,085,998	1.347
Oklahoma	56,069,637	26,451,767	.472	51,427,071	34,672,604	.674
Pennsylvania	8,248,158	10,894,074	1.321	7,837,948	12,886,752	1.644
Texas	9,526,474	6,554,552	.688	11,735,057	8,852,713	.754
Utah, Wyoming	186,695	124,037	.664	1,572,306	798,470	.507
West Virginia	9,795,464	12,767,293	1.303	12,128,962	19,927,721	1.643
Total	220,449,391	134,044,752	.608	222,113,218	163,802,334	.737

a Included in Ohio. b Includes Michigan.

Total production of petroleum and percentage of increase or decrease, by States, in 1912, as compared with 1911, in barrels.

State.	Production.		Increase.	Decrease.	Percentage.	
	1911	1912			Increase.	Decrease.
California	81,134,391	86,450,767	5,316,376	....	6.55	....
Colorado	226,926	206,052	....	20,874	....	9.20
Illinois	31,317,038	28,601,308	....	2,715,730	....	8.67
Indiana	1,695,289	970,009	....	725,280	....	42.78
Kansas	1,278,819	1,592,796	313,977	....	24.55	....
Kentucky	472,458	484,368	11,910	....	2.52	....
Louisiana	10,720,420	9,263,439	....	1,456,981	....	13.59
Michigan, Missouri	7,995	(a)	....	....	....	....
New York	952,515	874,128	....	78,387	....	8.23
Ohio	8,817,112	b 8,969,007	143,900	....	1.63	....
Oklahoma	56,069,637	51,427,071	....	4,642,566	....	8.28
Pennsylvania	8,248,158	7,837,948	....	410,210	....	4.97
Texas	9,526,474	11,735,057	2,208,583	....	23.18	....
Utah, Wyoming	186,695	1,572,306	1,385,611	....	742.18	....
West Virginia	9,795,464	12,128,962	2,333,498	....	23.82	....
Total	220,449,391	222,113,218	1,663,827	....	.755	....

a Production of Michigan included in Ohio. b Includes production of Michigan.

RANK OF STATES.

QUANTITY.

As forecasted in the report for 1911 there was no change in rank among the three great producing States—California, Oklahoma, and Illinois. These furnished over three-fourths of the production. Among the other States, West Virginia displaced Louisiana as fourth; Texas advanced from sixth to fifth place and its former position was taken by Louisiana; Kansas advanced to ninth place and Wyoming to tenth, preceding Indiana, New York, Kentucky, and Colorado. Wyoming produced more oil than New York, Kentucky, and Colorado taken together.

Rank of petroleum-producing States, with quantity and percentage produced by each, in 1911 and 1912, in barrels.

1911				1912			
State.	Rank.	Quantity.	Percentage.	State.	Rank.	Quantity.	Percentage.
California	1	81,134,391	36.80	California	1	86,450,767	38.92
Oklahoma	2	56,069,637	25.44	Oklahoma	2	51,427,071	23.15
Illinois	3	31,317,038	14.21	Illinois	3	28,601,308	12.88
Louisiana	4	10,720,420	4.86	West Virginia	4	12,128,962	5.46
West Virginia	5	9,795,464	4.44	Texas	5	11,735,057	5.28
Texas	6	9,526,474	4.32	Louisiana	6	9,263,439	4.17
Ohio	7	8,817,112	4.00	Ohio	7	[a] 8,969,007	4.04
Pennsylvania	8	8,248,158	3.74	Pennsylvania	8	7,837,948	3.53
Indiana	9	1,695,289	.77	Kansas	9	1,592,796	.72
Kansas	10	1,278,819	.58	Wyoming	10	1,572,306	.71
New York	11	952,515	.43	Indiana	11	970,009	.44
Kentucky	12	472,458	.22	New York	12	874,128	.39
Colorado	13	226,926	.10	Kentucky	13	484,368	.22
Wyoming	14	}		Colorado	14	206,052	.09
Missouri	15	} 194,690	.09	Michigan	15	([b])	....
Utah	16	}					
Michigan	17	}		Total	......	222,113,218	100.00
Total	......	220,449,391	100.00				

[a] Includes Michigan. [b] Included in Ohio.

VALUE.

The considerable gain in price of oils of Pennsylvania grade maintained the leading nine States in the relative positions as to value of their production, which they held in 1911. Among the minor States, the changes in value were only slight. Kansas exceeded Indiana, and Wyoming went above Kentucky and Colorado.

Rank of petroleum-producing States, with value of production and percentage of each, in 1911 and 1912.

1911				1912			
State.	Rank.	Value.	Percentage.	State.	Rank.	Value.	Percentage.
California	1	$38,719,080	28.89	California	1	$39,213,588	23.94
Oklahoma	2	26,451,767	19.73	Oklahoma	2	34,672,604	21.17
Illinois	3	19,734,339	14.72	Illinois	3	24,332,605	14.85
West Virginia	4	12,767,293	9.52	West Virginia	4	19,927,721	12.16
Pennsylvania	5	10,894,074	8.13	Pennsylvania	5	12,886,752	7.87
Ohio	6	9,479,542	7.07	Ohio	6	[a] 12,085,998	7.38
Texas	7	6,554,552	4.89	Texas	7	8,852,713	5.40
Louisiana	8	5,668,814	4.23	Louisiana	8	7,023,827	4.29
New York	9	1,248,950	.93	New York	9	1,401,880	.86
Indiana	10	1,228,835	.92	Kansas	10	1,095,698	.67
Kansas	11	608,756	.45	Indiana	11	885,975	.54
Kentucky	12	328,614	.25	Wyoming	12	798,470	.49
Colorado	13	228,104	.17	Kentucky	13	424,842	.26
Wyoming	14	}		Colorado	14	199,661	.12
Utah	15	} 132,032	.10	Michigan	15	([b])	....
Missouri	16	}					
Michigan	17	}		Total	......	163,802,334	100.00
Total	......	134,044,752	100.00				

[a] Includes Michigan. [b] Included in Ohio.

PRODUCTION OF PETROLEUM IN THE UNITED STATES FROM 1859 TO 1912, INCLUSIVE.

In the following table will be found a statement of the production of petroleum from each producing State of the United States from the year 1859 to and including the production of the year 1912:

Production of petroleum in the United States, 1859–1912, 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.
1859	2,000	....	....	....	....	....	....	....
1860	500,000	....	....	....	....	....	....	....
1861	2,113,609	....	....	....	....	....	....	....
1862	3,056,690	....	....	....	....	....	....	....
1863	2,611,309	....	....	....	....	....	....	....
1864	2,116,109	....	....	....	....	....	....	....
1865	2,497,700	....	....	....	....	....	....	....
1866	3,597,700	....	....	....	....	....	....	....
1867	3,347,300	....	....	....	....	....	....	....
1868	3,646,117	....	....	....	....	....	....	....
1869	4,215,000	....	....	....	....	....	....	....
1870	5,260,745	....	....	....	....	....	....	....
1871	5,205,234	....	....	....	....	....	....	....
1872	6,293,194	....	....	....	....	....	....	....
1873	9,893,786	....	....	....	....	....	....	....
1874	10,926,945	....	....	....	....	....	....	....
1875	8,787,514	....	....	....	....	....	....	....
1876	8,968,906	31,763	120,000	12,000	....	....	....	....
1877	13,135,475	29,888	172,000	13,000	....	....	....	....
1878	15,163,462	38,179	180,000	15,227	....	....	....	....
1879	19,685,176	29,112	180,000	19,858	....	....	....	....
1880	26,027,631	38,940	179,000	40,552	....	....	....	....
1881	27,376,509	33,867	151,000	99,862	....	....	....	....
1882	30,053,500	39,761	128,000	128,636	....	....	....	....
1883	23,128,389	47,632	126,000	142,857	4,755	....	....	....
1884	23,772,209	90,081	90,000	262,000	4,148	....	....	....
1885	20,776,041	661,580	91,000	325,000	5,164	....	....	....
1886	25,798,000	1,782,970	102,000	377,145	4,726	....	....	....
1887	22,356,193	5,022,632	145,000	678,572	4,791	76,295	....	....
1888	16,488,668	10,010,868	119,448	690,333	5,096	297,612	....	....
1889	21,487,435	12,471,466	544,113	303,220	5,400	316,476	33,375	1,460
1890	28,458,208	16,124,656	492,578	307,360	6,000	368,842	63,496	900
1891	33,009,236	17,740,301	2,406,218	323,600	9,000	665,482	136,634	675
1892	28,422,377	16,362,921	3,810,086	385,049	6,500	824,000	698,068	521
1893	20,314,513	16,249,769	8,445,412	470,179	3,000	594,390	2,335,293	400
1894	19,019,990	16,792,154	8,577,624	705,969	1,500	515,746	3,688,666	300
1895	19,144,390	19,545,233	8,120,125	1,208,482	1,500	438,232	4,386,132	200
1896	20,584,421	23,941,169	10,019,770	1,252,777	1,680	361,450	4,680,732	250
1897	19,262,066	21,560,515	13,090,045	1,903,411	322	384,934	4,122,356	500
1898	15,948,464	18,738,708	13,615,101	2,257,207	5,568	444,383	3,730,907	360
1899	14,374,512	21,142,108	13,910,630	2,642,095	18,280	390,278	3,848,182	360
1900	14,559,127	22,362,730	16,195,675	4,324,484	62,259	317,385	4,874,392	200
1901	13,831,996	21,648,083	14,177,126	8,786,330	137,259	460,520	5,757,086	250
1902	13,183,610	21,014,231	13,513,345	13,984,268	185,331	396,901	7,480,896	200
1903	12,518,134	20,480,286	12,899,395	24,382,472	554,286	483,925	9,186,411	....
1904	12,239,026	18,876,631	12,644,686	29,649,434	998,284	501,763	11,339,124	....
1905	11,554,777	16,346,660	11,578,110	33,427,473	1,217,337	376,238	10,964,247	181,084
1906	11,500,410	14,787,763	10,120,935	33,098,598	1,213,548	327,582	7,673,477	4,397,050
1907	11,211,606	12,207,448	9,095,296	39,748,375	820,844	331,851	5,128,037	24,281,973
1908	10,584,453	10,858,797	9,523,176	44,854,737	a 727,767	379,653	3,283,629	33,686,238
1909	10,434,300	10,632,793	10,745,092	55,471,601	a 639,016	310,861	2,296,086	30,898,339
1910	9,848,500	9,916,370	11,753,071	73,010,560	a 468,774	239,794	2,159,725	33,143,262
1911	9,200,673	8,817,112	9,795,464	81,134,391	a 472,458	226,926	1,695,289	31,317,038
1912	8,712,076	b 8,969,007	12,128,962	86,450,767	a 484,368	206,052	970,009	28,601,308
Total.	736,205,411	415,444,184	238,985,483	542,887,881	8,068,961	10,237,571	100,532,249	186,512,968

a No production in Tennessee recorded.

b Includes production of Michigan.

Production of petroleum in the United States, 1859–1912, by years and by States, in barrels of 42 gallons—Continued.

Year.	Kansas.	Texas.	Missouri.	Oklahoma.	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	[a] 2,335	10,000	5,400		69,389,194	66,417,335
1902	331,749	18,083,658	[a] 757	37,100	6,253	548,617	88,766,916	71,178,910
1903	932,214	17,955,572	[a] 3,000	138,911	8,960	917,771	100,461,337	94,694,050
1904	4,250,779	22,241,413	[a] 2,572	1,366,748	11,542	2,958,958	117,080,960	101,175,455
1905	[b] 12,013,495	28,136,189	[a] 3,100	(c)	8,454	8,910,416	134,717,580	84,157,399
1906	[b] 21,718,648	12,567,897	[a] 3,500	(c)	[d] 7,000	9,077,528	126,493,936	92,444,735
1907	2,409,521	12,322,696	[a] 4,000	43,524,128	[e] 9,339	5,000,221	166,095,335	120,106,749
1908	1,801,781	11,206,464	[a] 15,246	45,798,765	[e] 17,775	5,788,874	178,527,355	129,079,184
1909	1,263,764	9,534,467	[a] 5,750	47,859,218	[e] 20,056	3,059,531	183,170,874	128,328,487
1910	1,128,668	8,899,266	[a] 3,615	52,028,718	[e] 115,430	6,841,395	209,557,248	127,899,688
1911	1,278,819	9,526,474	[a] 7,995	56,069,637	[e] 186,695	10,720,420	220,449,391	134,044,752
1912	1,592,796	11,735,057	(f)	51,427,071	[e] 1,572,306	9,263,439	222,113,218	163,802,334
Total.	49,422,978	168,721,719	54,077	298,267,850	1,998,047	63,087,170	2,820,426,549	2,338,032,130

[a] Includes the production of Michigan.
[b] Includes production of Oklahoma.
[c] Included with Kansas.
[d] Estimated.
[e] Includes the production of Utah.
[f] No production in Missouri.

PRODUCTION BY FIELDS.

The previous reports of this series have described the characteristics of the chief oil fields of the United States. In this report the section devoted to each State will show the changes which have taken place in the conditions of occurrence of petroleum in each field.

As the fields gradually approach one another the grouping loses its value. The following tables, however, are valuable as showing the increasing importance of the western fields:

Production of petroleum in the United States, 1908–1912, by fields, in barrels.

Field.	1908	1909	1910	1911	1912
Appalachian	24,945,517	26,535,844	26,892,579	23,749,832	26,338,516
Lima-Indiana	10,032,305	8,211,443	7,253,861	6,231,164	[a] 4,925,906
Illinois	33,686,238	30,898,339	33,143,362	31,317,038	28,601,308
Mid-Continent [b]	48,823,747	50,833,740	59,217,582	66,595,477	65,473,345
Gulf	15,772,137	10,883,240	9,680,465	10,999,873	8,545,018
California	44,854,737	55,471,601	73,010,560	81,134,391	86,450,767
Other	412,674	336,667	358,839	421,616	1,778,358
Total	178,527,355	183,170,874	209,557,248	220,449,391	222,113,218

[a] Includes Michigan. [b] Includes Caddo production for commercial purposes.

Percentages of total petroleum produced in the several fields, 1908–1912.

Field.	1908	1909	1910	1911	1912
Appalachian	13.97	14.49	12.83	10.77	11.86
Lima-Indiana	5.62	4.48	3.46	2.83	2.22
Illinois	18.87	16.87	15.82	14.21	12.87
Mid-Continent [a]	27.35	27.75	28.26	30.21	29.48
Gulf	8.83	5.94	4.62	4.99	3.85
California	25.13	30.29	34.84	36.80	38.92
Other	.23	.18	.17	.19	.80
Total	100.00	100.00	100.00	100.00	100.00

[a] Includes Caddo production for commercial purposes.

Production of petroleum in the United States, in 1911 and 1912, by fields, showing percentage of increase or decrease, in barrels.

Field.	Production.		Increase.	Decrease.	Percentage.	
	1911	1912			Increase.	Decrease.
Appalachian	23,749,832	26,338,516	2,588,684		10.90	
Lima-Indiana	6,231,164	[a] 4,925,906		1,305,258		20.95
Illinois	31,317,038	28,601,308		2,715,730		8.67
Mid-Continent [b]	66,595,477	65,473,345		1,122,132		1.68
Gulf	10,999,873	8,545,018		2,454,855		22.32
California	81,134,391	86,450,767	5,316,376		6.34	
Other	421,616	1,778,358	1,356,742		321.84	
Total	220,449,391	222,113,218	1,663,827		.755	

[a] Includes production of Michigan. [b] Includes Caddo production for commercial purposes.

Quantity, total value, and price per barrel received at wells for petroleum produced in the United States in 1911 and 1912, by fields, in barrels.

Field.	1911			1912		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Appalachian	23,749,831	$30,830,354	$1.298	26,338,516	$42,818,384	$1.626
Lima-Indiana	6,231,164	5,116,954	.821	[a] 4,925,906	4,794,784	.932
Illinois	31,317,038	19,734,339	.630	28,601,308	24,332,605	.851
Mid-Continent [b]	66,595,477	31,928,208	.479	65,473,345	45,300,669	.692
Gulf	10,999,873	7,355,681	.669	8,545,018	6,344,173	.742
California	81,134,391	38,719,080	.477	86,450,767	39,213,588	.454
Other	421,616	360,136	.854	1,778,358	998,131	.561
Total	220,449,391	134,044,752	.608	222,113,218	163,802,334	.737

[a] Includes Michigan. [b] Includes Caddo production for commercial purposes.

Deliveries to trade of petroleum and purposes for which shipped in 1912, by fields, in barrels.

Field.	1911			1912		
	Delivered for—		Total.	Delivered for—		Total.
	Refining.	Fuel.		Refining.	Fuel.	
Appalachian	[a]24,021,735	....	24,021,735	[b]27,042,540	....	27,042,540
Lima-Indiana	7,758,301	8,287	7,766,588	5,688,025	13,325	5,701,350
Illinois	[c]38,437,752	140,200	38,577,952	[c]36,820,455	134,985	36,955,440
Kansas, Oklahoma	[d]53,623,845	1,954,819	55,578,664	[e]58,108,633	954,924	59,063,557
Louisiana	3,446,410	5,419,062	8,865,472	6,122,753	4,693,135	10,815,888
Texas	[f]4,769,305	4,261,007	9,030,312	[f]7,574,605	4,528,310	12,102,915
California	[g]20,120,000	49,859,391	69,979,391	[h]34,918,167	48,220,326	83,138,493
Other	225,870	[i]200,567	426,437	1,641,297	15,034	1,656,331
Total	152,403,218	61,843,333	214,246,551	177,916,475	58,560,039	236,476,514

[a] Includes 41,287 barrels of lubricating oil.
[b] Includes 55,812 barrels of lubricating oil
[c] Includes small amount used for street sprinkling.
[d] Includes 247,511 barrels shipped by rail that can not be classified.
[e] Includes 271,252 barrels shipped by rail that can not be classified.
[f] Includes small amount of lubicating oil.
[g] 3,620,000 barrels estimated used for road oil and gas manufacture.
[h] 6,000,000 barrels estimated used for road oil and gas manufacture.
[i] The corresponding amount for 1912 consisted of residuum from refined oil.

Total stocks in the United States decreased from 137,232,998 barrels at the close of the year 1911 to 122,869,702 barrels at the end of 1912. The only material increase was in stocks in California. The decline was greatest for Illinois oil, not only the supply held by the eastern pipe lines decreasing, but also that held in storage within the State. Mid-Continent oil also showed considerable decrease. The next largest decline was in Louisiana oil.

Stocks, runs, and deliveries to trade of petroleum in 1912, by fields, in barrels.

Field.	Stocks, Dec. 31, 1910.	Production in 1911.	Deliveries to trade in 1911.	Stocks, Dec. 31, 1911.	Production in 1912.	Deliveries to trade in 1912.	Stocks, Dec. 31, 1912.
Appalachian	5,006,445	23,749,832	24,021,735	4,734,542	26,338,516	27,042,540	4,030,518
Lima-Indiana	4,730,409	6,231,164	7,766,588	3,194,985	[a]4,925,906	5,701,350	2,419,541
Illinois	31,324,784	31,317,038	38,577,952	24,063,870	28,601,308	36,955,440	15,709,738
Kansas, Oklahoma	52,659,506	57,348,456	55,578,664	54,429,298	53,019,867	59,063,557	48,385,608
Louisiana	1,834,775	10,720,420	8,865,472	3,689,723	9,263,439	10,815,888	2,137,274
Texas	2,358,840	9,526,474	9,030,312	2,855,002	11,735,057	12,102,915	2,487,144
California	33,085,118	81,134,391	69,979,391	44,240,118	86,450,767	83,138,493	47,552,392
Other	30,281	421,616	426,437	25,460	1,778,358	1,656,331	147,487
Total	131,030,158	220,449,391	214,246,551	137,232,998	222,113,218	236,476,514	122,869,702

[a] Includes production in Michigan.

Stocks of all grades of petroleum at the close of 1911 and 1912, in barrels.

Kind of oil.	Held by eastern pipe lines and refineries.[a]		In pipe-line storage outside of eastern field.		Total.		Increase.	Decrease.
	1911	1912	1911	1912	1911	1912		
Pennsylvania[b]	4,479,779	3,804,483			4,479,779	3,804,483		675,296
Lima	3,147,427	2,297,861	47,558	121,680	3,194,985	2,419,541		775,444
Illinois[c]	2,795,623	2,368,271	21,268,247	13,341,467	24,063,870	15,709,738		8,354,132
Kentucky	254,763	226,035			254,763	226,035		28,728
Kansas, Oklahoma	3,849,479	2,034,695	50,579,819	46,350,913	54,429,298	48,385,608		6,043,690
Texas			2,855,002	2,487,144	2,855,002	2,487,144		367,858
Louisiana			3,689,723	2,137,274	3,689,723	2,137,274		1,552,449
California			44,240,118	47,552,392	44,240,118	47,552,392	3,312,274	
Other			25,460	147,487	25,460	147,487	122,027	
Total	14,527,071	10,731,345	122,705,927	112,138,357	137,232,998	122,869,702		14,363,296

[a] These pipe lines connect with the collecting lines of the Lima-Indiana, Illinois, Kansas, and Oklahoma fields and receive and transfer large quantities of these western oils to the Atlantic seaboard in addition to the oil from wells directly tributary to their own systems.
[b] Includes natural lubricating oil from Pennsylvania and West Virginia.
[c] Includes some Indiana oil of Illinois grade.

WELL RECORD.

The following tables give the well record for the United States for 1911 and 1912, by fields:

Well record in the United States in 1911, by fields.

Field.	Wells completed.				Initial daily production (barrels).	
	Oil.	Gas.	Dry.	Total.	Total.	Average per well.
Appalachian	2,978	976	1,060	5,014	28,100	9.44
Pennsylvania and New York	1,491	219	297	2,007	4,912	3.29
Central and southeastern Ohio	765	403	512	1,680	10,923	14.28
West Virginia	622	351	218	1,191	10,443	16.79
Kentucky	100	3	33	136	1,822	18.22
Lima-Indiana	554	23	67	644	7,477	13.50
Lima, Ohio	480	15	32	527	6,381	13.29
Indiana	74	8	35	117	1,096	14.81
Illinois	1,061	41	263	1,365	66,851	63.01
Mid-Continent	3,796	490	686	4,972	453,907	119.58
Kansas	172	150	96	418	3,271	19.01
Oklahoma	3,294	304	489	4,087	262,333	79.64
Northern Texas	84	4	38	126	19,180	228.33
Caddo[a]	246	32	63	341	169,123	687.49
Gulf	415	50	149	614	106,885	257.55
Coastal Texas	352	33	117	502	32,740	93.01
Coastal Louisiana	63	17	32	112	74,145	1,176.90
California	970		104	1,074		
Colorado	14		18	32		
Wyoming and Utah	37		16	53		
Total	9,825	1,580	2,363	13,768		

[a] Includes Marion County, Tex.

Well record in the United States in 1912, by fields.

Field.	Wells completed.				Initial daily production (barrels).	
	Oil.	Gas.	Dry.	Total.	Total.	Average per well.
Appalachian	3,931	1,016	1,077	6,024	142,711	36.3
Pennsylvania and New York	1,911	239	322	2,472	6,771	3.5
Central and southeastern Ohio	846	411	460	1,717	24,193	28.6
West Virginia	1,062	361	234	1,657	109,804	103.4
Kentucky	112	5	61	178	1,943	17.3
Lima-Indiana	547	18	75	640	8,312	15.2
Lima, Ohio	482	14	55	551	7,229	15.0
Indiana	65	4	20	89	1,083	16.7
Illinois	980	23	257	1,260	65,686	67.0
Mid-Continent	5,786	754	1,189	7,729	348,442	60.2
Kansas	536	253	160	949	7,245	13.5
Oklahoma	4,712	438	843	5,993	228,886	48.6
Northern Texas	299	11	124	434	28,213	94.3
Caddo, La	239	52	62	353	84,098	351.9
Gulf	412		134	546	58,602	142.2
Coastal Texas	353		109	462	33,082	93.7
Coastal Louisiana	59		25	84	25,520	432.5
California	776		71	847		
Colorado	15		13	28		
Wyoming and Utah	59		25	84		
Michigan	6		2	8		
Miscellaneous			12	12		
Total for 1912	12,512	1,811	2,855	17,178		
Corresponding total for 1911	9,825	1,580	2,363	13,768		

FUEL OILS.

GENERAL STATEMENT.

Of the total production of 222,113,218 barrels of crude petroleum produced in the United States in 1912 about 85,000 000 barrels, or over one-third, was burned as fuel for power purposes. This includes deliveries by pipe lines of 58,560,039 barrels of crude oil, crude oil consumed in the field, and some manufactured fuel oils.

RAILROADS.

Exact statistics of consumption of fuel oil are obtainable only for the quantity used by railroads, which amounted to 33,605,598 barrels in 1912, an increase over the 29,748,845 barrels used in 1911 of nearly 13 per cent. The number of miles of railroad operated by the use of oil declined from 30,039 miles to 28,451 miles. The total mileage, however, made by oil-burning engines increased—in other words, more trains were run on less track. In 1906 the number of miles made for each barrel of oil consumed was 3.93. This figure has declined almost continuously since then, till in 1912 only 3.61 miles per barrel was the result. It is not necessary to assume that this anomalous result is due to poorer quality of fuel oil or to less careful use or to any other form of decreased efficiency. The more probable reason is the introduction of heavier steel freight and passenger cars. A really accurate comparison in the future must consider the ton-mile.

The decrease in number of miles operated by oil is due to the return of a few railroads to coal. On one road this was due to the partial exhaustion of oil fields adjacent to the portion of the line which went back to coal. On another road, the change is attributed solely to the increased cost of fuel oil. The change back to coal will be still more evident in 1913, as increasing prices for oil offset its advantages as a fuel.

Consumption of fuel oil by the railroads of the United States, 1906–1912.

Year.	Length of line operated by the use of fuel oil.[a]	Quantity of fuel oil consumed by railroads.	Total mileage made by oil-burning engines.	Average number of miles per barrel of oil consumed.
	Miles.	*Barrels.*	*Miles.*	*Miles.*
1906	....	15,577,677	....	....
1907	13,573	18,849,803	74,079,726	3.93
1908	15,474	16,870,882	64,279,509	3.81
1909	17,676	19,905,335	72,918,118	3.66
1910	22,709	23,817,346	89,107,883	3.74
1911	30,039	29,748,845	109,680,976	3.69
1912	28,451	33,605,598	121,393,228	3.61

[a] Some of these lines also used coal.

The following are the names of the railroad companies which used fuel oil on their lines in 1912:

Pacific System (excluding Sonora Railway) of the Southern Pacific Co., in California Arizona, and New Mexico.
Galveston, Harrisburg & San Antonio Railway Co., in Texas.
Texas & New Orleans Railroad Co., in Texas.
Houston & Texas Central Railroad Co., in Texas.
Houston, East & West Texas Railway Co., in Texas.
Houston & Shreveport Railroad Co., in Louisiana.
Louisiana Western Railroad Co., in Louisiana.
Morgan's Louisiana & Texas Railroad & Steamship Co., in Louisiana.
Iberia & Vermillion Railroad Co., in Louisiana.
Oregon Short Line Railroad Co., in Idaho and Montana.
Oregon-Washington Railroad & Navigation Co., in Oregon and Washington.
St. Louis & San Francisco Railroad Co., and branches, in Missouri, Kansas, Texas, Oklahoma, and Arkansas.
St. Louis, San Francisco & Texas Railway (including Fort Worth & Rio Grande Railway), in Texas.
St. Louis, Brownsville & Mexico Railway, in Texas.
New Orleans, Texas & Mexico Co., in Louisiana and Texas.
Rock Island Lines (including Chicago, Rock Island & Gulf Railway in Texas), in Kansas, Oklahoma, and Texas.
Atchison, Topeka & Santa Fe Railway System, in California, Nevada, Louisiana, Arizona, Texas, Kansas, and Oklahoma.
Kansas City Southern Railway Co., in Texas and Louisiana, exclusively, and in Missouri, Kansas, Arkansas, and Oklahoma, partly.
International & Great Northern Railway Co., in Texas.
San Pedro, Los Angeles & Salt Lake Railroad Co., in California, Nevada, and Utah.
Trinity & Brazos Valley Railway Co., in Texas.
Galveston, Houston & Henderson Railroad Co., in Texas.
San Antonio & Aransas Pass Railway Co., in Texas.
Texas & Pacific Railway Co., in Texas and Louisiana.
Artesian Belt Railroad Co., in Texas.
Chicago & North Western Railway Co., in Nebraska, South Dakota, and Wyoming.
Wyoming & Northwestern Railway, in Wyoming.
Northern Pacific Railway Co., in Oregon and Washington.
Great Northern Railway Co., in Washington.

Chicago, Milwaukee & Puget Sound Railway Co., in Washington and Idaho, and in Montana west of Deer Lodge to the Idaho State line.
Tonopah & Goldfield Railroad Co., in Nevada.
New York Central & Hudson River Railroad Co (including Old Forge & Fulton Chain on Old Forge & Fulton Chain Railway), in the Adirondacks, New York.
Northwestern Pacific Railroad Co., in California.
San Diego & Arizona Railway Co., in California.
San Diego & South Eastern Railway Co., in California.
Delaware & Hudson Co., in the Adirondacks, New York.
Central of Georgia Railway Co., in Georgia on Tybee district.
Western Pacific Railway Co., in Nevada and California.
Las Vegas & Tonopah Railroad Co., in Nevada.
Bellingham & Northern Railway Co., in Washington.
Idaho & Washington Northern Railroad, in Idaho and Washington.
Washington, Idaho & Montana Railway Co., in Idaho.
El Paso & Southwestern Co., in New Mexico.
Spokane, Portland & Seattle Railway Co., in Oregon and Washington.
Corvallis & Eastern Railroad Co., in Oregon.
Pacific Railway & Navigation Co., in Oregon.
Tonopah & Tidewater Railroad, in California and Nevada.
Bullfrog Goldfield Railroad, in Nevada.

MANUFACTURES.

Oil consumption in the production of power for industrial purposes increased so considerably that there was very little addition to the stock. It is estimated that 65,000,000 barrels were used in California last year for fuel by railroads and for industrial purposes. This use will undoubtedly spread to other parts of the United States when the popularity of internal-combustion engines burning heavy oils becomes established. The increased facility of transportation of oils from Mexico should be shown by an increase in the consumption of fuel oil in the East in 1914.

OIL FOR WATER NAVIGATION.

The west coast has adopted oil almost exclusively for vessels of the coastwise trade, and this use may be expected to extend to the east coast with the opening of the Panama Canal. The considerable use of oil for trans-Atlantic trade is improbable with the present supply.

The United States Navy has definitely abandoned the use of coal in future fighting-ship design. All new destroyers, submarines, and battleships are designed for oil burning; there are now built or building 4 battleships, 41 destroyers, 30 submarines, 1 monitor, 3 tank ships, 1 collier, 1 submarine tender, and several tugs and small vessels burning oil exclusively. Also 8 battleships burn both coal and oil. One transport and 1 supply ship will be fitted to burn either oil or coal.

The Navy is extending its oil facilities rapidly. The President has set aside about 100 square miles of oil-producing lands in the Elk Hills and Buena Vista fields of California as Navy petroleum reserves. These reserves have an estimated capacity of 250,000,000 barrels. The Navy Department intends to hold this oil in the ground as an emergency supply and as a precaution against sudden decline of oil production in the United States. Tank storage is provided as follows: Boston, Mass., 36,000 barrels; Melville, R. I., 36,000 barrels; Norfolk, Va., 36,000 barrels; Charleston, S. C., 36,000 barrels; Key West, Fla., 36,000 barrels; Guantanamo, Cuba, 223,000 barrels; and

Pearl Harbor, Hawaii, 200,000 barrels. Tanks will also be established at New York, San Francisco, San Diego, Puget Sound, Guam, and Cavite, and the storage facilities increased to keep pace with the number of oil-burning vessels commissioned. The Navy also maintains a well-equipped fuel-oil testing plant at the Philadelphia Navy Yard, where evaporative tests with various burners and boilers are conducted and where officers and enlisted men receive instruction.

During the year 1912 the Navy used 21,000,000 gallons of fuel oil, and it is estimated that the consumption for the present year will be 30,000,000 gallons.

The Navy tanker *Maumee* will have two 2,500-horsepower Diesel engines, and will also have two 300-horsepower dynamo Diesel engines. All submarines building are to be equipped with heavy oil engines.

The *Selandia*, the *Eavestone*, the *Christian X*, the *Rolandseak*, all heavy oil engined vessels, visited this country and aroused great interest in engineering circles. Other interesting foreign vessels of this type are the *Sembilam*, the *Jutlandia*, the *Juno*, the *Savonia*, and the *Fordonian*.

The ship *Hagen*, which has a displacement of 8,350 tons and is 400 feet over all in length, recently made a trial trip in lower New York Bay. The ship is equipped with two 6-cylinder Diesel engines of two-cycle type to develop 2,400 horsepower. During the test the ship ran at about 11 knots.

PETROLEUM OPERATORS' STATISTICS.

The results given in the tables that follow are of statistics collected directly from the oil producers. The object of this investigation, in addition to determining the production by the pipe-line statistics, is to avoid by this double system any serious errors by either method. The results have fully justified the additional labor and have been especially useful in distributing the product to the producing States. It is the only means by which record is kept of the total number of wells producing in the United States and of the acres under development.

Production and value of petroleum, well records, and acreage for the United States in 1911, by States, from statistics furnished by producers.

State.	Production (in barrels). Placed to credit of— Producer.	Production (in barrels). Placed to credit of— Landowner.	Production (in barrels). Total.	Value.	Average price per barrel.	Wells. Productive Jan. 1.	Wells. Completed. Oil.	Wells. Completed. Dry.	Wells. Abandoned.	Wells. Productive Dec. 31.	Average daily production (in barrels) per well.	Acreage. Fee.	Acreage. Lease.	Acreage. Total.
California	77,140,431	3,993,960	81,134,391	$38,719,080	$0.477	5,188	963	104	246	5,905	38.1	326,009	237,552	563,561
Colorado	222,957	3,969	226,926	228,104	1.005	116	14	18	9	121	5.1	13,230	20,140	33,370
Illinois	25,873,928	4,734,235	30,608,163	19,505,303	.637	12,171	969	160	387	12,753	4.2	4,033	314,338	318,371
Indiana	1,106,358	173,143	1,279,501	886,488	.693	6,493	167	10	1,533	5,127	.7	[a]3,494	123,451	126,945
Kansas	1,089,890	137,842	1,227,732	626,431	.510	1,787	164	25	194	1,757	1.9	10,031	110,199	120,230
Kentucky	385,856	47,986	433,842	302,651	.698	988	91	38	91	988	1.2	[a]3,678	132,435	136,113
Louisiana	10,356,642	1,892,988	12,249,630	6,317,559	.516	318	302	84	65	555	60.5	24,570	815,791	840,361
Michigan, Missouri	7,795	200	7,995	7,995	1.000	26	1	3	....	27	.8	815	5,115	5,930
New York	868,621	71,106	939,727	1,248,886	1.329	10,874	147	9	396	10,625	.2	[a]38,690	70,253	108,943
Ohio	6,464,111	1,004,135	7,468,246	7,567,069	1.013	31,255	1,754	289	1,672	31,337	.7	[a]29,659	655,327	684,986
Oklahoma	42,016,485	6,192,090	48,208,575	23,304,883	.485	13,602	2,778	319	682	15,698	8.4	40,621	1,147,969	1,188,590
Pennsylvania	6,763,085	727,659	7,490,744	9,896,604	1.321	50,991	2,835	202	1,081	52,745	.4	[a]229,388	797,546	1,026,934
Texas	7,524,926	897,482	8,422,408	5,540,876	.658	2,507	460	124	494	2,473	9.3	26,415	362,929	389,344
Utah, Wyoming	172,989	13,706	186,695	124,037	.664						3.1			
Utah						11	1	7	....	12		16,000	2,740	18,740
Wyoming						112	45	9	6	151		12,220	27,330	39,550
West Virginia	8,347,518	1,166,046	9,513,564	12,375,618	1.301	12,964	664	143	614	13,014	2.0	[a]31,706	2,689,188	2,720,894
Total	188,341,592	21,056,547	209,398,139	126,651,584	.604	149,403	11,355	1,544	7,470	153,288	3.7	810,559	7,512,303	8,322,862

[a] 1910 data.

Production and value of petroleum, well records, and acreage for the United States in 1912, by States, from statistics furnished by producers.

State.	Production (in barrels). Placed to credit of— Producer.	Production (in barrels). Placed to credit of— Landowner.	Production (in barrels). Total.	Value.	Average price per barrel.	Wells. Productive Jan. 1.	Wells. Completed. Oil.	Wells. Completed. Dry.	Wells. Abandoned.	Wells. Productive Dec. 31.	Average daily production (in barrels) per well.	Acreage. Fee.	Acreage. Lease.	Acreage. Total.
Alabama								2				80	9,000	9,080
Arizona								1				160		160
Arkansas								5				80	89,800	89,880
California	83,150,304	3,300,463	86,450,767	$39,213,588	$0.454	5,947	776	71	402	6,321	37.4	334,902	208,926	543,828
Colorado	204,852	1,200	206,052	199,661	.968	111	15	13	14	112	5.0	9,404	11,365	20,769
Georgia								1					1,500	1,500
Illinois	23,891,074	4,287,014	28,178,088	24,403,811	.866	12,753	982	208	513	13,222	17.9	3,161	285,046	288,207
Indiana	736,233	114,364	850,597	793,891	.933	5,127	82	17	1,038	4,171	.6	(a)	(a)	(a)
Kansas	1,117,325	132,184	1,249,509	832,171	.665	1,757	279	41	224	1,812	1.9	18,458	119,274	137,732
Kentucky	348,714	43,376	392,090	331,738	.846	988	94	56	183	899	1.2	(a)	(a)	(a)
Louisiana	9,140,524	1,611,172	10,751,696	7,970,977	.741	555	315	91	90	780	37.7	30,880	263,885	294,765
Michigan			(b)	(b)										
Missouri						26	6	2		32				
New Mexico								1				800	1,920	2,720
New York	812,334	65,193	877,527	1,346,448	1.534	10,625	248	6	357	10,516	.2	(a)	(a)	(a)
Ohio	6,709,770	1,011,632	c 7,721,402	c 10,417,921	1.349	31,337	1,485	297	2,083	30,739	.7	(a)	(a)	(a)
Oklahoma	38,030,156	5,441,310	43,471,466	29,467,275	.678	15,698	3,668	440	651	18,715	6.3	45,231	1,421,117	1,466,348
Oregon								1				7,000	700	7,700
Pennsylvania	6,348,298	688,293	7,036,591	11,307,465	1.606	52,745	1,757	195	1,396	53,106	.4	(a)	(a)	(a)
Tennessee								1				684	27,500	28,184
Texas	9,776,241	1,199,738	10,975,979	8,100,329	.738	2,473	756	284	246	2,983	10.1	67,923	1,233,537	1,301,360
Utah	1,225,081	347,225	1,572,306	798,470	.507	17		1	4	13		13,717	1,160	14,877
Wyoming						160	59	24	30	189	22.7	20,144	44,666	64,810
West Virginia	10,160,301	1,424,285	11,584,586	18,785,748	1.602	13,014	1,327	140	616	13,725	2.3	310,799	1,636,611	1,947,410
Total	191,651,207	19,667,449	211,318,656	153,969,493	.729	153,333	11,849	1,898	7,847	157,335	3.7			

a Data for 1912 not complete. b Included in Ohio. c Includes production of Michigan.

Production of petroleum and increase or decrease by States in 1912 as compared with 1911, in barrels.

State.	Production. 1911	Production. 1912	Increase.	Decrease.	Percentage. Increase.	Percentage. Decrease.
California	81,134,391	86,450,767	5,316,376		6.55	
Colorado	226,926	206,052		20,874		9.20
Illinois	30,608,163	28,178,088		2,430,075		7.94
Indiana	1,279,501	850,597		428,904		33.52
Kansas	1,227,732	1,249,509	21,777		1.77	
Kentucky	433,842	392,090		41,752		9.62
Louisiana	12,249,630	10,751,696		1,497,934		12.22
Michigan } Missouri }	7,995	(a) (b)				
New York	939,727	877,527		62,200		6.61
Ohio	7,468,246	c 7,721,402	245,161		3.28	
Oklahoma	48,208,575	43,471,466		4,737,109		9.8
Pennsylvania	7,490,744	7,036,591		454,153		6.06
Texas	8,422,408	10,975,979	2,553,571		30.31	
Utah } Wyoming }	186,695	1,572,306	1,385,611		742.00	
West Virginia	9,513,564	11,584,586	2,071,022		21.76	
Total	209,398,139	211,318,656	1,920,517		.92	

a Included in Ohio.
b No production in 1912.
c Includes Michigan.

The following tables give the well records of the petroleum industry in 1911 and 1912 for the respective States by counties:

Petroleum well record in 1911 and 1912, by counties.

NEW YORK.

County.	1911 Productive Jan. 1.	1911 Completed. Oil.	1911 Completed. Dry.	1911 Abandoned.	1911 Productive Dec. 31.	1912 Completed. Oil.	1912 Completed. Dry.	1912 Abandoned.	1912 Productive Dec. 31.
Allegany	7,784	114	8	278	7,620	175	6	280	7,515
Cattaraugus	2,871	33	1	117	2,787	61		66	2,782
Steuben	219			1	218	12		11	219
Total	10,874	147	9	396	10,625	248	6	357	10,516

PENNSYLVANIA.

County.	1911 Productive Jan. 1.	1911 Completed. Oil.	1911 Completed. Dry.	1911 Abandoned.	1911 Productive Dec. 31.	1912 Completed. Oil.	1912 Completed. Dry.	1912 Abandoned.	1912 Productive Dec. 31.
Allegheny	1,591	191	24	94	1,688	50	19	74	1,664
Armstrong	178	10	2	9	179	8		17	170
Beaver	613	31	5	51	593	33	11	17	609
Butler	5,351	120	50	355	5,116	258	51	106	5,268
Clarion	1,696	138	24	42	1,792	39	7	82	1,749
Crawford	507	115		6	616	24		43	597
Elk	1,078	47		9	1,116	10	2	8	1,118
Forest	1,501	172	15	40	1,633	39	15	60	1,612
Greene	428	70	9	14	484	31	19	19	496
Jefferson	126	7		2	131	5	6	1	135
Lawrence	33	35	1		68	113	5	3	178
McKean	14,630	531	10	106	15,055	288	12	373	14,970
Mercer	271	2		7	266	11		1	276
Potter	149	6		70	85			7	78
Tioga	41			15	26			19	7
Venango	14,533	736	39	70	15,199	634	27	281	15,552
Warren	6,348	618	18	60	6,906	189	16	196	6,899
Washington	1,917	6	5	131	1,792	25	5	89	1,728
Total	50,991	2,835	202	1,081	52,745	1,757	195	1,396	53,106

Petroleum well record in 1911 and 1912, by counties—Continued.

WEST VIRGINIA.

County.	1911					1912			
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Completed.		Abandoned.	Productive Dec. 31.
		Oil.	Dry.			Oil.	Dry.		
Braxton		1			1		1		1
Brooke	355	1	2	30	326	5	1	58	273
Cabell	26	2	4	5	23	1			24
Calhoun	265	10	1	1	274	37	5	21	290
Clay		4	1	1	3	11	3	2	12
Doddridge	587	9	2	42	554	19	5	3	570
Gilmer	84			1	83	4		3	84
Hancock	320	7	10	27	300	52	1	4	348
Harrison	1,143	52	11	47	1,148	58	8	50	1,156
Kanawha		13	3	8	5	409	17	4	410
Lewis	231	2	4	9	224	34	6	3	255
Lincoln	438	57		2	493	68		2	559
Logan		2	3		2			1	1
Marion	672	16	2	48	640	19	2	15	644
Marshall	197			30	167	9		41	135
Mason			2			1	2		1
Monongalia	745	8	5	76	677	20	1	13	684
Ohio		4			4			2	2
Pleasants	1,608	52	16	47	1,613	69	13	166	1,516
Putnam							2		
Ritchie	1,869	48	38	116	1,801	110	18	64	1,847
Roane	548	177	4	11	714	122	10	10	826
Taylor			1						
Tyler	1,610	19	18	52	1,577	40	18	64	1,553
Upshur			2				1		
Wayne	2				2	1		2	1
Wetzel	1,175	59	3	38	1,196	56	3	72	1,180
Wirt	360	81	11	10	431	56	2	10	477
Wood	729	40		13	756	126	21	6	876
Total	12,964	664	143	614	13,014	1,327	140	616	13,725

KENTUCKY.

County.	Productive Jan. 1, 1911	Oil, 1911	Dry, 1911	Abandoned, 1911	Productive Dec. 31, 1911	Oil, 1912	Dry, 1912	Abandoned, 1912	Productive Dec. 31, 1912
Barren	9			2	7	6			13
Bath	91				91			1	90
Boyd			2				19		
Floyd	18	1	2		19	3		2	20
Hancock							2		
Knott	1	1	1		2				2
Lawrence		11	1	1	10	14	6	6	18
Logan	7			2	5	3			8
Morgan						4			4
Ohio						1		1	
Rowan	35				35			35	
Wayne	685	76	32	73	688	53	28	126	615
Wolfe	142	2		13	131	10	1	12	129
Total	988	91	38	91	988	94	56	183	899

OHIO.

County.	Productive Jan. 1, 1911	Oil, 1911	Dry, 1911	Abandoned, 1911	Productive Dec. 31, 1911	Oil, 1912	Dry, 1912	Abandoned, 1912	Productive Dec. 31, 1912
Allen	1,930	25	1	152	1,803	31		255	1,579
Athens	121	8		8	121	18	4	14	125
Auglaize	604	9		52	561	13		44	530
Belmont	185	10	2	10	185	8	2	41	152
Carroll	45	3		5	43	6		2	47
Columbiana	309	14	2	32	291	21	10	46	266
Coshocton	13	4	4		17	2	5		19
Fairfield	177	73	12	8	242	50	1	12	280
Guernsey	10	1	1	1	10	4			14
Hancock	3,666	59	6	432	3,293	70	2	137	3,226
Hardin						2	1		2
Harrison	789	93	11	10	862	20	13	136	746
Hocking	2	20	1	2	20	79	12	2	97
Holmes	23	6	1	1	28	3			31
Jackson	17			3	14			14	
Jefferson	354	82	23	10	426	31	16	22	435

Petroleum well record in 1911 and 1912, by counties—Continued.

OHIO—Continued.

County.	1911 Productive Jan. 1.	1911 Completed. Oil.	1911 Completed. Dry.	1911 Abandoned.	1911 Productive Dec. 31.	1912 Completed Oil.	1912 Completed Dry.	1912 Abandoned.	1912 Productive Dec. 31.
Knox	8			2	6	6	2		12
Lake						1			1
Licking		1	1		1	23	10		24
Logan		1	1	1		3	2		3
Lorain	9				9		5	1	8
Lucas	579	22	2	71	530	20	2	65	485
Mahoning		2	2	2					
Marion							1		
Medina	3				3				3
Meigs						1	1		1
Mercer	811	8	1	117	702	11		57	656
Monroe	2,503	105	42	21	2,587	118	38	72	2,633
Morgan	632	188	31	17	803	141	52	69	875
Muskingum	157	8	2	3	162	8	2	8	162
Noble	378	50	16	4	424	59	16	36	447
Ottawa	434	85	4	11	508	21	2	49	480
Perry	235	93	14	8	320	212	17	33	499
Sandusky	4,467	41	3	413	4,095	95	5	179	4,011
Seneca	623	64	8	15	672	20	4	55	631
Shelby	26			4	22			3	19
Stark							1		
Summit							1		
Trumbull	13	4	1	1	16	10	1	11	15
Tuscarawas	3		2	3					
Van Wert	790	69	1	17	842	20	4	132	730
Vinton	16	1		2	15			9	6
Washington	3,624	416	83	172	3,878	176	56	321	3,733
Wayne						11	5		11
Wood	7,562	187	11	30	7,719	168	1	258	7,629
Wyandot	137	2		32	107	3	3		110
Total	31,255	1,754	289	1,672	31,337	1,485	297	2,083	30,739

INDIANA.

County.	1911 Productive Jan. 1.	1911 Completed. Oil.	1911 Completed. Dry.	1911 Abandoned.	1911 Productive Dec. 31.	1912 Completed Oil.	1912 Completed Dry.	1912 Abandoned.	1912 Productive Dec. 31.
Adams	903	10		184	729	18		196	551
Blackford	329			90	239	4		59	184
Daviess			1			1	1		1
Delaware	198	9	2	43	164	16	3	52	128
Gibson	152			37	115	3	1	4	114
Grant	1,461			611	850			238	612
Harrison						3	2		3
Huntington	572	1		81	492			70	422
Jay	889	45		22	912	17	3	99	830
Montgomery							1		
Pike	96	71	4	9	158	5	3	15	148
Porter							1		
Randolph	43	2		6	39	5			44
Sullivan	6				6	2			8
Vigo	8				8	1			9
Wayne							1		
Wells	1,825	28	2	440	1,413	5	1	305	1,113
Miscellaneous [a]	11	1	1	10	2	2			4
Total	6,493	167	10	1,533	5,127	82	17	1,038	4,171

[a] Includes Greene, Hamilton, and Perry counties and undeveloped leases.

Petroleum well record in 1911 and 1912, by counties—Continued.

ILLINOIS.

1911

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Bond	....	....	6	....	....	....	20,276	20,276
Clark	2,341	48	15	135	2,254	1,503	53,688	55,171
Clinton	....	111	33	1	110	....	39,893	39,893
Coles	67	1	....	14	54	....	625	625
Crawford	6,652	272	56	71	6,853	1,411	69,384	71,295
Cumberland	677	4	1	19	662	19	6,185	6,204
Edgar	6	4	2	4	6	470	230	700
Lawrence	2,411	497	40	139	2,769	288	75,484	75,772
Macoupin	....	1	1	....	1	....	6,873	6,873
Madison	....	1	....	....	1	342	8,498	8,840
Marion	12	29	5	1	40	....	19,479	19,479
Randolph	5	1	....	3	3	....	778	778
Richland	....	....	1	....	....	....	20	20
Miscellaneous (undeveloped)	....	....	....	....	....	....	12,445	12,445
Total	12,171	969	160	387	12,753	4,033	314,338	318,371

1912.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Bond	....	....	1	....	....	....	6,315	6,315
Clark	2,254	62	7	90	2,226	1,260	23,865	25,125
Clinton	110	39	6	15	134	....	4,598	4,598
Coles	54	....	11	6	48	....	630	630
Crawford	6,853	263	104	274	6,842	827	83,595	84,422
Cumberland	662	27	10	27	662	13	5,796	5,809
Edgar	6	....	....	....	6	470	80	550
Jasper	....	4	....	....	4	....	651	651
Jackson	....	....	3	....	....	....	....	....
Lawrence	2,769	543	53	92	3,220	591	63,786	64,377
Macoupin	1	3	4	....	4	....	3,280	3,280
Madison	1	1	....	....	2	....	8,758	8,758
Marion	40	28	1	6	62	....	19,688	19,688
Montgomery	....	....	2	....	....	....	18,165	18,165
Perry	....	....	2	....	....	....	12,656	12,656
Randolph	3	3	2	3	3	....	600	600
Wabash	....	9	2	....	9	....	3,380	3,380
Miscellaneous (undeveloped)	....	....	....	....	....	....	29,203	29,203
Total	12,753	982	208	513	13,222	3,161	285,046	288,207

KANSAS.

1911.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Allen	160	46	11	36	170	613	8,465	9,078
Chautauqua	767	53	4	54	766	5,967	36,911	42,878
Coffey	2	....	....	....	2	....	240	240
Elk	5	....	....	1	4	....	150	150
Franklin	25	1	....	....	26	....	77	77
Labette	1	....	....	....	1	....	....	....
Miami	33	....	....	9	24	32	391	423
Montgomery	431	38	3	58	411	851	45,307	46,158
Neosho	170	26	1	13	183	1,050	3,798	4,848
Wilson	193	....	6	23	170	1,518	14,860	16,378
Total	1,787	164	25	194	1,757	10,031	110,199	120,230

Petroleum well record in 1911 and 1912, by counties—Continued.

KANSAS—Continued.

1912.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allen	170	34	14	32	172	1,452	7,913	9,365
Chautauqua	766	106	19	61	811	10,600	47,982	58,582
Coffey	2	......	......	......	2	......	398	398
Elk	4	2	......	......	6	......	150	150
Franklin	26	......	......	14	12	......	77	77
Labette	1	......	......	......	1	......	......	......
Miami	24	3	......	......	27	30	388	418
Montgomery	411	101	2	68	444	3,548	51,684	55,232
Neosho	183	24	5	39	168	1,778	3,860	5,638
Wilson	170	9	1	10	169	1,050	6,822	7,872
Total	1,757	279	41	224	1,812	18,458	119,274	137,732

OKLAHOMA.

1911.

Atoka	4	......	10	4	......	......	3,500	3,500
Carter	35	7	......	......	42	1,830	8,902	10,732
Comanche	3	......	1	......	3	......	15,700	15,700
Craig	1	......	......	1	......	......	300	300
Creek	1,866	99	39	181	1,784	4,188	90,172	94,360
Jackson	1	......	1	1	......	......	5	5
Jefferson	......	2	5	2	......	3,700	12,300	16,000
Johnston	......	......	5	......	......	......	1,780	1,780
Kay	......	4	7	......	4	......	4,000	4,000
Kiowa	5	......	......	......	5	......	660	660
Le Flore	......	......	2	......	......	......	13,488	13,488
Marshall	3	1	......	1	3	30	5,669	5,699
Muskogee	229	72	21	16	285	863	28,073	28,936
Nowata	4,626	642	35	191	5,077	5,644	75,124	80,768
Okfuskee	......	......	1	......	......	......	12,571	12,571
Okmulgee	206	53	16	15	244	5,015	79,148	84,163
Osage	1,179	461	44	47	1,593	1,970	180,114	182,084
Pawnee	189	141	12	13	317	255	32,353	32,608
Pittsburg	7	......	1	7	......	......	2,015	2,015
Rogers	1,643	142	10	22	1,763	1,999	21,972	23,971
Sequoyah	......	......	1	......	......	......	3,000	3,000
Stephens	......	......	1	......	......	......	4,680	4,680
Tulsa	1,010	358	29	62	1,306	3,695	70,246	73,941
Wagoner	1	......	......	1	......	......	3,692	3,692
Washington	2,594	796	78	118	3,292	7,224	433,343	440,567
Miscellaneous (undeveloped)	......	......	......	......	......	4,208	45,162	49,370
Total	13,602	2,778	319	682	15,698	40,621	1,147,969	1,188,590

1912.

Canadian	......	......	2	......	......	300	......	300
Carter	42	6	2	......	48	1,860	4,594	6,454
Cherokee	......	......	1	......	......	......	200	200
Cleveland	......	......	2	......	......	......	560	560
Coal	......	......	1	......	......	......	4,230	4,230
Comanche	3	2	3	......	5	......	20,580	20,580
Creek	1,784	238	39	43	1,979	6,547	176,252	182,799
Greer	......	......	1	......	......	......	......	......
Haskell	......	......	1	......	......	......	1,500	1,500
Jefferson	......	......	3	......	......	5,000	14,500	19,500
Kay	4	35	10	4	35	......	51,456	51,456
Kiowa	5	6	2	......	11	......	6,640	6,640
Le Flore	......	......	1	......	......	......	10,000	10,000
Logan	......	......	1	......	......	......	......	......
McIntosh	......	......	1	......	......	......	3,010	3,010
Marshall	3	......	......	......	3	......	3,594	3,594
Muskogee	285	36	6	18	303	684	15,248	15,932
Noble	......	......	1	......	......	......	5,000	5,000

Petroleum well record in 1911 and 1912, by counties—Continued.

OKLAHOMA—Continued.

1912—Continued.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Nowata	5,077	950	29	122	5,905	7,477	95,441	102,918
Okmulgee	244	189	52	37	396	3,992	111,649	115,641
Osage	1,593	366	45	91	1,868	1,400	520,754	522,154
Pawnee	317	133	27	59	391	400	42,819	43,219
Pittsburg			1				7,134	7,134
Rogers	1,763	103	12	161	1,705	1,390	23,438	24,828
Sequoyah			1				2,000	2,000
Tillman			1				10,500	10,500
Tulsa	1,306	643	70	32	1,917	7,683	105,568	113,251
Wagoner		6	4		6		4,796	4,796
Washington	3,272	955	121	84	4,143	6,998	141,242	148,240
Miscellaneous (undeveloped)						1,500	37,412	38,912
Total	15,698	3,668	440	651	18,715	45,231	1,421,117	1,466,348

TEXAS.

1911.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Bexar	5			2	3	597	375	972
Brazoria	4		6		4	3,000	700	3,700
Brewster			1					
Brown	5	1			6	500		500
Clay	163	18	2	30	151	5,538	41,346	46,884
Coleman	1	1		1	1		8,200	8,200
Dallas	3			3				
Denton		2		2			3,000	3,000
Duval	4		3	3	1	84	700	784
Fannin			2					
Fort Bend			1				4,204	4,204
Gregg			1				5,000	5,000
Hardin	820	138	28	113	845	3,690	2,282	5,972
Harris	330	131	38	56	405	855	17,176	18,031
Jefferson	126	16	7	42	100	100	1,147	1,247
Liberty	3	5		3	5	10	2,044	2,054
McLennan	12		1		12	80	365	445
McMullen	16	3			19		7,000	7,000
Marion	6	6	4		12	2,570	15,562	18,132
Matagorda	13	20	7	3	30	1	1,369	1,370
Navarro	995	37	2	235	797	3,128	39,284	42,412
Rush			1			1,250	3,369	4,619
Reeves	1		4	1		2,773		2,773
Robertson		1	1		1		5,000	5,000
Smith			1				2,950	2,950
Starr			1					
Walker			2				2,583	2,583
Waller			1					
Wichita		80			80	342	108,541	108,883
Wilbarger		1	7		1	17	7,150	7,167
Wilson			1			80	14,600	14,680
Miscellaneous (undeveloped)			2			1,800	68,982	70,782
Total	2,507	460	124	494	2,473	26,415	362,929	389,344

1912.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Archer		1	8		1		17,833	17,833
Baylor			3				19,000	19,000
Bexar	3		1		3	597	44	641
Brazoria	4		3		4	3,050	1,500	4,550
Brewster	1				1			
Brown	6			1	5		20	20
Burleson			1					
Callahan			1				2,500	2,500
Chambers			2				1,227	1,227
Clay	151	64	14	14	201	7,404	51,162	58,566
Coleman	1		8		1	2,320	7,420	9,740
Duval	1				1	500	1,200	1,700
Edwards			2				70,000	70,000
Franklin			1				12,000	12,000

Petroleum well record in 1911 and 1912, by counties—Continued.

TEXAS—Continued.

1912—Continued.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Fayette			1					
Freestone			1				2,500	2,500
Gaines			1				26,974	26,974
Hardin	845	151	28	55	941	3,546	3,725	7,271
Harris	405	101	36	88	418	2,002	26,429	28,431
Hill			1			79		79
Howard			1				5,000	5,000
Jackson		2			2		1,000	1,000
Jefferson	100	36	16	33	103	73	1,027	1,100
Kaufman			2				3,000	3,000
Liberty	5	1	6	2	4	603	6,214	6,817
McCulloch		5	5		5	12,206	72,000	84,206
McLennan	12			1	11	360	360	720
Limestone			1					
McMullen	19	1			20	7,000		7,000
Marion	12	3	7	4	11	3,141	10,225	13,366
Matagorda	30	19	14	12	37	124	1,173	1,297
Maverick			1				7,127	7,127
Montgomery			2					
Navarro	797	69	22	34	832	2,155	38,430	40,585
Nueces			1			554	350,000	350,554
Polk			2				3,845	3,845
Robertson	1				1		5,000	5,000
Rusk		2			2			
Scurry			1					
Shackelford			1					
Shelby			1				1,100	1,100
Smith			1				3,000	3,000
Tarrant		1			1		7,000	7,000
Walker		1		1			2,583	2,583
Wichita	80	297	82		377	5,125	371,348	376,473
Wilbarger	1	1	2	1	1		35,524	35,524
Wilson			2			90	1,942	2,032
Wood			1			160	2,800	2,960
Wise			1				13,338	13,338
Miscellaneous (undeveloped)						16,834	46,867	63,701
Total	2,473	756	284	246	2,983	67,923	1,233,537	1,301,360

LOUISIANA.

1911.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Acadia	91	9	1	18	82	742	1,766	2,508
Caddo	207	257	44	31	413	20,022	631,674	651,696
Calcasieu	18	53	29	13	58	556	3,319	3,875
Natchitoches			1				24,000	24,000
Sabine			2				45,436	45,436
St. Landry			3			1,000	9,115	10,115
St. Martin	2	2	1	2	2		37	37
St. Tammany			2				2,000	2,000
Terrebonne		1		1				
West Feliciana			1				50,000	50,000
Miscellaneous (undeveloped)						2,250	48,444	50,694
Total	318	302	84	65	555	24,570	815,791	840,361

1912.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Acadia	82	46	2	21	107	642	4,157	4,799
Caddo	413	230	58	57	586	20,844	167,188	188,032
Calcasieu	58	27	21	12	73	714	933	1,647
Evangeline		1	4		1	800	6,907	7,707
Natchitoches			2				41,400	41,400
St. Martin	2	11	3		13	6,345	449	6,794
Terrebonne			1					
Miscellaneous (undeveloped)						1,535	42,851	44,386
Total	555	315	91	90	780	30,880	263,885	294,765

PIPE-LINE STATISTICS.

APPALACHIAN OIL FIELD.

PRODUCTION.

The Appalachian oil field embraces the region extending from New York slightly west of south through Pennsylvania, West Viriginia, southeastern Ohio, and Kentucky into Tennessee.

Ohio, West Virginia, and Kentucky showed increased production in 1912, West Virginia leading in the amount of increase. Pennsylvania and New York showed a slight decrease. The detailed statistics for 1911 and 1912 are shown in the following tables:

Production of the Appalachian oil field, by States and months, 1911–1912, in barrels.

1911.

Month.	Pennsylvania.	New York.	Southeastern Ohio.	West Virginia.	Kentucky.	Total.
January	697,290	83,160	346,170	814,743	33,237	1,974,564
February	637,719	73,007	341,747	800,712	31,151	1,884,300
March	722,755	83,226	372,270	881,172	37,910	2,097,297
April	701,489	81,239	345,162	810,661	35,484	1,973,999
May	765,470	88,594	383,774	882,093	42,906	2,162,801
June	704,082	84,442	371,118	832,920	38,509	2,031,036
July	668,324	75,885	341,329	787,171	42,237	1,914,911
August	704,627	81,368	364,138	838,922	44,087	2,033,106
September	661,775	76,263	352,353	773,024	44,356	1,907,735
October	690,360	78,469	358,100	795,687	41,556	1,964,136
November	622,543	70,101	343,691	757,029	40,818	1,834,146
December	671,724	76,761	361,385	821,330	40,207	1,971,371
Total	8,248,158	952,515	4,281,237	9,795,464	472,458	23,749,832

1912.

Month.	Pennsylvania.	New York.	Southeastern Ohio.	West Virginia.	Kentucky.	Total.
January	562,665	64,950	333,489	694,619	38,425	1,694,148
February	575,180	63,080	356,983	801,699	37,723	1,834,665
March	686,178	73,371	443,795	983,502	40,923	2,227,769
April	699,856	79,188	440,834	1,018,955	37,375	2,276,208
May	728,127	81,935	453,807	1,153,945	44,967	2,462,781
June	657,545	73,950	416,396	1,172,331	40,311	2,360,533
July	678,789	75,875	439,778	1,174,367	44,997	2,413,806
August	675,848	74,663	460,390	1,190,552	40,866	2,442,319
September	634,114	68,884	410,131	981,052	39,146	2,133,327
October	686,184	76,766	437,877	1,013,980	38,484	2,253,291
November	610,314	68,045	397,129	918,313	40,000	2,033,801
December	643,148	73,421	422,501	1,025,647	41,151	2,205,868
Total	7,837,948	874,128	5,013,110	12,128,962	484,368	26,338,516

The production of petroleum in the Appalachian oil field from 1859 to 1912, inclusive, is given in the following table:

Production of petroleum in the Appalachian field, 1859–1912, in barrels.

Year	Production.	Per cent of total production.	Increase (+) or decrease (−) from previous year.	Yearly average price per barrel.[a]	Year.	Production.	Per cent of total production.	Increase (+) or decrease (−) from previous year.	Yearly average price per barrel.[a]
1859	2,000	100		$16.00	1886	26,549,827	94.60	+5,016,042	$0.713
1860	500,000	100	+ 498,000	9.59	1887	22,878,241	80.90	−3,671,586	.668
1861	2,113,609	100	+1,613,609	.49	1888	16,941,397	61.36	−5,936,844	.876
1862	3,056,690	100	+ 943,081	1.05	1889	22,355,225	63.57	+5,413,828	.941
1863	2,611,309	100	+ 445,381	3.15	1890	30,073,307	65.63	+7,718,082	.868
1864	2,116,109	100	− 495,200	8.06	1891	35,848,777	66.03	+5,775,470	.670
1865	2,497,700	100	+ 381,591	6.59	1892	33,432,377	66.19	−2,416,400	.556
1866	3,597,700	100	+1,100,000	3.74	1893	31,365,890	64.76	−2,066,487	.640
1867	3,347,300	100	− 250,400	2.41	1894	30,783,424	62.38	− 582,466	.839
1868	3,646,117	100	+ 298,817	3.62½	1895	30,960,639	58.54	+ 177,215	1.359
1869	4,215,000	100	+ 568,883	5.63¾	1896	33,971,902	55.73	+3,010,263	1.179
1870	5,260,745	100	+1,045,745	3.86	1897	35,230,271	58.25	+1,258,369	.786
1871	5,205,234	100	− 55,511	4.34	1898	31,717,425	57.29	−3,512,846	.911
1872	6,293,194	100	+1,087,960	3.64	1899	33,068,356	57.94	+1,350,931	1.294
1873	9,893,786	100	+3,600,592	1.83	1900	36,295,433	57.05	+3,227,077	1.353
1874	10,926,945	100	+1,033,159	1.17	1901	33,618,171	48.45	−2,677,262	1.210
1875	8,787,514	100	−2,139,431	1.35	1902	32,018,787	36.07	−1,599,384	1.238
1876	9,120,669	99.87	+ 333,155	2.56¼	1903	31,558,248	31.41	− 460,539	1.590
1877	13,337,363	99.90	+4,216,694	2.42	1904	31,408,567	26.83	− 149,681	1.628
1878	15,381,641	99.90	+2,044,278	1.19	1905	29,366,960	21.80	−2,041,607	1.394
1879	19,894,288	99.90	+4,512,647	.85⅞	1906	27,741,472	21.93	−1,625,488	1.598
1880	26,245,571	99.85	+6,351,283	.94½	1907	25,342,137	15.26	−2,399,335	1.745
1881	27,561,376	99.64	+1,315,805	.85⅞	1908	24,945,517	13.97	− 396,620	1.780
1882	30,221,261	99.58	+2,659,885	.78⅛	1909	26,535,844	14.49	+1,590,327	1.646
1883	23,306,776	99.39	−6,914,485	1.05¾	1910	26,892,579	12.83	+ 356,735	1.336
1884	23,956,438	98.92	+ 649,662	.83½	1911	23,749,832	10.77	−3,042,748	1.308
1885	21,533,785	98.51	−2,422,653	.87⅞	1912	26,338,516	11.86	+2,588,564	1.598

[a] Price of oil of "Pennsylvania" grade as given by Seep Purchasing Agency.

In the following table is shown the production of the Appalachian field, by States, in the years 1911 and 1912, with the increase and decrease for each State and the percentage of increase or decrease in 1912:

Production of petroleum in the Appalachian field in 1911 and 1912, by States, showing increase or decrease and percentage of increase or decrease, in barrels.

State.	Production.		Increase.	Decrease.	Percentage.	
	1911	1912			Increase.	Decrease.
Pennsylvania	8,248,158	7,837,948		410,210		4.97
New York	952,515	874,128		78,387		8.23
Southeastern Ohio	4,281,237	5,013,110	731,873		17.09	
West Virginia	9,795,464	12,128,962	2,333,498		23.82	
Kentucky	472,458	484,368	11,910		2.53	
Total	23,749,832	26,338,516	2,588,684		10.90	

In the following table are given the quantity, value, and price per barrel of the oil produced in the Appalachian field during the years 1911 and 1912, by States:

Quantity and value at wells of petroleum produced in the Appalachian field in 1911 and 1912, by States.

State.	1911			1912		
	Quantity, in barrels.	Value.	Price per barrel.	Quantity, in barrels.	Value.	Price per barrel.
Pennsylvania	8,248,158	$10,894,074	$1.321	7,837,948	$12,886,752	$1.644
New York	952,515	1,248,950	1.311	874,128	1,401,880	1.604
Southeastern Ohio	4,281,237	5,591,423	1.306	5,013,110	8,177,189	1.631
West Virginia	9,795,464	12,767,293	1.303	12,128,962	19,927,721	1.643
Kentucky	472,458	328,614	.696	484,368	424,842	.877
Total	23,749,832	30,830,354	1.298	26,338,516	42,818,384	1.626

Production and value of petroleum in the Appalachian field, 1903–1912, by States, in barrels.

Year.	Pennsylvania.		New York.		Southeastern Ohio.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	11,355,156	$18,170,881	1,162,978	$1,849,135	5,586,433	$8,883,182
1904	11,125,762	18,222,242	1,113,264	1,811,837	5,526,571	8,995,386
1905	10,437,195	14,653,278	1,117,582	1,557,630	5,016,736	6,992,885
1906	10,256,893	16,596,943	1,243,517	1,995,377	4,906,579	7,839,359
1907	9,999,306	17,579,706	1,212,300	2,127,748	4,214,391	7,344,408
1908	9,424,325	16,881,194	1,160,128	2,071,533	4,110,121	7,316,617
1909	9,299,403	15,424,554	1,134,897	1,878,217	4,717,436	7,773,880
1910	8,794,662	11,908,914	1,053,838	1,414,668	4,822,234	6,469,939
1911	8,248,158	10,894,074	952,515	1,248,950	4,281,237	5,591,423
1912	7,837,948	12,886,752	874,128	1,401,880	5,013,110	8,177,189

Year.	West Virginia.		Kentucky-Tennessee.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	12,899,395	$20,516,532	554,286	$486,083	31,558,248	$49,905,813
1904	12,644,686	20,583,781	998,284	984,938	31,408,567	50,598,184
1905	11,578,110	16,132,631	1,217,337	943,211	29,366,960	40,279,635
1906	10,120,935	16,170,293	1,213,548	1,031,629	27,741,472	43,633,601
1907	9,095,296	15,852,428	820,344	862,396	25,342,137	43,766,686
1908	9,523,176	16,911,865	a 727,767	706,811	24,945,517	43,888,020
1909	10,745,092	17,642,283	a 639,016	518,299	26,535,844	43,237,233
1910	11,753,071	15,723,544	a 468,774	324,684	26,892,579	35,841,749
1911	9,795,464	12,767,293	a 472,458	328,614	23,749,832	30,830,354
1912	12,128,962	19,927,721	a 484,368	424,842	26,338,516	42,818,384

a No production in Tennessee recorded.

In the two following tables is given the production of petroleum in the Appalachian field from 1908 to 1912—in the first by months and in the second by days:

Production of petroleum in the Appalachian oil field, 1908–1912, by months and years, in barrels.

Month.	1908	1909	1910	1911	1912
January	1,968,724	1,989,577	2,274,236	1,974,600	1,694,048
February	1,873,646	1,906,109	2,019,229	1,884,336	1,834,665
March	2,105,483	2,237,778	2,494,868	2,097,333	2,227,769
April	2,072,861	2,158,382	2,296,566	1,974,035	2,276,208
May	2,120,427	2,194,631	2,349,595	2,162,836	2,462,881
June	2,182,340	2,220,971	2,382,097	2,031,071	2,360,533
July	2,172,802	2,306,654	2,239,118	1,914,966	2,413,806
August	2,098,144	2,273,277	2,325,953	2,033,142	2,442,319
September	2,120,175	2,288,067	2,208,040	1,907,771	2,133,327
October	2,103,249	2,309,898	2,148,205	1,964,172	2,253,291
November	1,938,239	2,321,230	2,046,835	1,834,182	2,033,801
December	2,189,427	2,329,270	2,107,837	1,971,408	2,205,868
Total	24,945,517	26,535,844	26,892,579	23,749,832	26,338,516

Average daily production of petroleum in the Appalachian oil field each month, 1908–1912, by months and years, in barrels.

Month.	1908	1909	1910	1911	1912
January	63,507	64,180	73,362	63,697	54,647
February	64,608	68,075	72,115	67,298	63,264
March	67,919	72,186	80,480	67,656	71,864
April	69,095	71,946	76,552	65,801	74,259
May	68,401	70,795	75,793	69,769	82,029
June	72,745	74,032	79,403	67,702	76,684
July	70,090	74,408	72,230	61,773	77,865
August	67,682	73,332	75,031	65,585	78,784
September	70,673	76,269	73,601	63,592	71,111
October	67,847	74,513	69,297	63,360	72,687
November	64,608	77,374	68,228	61,139	67,793
December	70,627	75,138	67,995	63,594	71,157
Average	68,157	72,701	73,678	65,068	71,963

In the following tables are given the runs of Appalachian oil for he principal pipe lines in the Appalachian fields in 1912, together with the stocks of the same at the close of each month.

Pipe-line runs of Appalachian oil in 1912, by lines and month, in barrels.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	New York Transit.	Tidewater.
January	214,880	122,234	651,770	37,697	13,049	89,229
February	219,690	123,185	756,924	36,995	13,038	92,121
March	268,486	133,574	932,405	40,195	13,922	108,002
April	282,625	126,334	971,098	36,646	16,883	111,262
May	282,533	137,181	1,101,421	44,238	16,740	115,595
June	250,379	120,237	1,125,895	39,582	14,774	107,147
July	258,814	126,039	1,121,256	44,268	15,574	105,660
August	248,731	120,296	1,133,662	40,137	15,822	108,094
September	233,625	111,048	929,369	38,417	15,060	97,329
October	249,239	116,320	954,537	37,756	16,948	110,429
November	213,913	108,629	859,982	39,272	14,721	95,920
December	216,634	111,360	961,346	40,343	15,760	102,274
Total	2,939,549	1,456,437	11,499,665	475,546	182,291	1,243,062

Pipe-line runs of Appalachian oil in 1912, by lines and month, in barrels—Continued.

Month.	Producers and Refiners.	Emery.	Buckeye Macksburg.	Franklin.	Other lines.	Total.
January	144,391	23,802	273,483	1,822	121,791	1,694,148
February	141,020	23,514	300,880	2,094	125,204	1,834,665
March	164,865	28,700	380,187	3,652	153,781	2,227,769
April	158,520	28,160	377,519	3,690	163,471	2,276,208
May	169,039	27,693	385,050	3,744	179,547	2,462,781
June	157,740	25,472	353,926	2,972	162,409	2,360,533
July	166,630	27,015	370,090	3,161	175,299	2,413,806
August	179,696	28,598	378,369	3,510	185,404	2,442,319
September	170,121	24,951	335,470	3,086	174,851	2,133,327
October	202,172	28,373	337,329	2,989	197,199	2,253,291
November	205,365	24,348	288,237	2,900	180,514	2,033,801
December	221,976	27,087	303,531	3,394	202,163	2,205,868
Total	2,081,535	317,713	4,084,071	37,014	2,021,633	26,338,516

Stocks held by eastern [a] pipe lines and refineries in the Appalachian field at close of each month, in 1912, in barrels.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	Southern.	Crescent.
Dec. 31, 1911	1,161,046	996,483	1,302,420	178,544	637,852	84,612
January	1,118,967	1,031,549	1,354,971	176,431	636,789	97,443
February	1,083,298	1,027,835	1,436,968	169,683	561,145	113,489
March	1,156,060	1,030,083	1,456,423	192,189	606,793	96,290
April	1,108,056	844,441	1,450,351	197,663	617,113	102,182
May	1,271,181	843,314	1,339,603	216,700	655,708	75,367
June	1,161,394	733,850	1,484,997	212,287	606,946	92,974
July	1,104,934	754,661	1,459,698	204,665	646,831	91,460
August	1,153,372	892,819	1,442,613	202,104	613,915	85,278
September	1,208,089	627,339	1,423,452	195,895	664,063	104,004
October	1,142,205	603,213	1,332,901	170,686	557,055	56,082
November	1,027,972	554,519	1,237,112	150,953	563,915	52,703
December	889,359	522,506	1,532,946	129,225	573,740	72,121

Month.	New York Transit.	Tidewater.	Northern.	Producers and Refiners.	Emery.	United States.
Dec. 31, 1911	2,488,641	291,069	1,672,216	197,827	12,767	58,137
January	2,589,680	252,541	1,236,093	211,136	16,550	8,276
February	2,107,399	245,586	947,517	206,624	17,774	11,006
March	1,512,481	269,190	1,113,766	188,119	18,111	42,870
April	1,268,886	256,825	1,046,753	175,762	19,253	41,659
May	1,215,929	249,697	1,069,244	208,493	22,178	41,599
June	1,204,030	237,349	844,989	219,768	21,268	27,623
July	669,751	227,731	716,741	188,387	21,206	37,449
August	674,891	255,706	675,423	178,356	20,408	21,529
September	758,872	269,511	694,682	187,499	15,340	23,708
October	815,188	247,021	688,689	217,818	19,739	12,113
November	938,522	239,547	787,634	234,066	21,567	29,302
December	1,154,211	200,337	575,730	274,921	23,565	2,918

[a] These pipe lines connect with the collecting lines of the Lima, Indiana, Illinois, Kansas, and Oklahoma fields and receive and transfer large quantities of these western oils to the Atlantic seaboard in addition to the oil from wells directly tributary to their own systems.

Stocks held by eastern pipe lines and refineries in the Appalachian field at close of each month, in 1912, in barrels—Continued.

Month.	Buckeye Macksburg.	Buckeye Lima.	Indiana.	Franklin.	Other pipe lines.	Total.
Dec. 31, 1911	282,090	4,066,820	965,890	59,998	70,659	14,527,071
January	307,823	3,697,265	939,800	53,453	69,006	13,797,773
February	346,231	3,984,320	1,036,868	50,295	68,176	13,414,214
March	362,309	3,769,143	913,465	51,584	66,868	12,845,744
April	397,155	3,331,890	1,024,989	55,274	65,860	12,004,112
May	406,146	3,204,185	1,019,320	59,019	63,256	11,960,939
June	401,033	3,307,593	970,288	61,990	63,762	11,652,141
July	424,608	3,483,200	1,070,395	65,151	63,105	11,229,973
August	390,059	3,810,159	1,120,611	68,173	64,140	11,669,556
September	364,477	3,934,567	1,017,383	70,772	65,167	11,624,820
October	314,249	3,623,883	1,030,069	67,664	67,698	10,966,273
November	339,455	3,377,926	993,918	59,145	71,818	10,680,074
December	384,553	3,291,256	963,306	50,581	90,070	10,731,345

Stocks of all grades of petroleum held by eastern [a] *pipe lines and refineries in the Appalachian field at close of each month in 1912, in barrels.*

Month.	Pennsylvania.[b]	Lima.	Illinois.	Kentucky.	Kansas and Oklahoma.	Total.
Dec. 31, 1911	4,479,779	3,147,427	2,795,623	254,763	3,849,479	14,527,071
January	3,932,010	2,967,238	2,634,323	281,784	3,982,418	13,797,773
February	4,120,618	2,990,299	2,295,660	210,438	3,797,199	13,414,214
March	4,318,220	3,010,540	2,060,145	238,629	3,218,210	12,845,744
April	4,395,584	3,022,377	1,588,377	260,150	2,737,624	12,004,112
May	4,571,266	2,494,149	2,014,188	295,839	2,585,497	11,960,939
June	4,498,327	2,515,579	1,569,501	301,827	2,766,907	11,652,141
July	4,436,048	2,151,648	2,158,242	304,665	2,179,370	11,229,973
August	4,214,658	2,307,332	2,626,532	324,889	2,196,145	11,669,556
September	4,092,873	2,444,979	2,616,520	281,825	2,188,623	11,624,820
October	3,736,433	2,135,501	2,752,499	295,345	2,046,495	10,966,273
November	3,748,178	2,134,642	2,483,692	262,909	2,050,653	10,680,074
December	3,804,483	2,297,861	2,368,271	226,035	2,034,695	10,731,345

[a] These pipe lines connect with the collecting lines of the Lima, Indiana, Illinois, Kansas, and Oklahoma fields and receive and transfer large quantities of these western oils to the Atlantic seaboard in addition to the oil from wells directly tributary to their own systems.
[b] Includes natural lubricating oil from Pennsylvania and West Virginia.

Pipe-line runs and deliveries to trade of petroleum from the Appalachian field, by months, in barrels, in 1912, and stocks at end of each month.

	Runs.	Deliveries.	Stocks.
Dec. 31, 1911			4,734,542
January	1,694,148	2,214,896	4,213,794
February	1,834,665	1,717,403	4,331,056
March	2,227,769	2,001,976	4,556,849
April	2,276,208	2,177,323	4,655,734
May	2,462,781	2,251,410	4,867,105
June	2,360,533	2,427,484	4,800,154
July	2,413,806	2,473,247	4,740,713
August	2,442,319	2,643,485	4,539,547
September	2,133,327	2,298,176	4,374,698
October	2,253,291	2,596,211	4,031,778
November	2,033,801	2,054,492	4,011,087
December	2,205,868	2,186,437	4,030,518
Total	26,338,516	27,042,540	

Pipe-line deliveries to trade of eastern [a] pipe lines in 1912, by lines and months, in barrels.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	Southern.	Crescent.	New York Transit.
January	1,669,651	160,732	74,074	9,224	545,409	142,686	1,222,506
February	1,550,924	172,479	79,700	8,527	562,158	128,286	1,193,716
March	1,637,163	153,197	84,821	13,018	531,112	172,336	1,130,495
April	1,712,503	178,253	89,373	14,242	629,898	151,847	1,416,061
May	1,701,842	176,315	75,502	8,138	615,042	159,624	1,537,048
June	1,824,053	172,665	83,914	7,220	618,651	145,253	1,276,068
July	1,783,285	171,153	75,752	5,652	666,638	163,495	1,407,578
August	1,799,723	175,327	74,342	3,263	673,661	165,288	979,277
September	1,674,071	174,917	74,417	4,314	583,311	131,041	969,800
October	1,824,043	192,126	78,474	4,677	720,263	202,397	1,275,394
November	1,614,560	182,805	78,501	5,760	550,831	153,080	951,060
December	1,518,812	174,501	77,556	3,996	513,238	134,571	1,071,652
Total	20,310,630	2,084,470	946,426	88,031	7,210,212	1,849,904	14,430,655

Month.	Tidewater.	Producers and Refiners.	Emery.	United States.	Buckeye Macksburg.	Franklin.
January	153,929	131,082	20,019	30,453	6,349	8,367
February	180,313	145,532	22,290	19	6,460	5,252
March	166,172	183,371	28,363	7,413	6,473	2,363
April	178,791	170,877	27,018	33,082	6,802	....
May	152,875	136,308	24,768	2,945	7,105	....
June	190,278	146,466	26,383	16,241	6,431	....
July	146,629	198,010	27,077	14,277	8,484	....
August	141,793	189,728	29,396	29,758	7,287	488
September	114,922	160,977	30,019	12,209	7,569	487
October	175,835	171,853	23,974	28,277	7,636	6,097
November	174,446	189,117	22,519	9,788	7,080	11,418
December	188,023	181,122	25,089	12,811	7,234	11,959
Total	1,964,006	2,004,443	306,915	197,273	84,910	46,431

[a] These pipe lines connect with the collecting lines of the Lima, Indiana, Illinois, Kansas, and Oklahoma fields and receive and transfer large quantities of these western oils to the Atlantic seaboard in addition to the oil from wells directly tributary to their own systems.

PRICES OF APPALACHIAN OIL.

The following table shows the range of prices paid by the Seep Purchasing Agency for the different grades of Appalachian oil in 1911 and 1912:

Range of prices paid at wells by the Seep Purchasing Agency for light petroleum produced in the New York, Ohio, Pennsylvania, and West Virginia oil regions during 1911 and 1912, per barrel of 42 gallons.

Date.	Pennsylvania and Tiona, Pa.	Mercer black, Pennsylvania.	Corning, Ohio.	New Castle, Ohio.	Cabell, W. Va.
1911.					
Jan. 1	$1.30	$0.87	$0.77	$0.84	$0.94
Dec. 26	1.35	.92	.82	.89	.99
1912.					
Jan. 1	1.35	.92	.82	.89	.99
Jan. 8	1.40	.97	.87	.94	1.04
Jan. 22	1.45	1.02	.92	.99	1.09
Jan. 29	1.50	1.05	.95	1.02	1.12
Apr. 19	1.55	1.08	.98	1.05	1.15
June 5	1.60	1.13	1.03	1.10	1.20
June 15	....	....	1.13	1.13	....
Oct. 29	1.65	1.18	1.18	1.18	1.25
Nov. 8	1.70	1.23	1.23	1.23	1.30
Nov. 14	1.75	1.28	1.28	1.28	1.35
Nov. 18	1.80	1.33	1.33	1.33	1.40
Nov. 23	1.85	1.38	1.38	1.38	1.45
Dec. 2	1.90	1.43	1.43	1.43	1.50
Dec. 9	1.95	1.48	1.48	1.48	1.55
Dec. 14	2.00	1.53	1.53	1.53	1.60

In the following table is given the average price per month of the different light oils of New York, Pennsylvania, Ohio, and West Virginia during the years 1911 and 1912:

Average monthly prices of Appalachian petroleum in 1911 and 1912, per barrel.

Month.	Pennsylvania and Tiona, Pa.	Mercer black, Pennsylvania.	Corning, Ohio.	New Castle, Ohio.	Cabell, W. Va.
1911.					
January	$1.30	$0.87	$0.77	$0.84	$0.94
February	1.30	.87	.77	.84	.94
March	1.30	.87	.77	.84	.94
April	1.30	.87	.77	.84	.94
May	1.30	.87	.77	.84	.94
June	1.30	.87	.77	.84	.94
July	1.30	.87	.77	.84	.94
August	1.30	.87	.77	.84	.94
September	1.30	.87	.77	.84	.94
October	1.30	.87	.77	.84	.94
November	1.30	.87	.77	.84	.94
December	1.31	.88	.78	.85	.95
Average	1.301	.871	.771	.841	.941
1912.					
January	1.41	.98	.88	.95	1.05
February	1.50	1.05	.95	1.02	1.12
March	1.50	1.05	.95	1.02	1.12
April	1.52	1.06	.96	1.03	1.13
May	1.55	1.08	.98	1.05	1.15
June	1.59	1.12	1.08	1.11	1.19
July	1.60	1.13	1.13	1.13	1.20
August	1.60	1.13	1.13	1.13	1.20
September	1.60	1.13	1.13	1.13	1.20
October	1.60	1.13	1.13	1.13	1.20
November	1.75	1.28	1.28	1.28	1.35
December	1.96	1.49	1.49	1.49	1.56
Average	1.598	1.136	1.091	1.123	1.206

The average monthly and yearly prices per barrel of Pennsylvania petroleum at wells in the years 1903–1912 are given in the following table:

Monthly and yearly average prices of pipe-line certificates of Pennsylvania petroleum at wells in daily market, 1903–1912, per barrel.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
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	$1.590
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	1.628
1905	1.43⅛	1.39	1.38¼	1.32¾	1.28¾	1.27	1.27	1.27	1.35⅜	1.57½	1.59	1.58	1.394
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	1.598
1907	1.58	1.61¼	1.72⅞	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.745
1908	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.780
1909	1.78	1.78	1.78	1.78	1.70	1.67¼	1.60¼	1.58	1.58	1.56¼	1.49	1.44⅜	1.646
1910	1.40½	1.40	1.40	1.36⅛	1.35	1.31¾	1.30	1.30	1.30	1.30	1.30	1.30	1.336
1911	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.31	1.301
1912	1.41	1.50	1.50	1.52	1.55	1.59	1.60	1.60	1.60	1.60	1.75	1.96	1.598

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, 1859–1912, per barrel.

Year.	Highest.		Lowest.	
	Month.	Price.	Month.	Price.
1859	September	$20.00	December	$20.00
1860	January	20.00	....do	2.00
1861	....do	1.75	....do	.10
1862	December	2.50	January	.10
1863	....do	4.00	....do	2.00
1864	July	14.00	February	3.75
1865	January	10.00	August	4.00
1866	....do	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	....do	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	....do	.62½
1875	....do	1.82½	January	.75
1876	December	4.23¾	....do	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	....do	.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	....do	.95¾	....do	.78½
1895	April	2.60	....do	.95¼
1896	January	1.50	December	.90
1897	March	.96	October	.65
1898	December	1.19	January	.65
1899	....do	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	....do	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
1907	March to December, inclusive	1.78	January	1.58
1908	No change	1.78	No change	1.78
1909	January, February, March	1.78	December	1.43
1910	January	1.43	June to December, inclusive	1.30
1911	December	1.35	January to December	1.30
1912	....do	2.00	January	1.35

PENNSYLVANIA.

DEVELOPMENT.

In Pennsylvania an unusually good well was drilled in June, 1911, by Potts Bros. & Fife on the Stewart Park lots, in Canonsburg, on the east edge of Washington County. Over 30 wells were drilled on town lots as rapidly as they could be put down, the best yielding about 600 barrels a day. By the spring of 1912, however, the pool had declined very much in spite of efforts to extend the producing area farther north. In Allegheny County several wells yielding as much as 25 barrels a day were drilled in the neighborhood of Pine Creek and in the Perrysville pool. In Butler County the increased value of old oil wells, due to the rise in price of oil, was made evident by the purchase of 300 acres of land, including 24 producing wells, at a price that approximated $2,250 per barrel of daily production. This is the highest price which has been paid in this region in 20 years and is evidence of the great "staying qualities" of these wells. Interest in the county was also stimulated by the striking of a 100-barrel well on the Dodds farm, in Penn Township. Another 100-barrel well was obtained in the old Bristoria pool in Greene County.

PRODUCTION.

In 1912 Pennsylvania produced 7,837,948 barrels of petroleum; in 1911, 8,248,158 barrels were produced, a decrease in 1912 of 410,210 barrels, or 4.97 per cent. In 1911 the decline was 6.21 per cent.

The following table shows the production of petroleum in Pennsylvania and New York, 1908–1912, by months:

Production of petroleum in Pennsylvania and New York in 1908–1912, by months, in barrels.

PENNSYLVANIA.

Month.	1908	1909	1910	1911	1912
January	782,683	759,178	721,627	697,290	562,665
February	718,905	704,391	621,467	637,719	575,180
March	835,990	822,600	851,225	722,755	686,178
April	803,590	784,155	766,700	701,489	699,856
May	805,930	818,359	759,585	765,470	728,127
June	819,020	820,155	790,520	704,082	657,545
July	806,003	792,327	723,646	668,324	678,789
August	781,988	786,563	763,273	704,627	675,848
September	786,963	774,750	720,165	661,775	634,114
October	781,001	758,779	708,453	690,360	686,184
November	710,246	765,504	678,132	622,543	610,314
December	792,006	712,642	689,869	671,724	643,148
Total	9,424,325	9,299,403	8,794,662	8,248,158	7,837,948

NEW YORK.

Month.	1908	1909	1910	1911	1912
January	98,776	95,270	90,027	83,160	64,850
February	87,119	89,526	71,699	73,007	63,080
March	99,948	100,008	101,406	83,226	73,371
April	100,511	96,249	92,245	81,239	79,188
May	97,365	98,490	90,581	88,594	82,035
June	99,954	99,905	92,064	84,442	73,950
July	99,338	96,247	89,457	75,885	75,875
August	95,754	93,900	89,650	81,368	74,663
September	96,299	93,583	86,428	76,263	68,884
October	98,556	90,382	86,659	78,469	76,766
November	89,345	91,058	79,519	70,101	68,045
December	97,163	90,279	84,103	76,761	73,421
Total	1,160,128	1,134,897	1,053,838	952,515	874,128

WELL RECORD.

The following tables give the well records for Pennsylvania and New York from 1908 to 1912, inclusive:

Number of wells completed in the Pennsylvania and New York oil fields, 1908–1912, by districts.

District.	Completed.					Dry.					Oil.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Bradford	359	571	344	298	371	44	36	6	16	14	315	535	316	260	335
Allegany	473	459	283	194	246	66	40	13	9	17	407	419	219	128	177
Middle	620	506	235	247	266	89	65	34	39	36	531	441	195	208	226
Venango and Clarion	1,841	1,881	790	805	1,019	201	199	70	93	90	1,640	1,682	635	642	853
Butler and Armstrong	520	487	263	219	216	204	178	89	65	59	316	309	152	124	138
Southwest Pennsylvania	347	319	286	244	354	153	145	76	75	106	194	174	156	129	182
Total	4,160	4,223	2,201	2,007	2,472	[a] 757	[a] 663	[b] 288	[b] 297	[b] 322	3,403	3,560	1,673	1,491	1,911

[a] Including gas wells. [b] Not including gas wells.

Number of wells completed in the Pennsylvania and New York oil fields, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	241	146	207	324	337	428	417	414	455	434	405	352	4,160
1909	325	298	260	370	436	448	413	384	400	274	368	247	4,223
1910	147	132	109	190	266	250	222	211	179	182	188	125	2,201
1911	100	96	87	130	168	198	191	222	205	210	227	173	2,007
1912	112	91	125	190	232	266	237	284	252	242	228	213	2,472

Number of oil wells drilled in Pennsylvania and New York oil fields, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	176	119	151	265	289	352	356	342	379	373	319	282	3,403
1909	268	255	227	317	374	391	359	308	338	215	316	192	3,560
1910	114	94	82	145	213	192	170	158	140	136	146	83	1,673
1911	68	60	52	84	117	152	148	168	170	157	174	141	1,491
1912	73	71	90	150	181	210	191	224	190	190	167	174	1,911

Number of dry holes drilled in the Pennsylavania and New York oil fields, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1903	65	27	56	59	48	76	61	72	76	61	86	70	[a] 757
1909	57	43	33	53	62	57	54	76	62	59	52	55	[a] 663
1910	33	38	27	45	53	58	52	53	39	46	42	42	[a] 528
1911	22	25	23	33	33	28	19	32	22	22	25	13	[b] 297
1912	21	11	19	23	30	29	28	42	37	26	37	19	[b] 322

[a] Including gas wells. [b] Not including gas wells.

Total and average initial daily production of new wells in the Pennsylvania and New York oil fields, 1908–1912, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Bradford	874	1,345	952	730	817	2.77	2.51	3.01	2.81	2.44
Allegany	806	815	368	201	278	1.98	1.94	1.68	1.57	1.57
Middle	1,257	977	442	541	511	2.37	2.22	2.27	2.60	2.26
Venango and Clarion	4,052	4,573	1,276	1,302	1,943	2.47	2.72	2.00	2.03	2.28
Butler and Armstrong	1,532	2,493	1,489	422	696	4.85	8.07	9.80	3.40	5.04
Southwest Pennsylvania	1,383	1,130	2,156	1,716	2,526	7.13	6.49	13.82	13.30	13.88
Total	9,904	11,333	6,683	4,912	6,771	2.91	3.18	3.99	3.29	3.54

Total initial daily production of new wells in the Pennsylvania and New York oil fields, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	523	396	476	746	816	960	1,119	1,114	1,013	1,029	964	748	9,904
1909	869	785	608	930	1,084	1,027	1,011	1,148	1,046	1,082	991	752	11,333
1910	572	320	211	584	1,355	621	604	924	353	395	448	296	6,683
1911	204	345	154	313	319	368	435	611	517	507	695	444	4,912
1912	548	621	613	657	531	588	482	637	720	530	474	370	6,771

NEW YORK.

In New York the continuing annual decline in production of oil was partly checked in 1912 by the extensive cleaning out of old wells, which had been encouraged by the rising prices of oil, but the yield in New York State is now so small that even the increase in price has not stimulated much drilling of new wells. Drilling of gas wells, however, was fairly active.

The production in 1912 decreased 8.23 per cent, or 78,387 barrels, from the 1911 production, when the production reached 952,515 barrels; in 1912 it was only 874,128 barrels.

WEST VIRGINIA.

DEVELOPMENT.

In West Virginia the remarkable development in the Blue Creek pool, Kanawha County, begun in September, 1911, aroused greater enthusiasm than any other development in recent years. The first well was drilled by the Ohio Fuel Oil Co. simply to protect a lease which was about to expire on the Bart-Schwartz land. A good gusher was obtained. Next the Edwards Oil Co. struck a 720-barrel gusher on the farm of the Graham heirs. Gushers of much greater size followed quickly, drilled by the Ohio Fuel Oil Co., the Hamilton Co., and others. It is interesting to note that in 1864, when drilling began at Burning Springs, in Wirt County, it extended up to Elk Creek to the mouth of Blue Creek. A Mr. Goddard also leased the present Blue Creek region but did not drill.

In 1912 the field extended rapidly northeast and southwest until it attained a length of about 10 miles. In May its highest production was reached, 25,000 barrels a day, but wells were drilled so close together that a decline was inevitable, and by June 17 the production was estimated at 20,000 barrels and 12 days later had declined to 16,000 barrels a day. In July much new production was added, but the old wells declined so rapidly as to offset the increase, and production settled down to 15,000 barrels a day, by the middle of August to 13,000 barrels, and a month later to 8,500 barrels. By the middle of October it had increased slightly to 10,000 barrels, and at the end of the year there was a steady daily production of 8,000 barrels.

Meantime the excitement caused by this unusual development extended the drilling of the Falling Rock Creek pool and the Big Sandy district, both adjoining the Blue Creek pool. The former started with a 100-barrel well on September 21, and the interest still continued at the end of the year. The oil comes from the Berea sandstone. The Big Sandy region obtained a gusher of 2,000 barrels a day late in October, which quickly settled down to 200 barrels a day; this came also from the Berea sandstone. There is a prospect of considerable production from various extensions of the Blue Creek pool, especially in Clay County and Lincoln County. Roane County was second to Kanawha in the interest aroused during the year. A 50-barrel well was obtained early in February, 1912. Late in the year the Spencer district was developed in the Berea sandstone, and wells yielding from 100 to 450 barrels a day were very common. Prospecting was active in the old Shinnston district, in Harrison County, and on October 5 a 500-barrel well was obtained half a mile north of Shinnston. Before the end of the year sufficient oil was obtained to extend the old Shinnston pool half a mile to the north, with wells which held up satisfactorily. Other wells which developed interesting prospects during the year in West Virginia are in Calhoun, Cabell, Boone, Gilmer, Ohio, Pleasants, Ritchie, Tyler, and Wetzel counties.

The State showed a marked increase in production in 1912, when 12,128,962 barrels of petroleum were obtained, an increase of 2,333,498 barrels, or 23.82 per cent, over 1911, when the production was 9,795,464 barrels.

PRODUCTION.

In the following table is given the production of petroleum in West Virginia in the years 1908 to 1912, by months:

Total production of petroleum in West Virginia, 1908–1912, by months, in barrels.

Month.	1908	1909	1910	1911	1912
January	697,040	735,379	1,026,438	814,743	694,619
February	700,103	722,045	935,252	800,712	801,699
March	770,689	851,002	1,050,163	881,172	983,502
April	779,089	833,432	962,657	810,661	1,018,955
May	823,144	829,833	1,001,746	882,093	1,153,945
June	870,289	870,909	1,018,694	832,920	1,172,331
July	864,877	904,745	984,813	787,171	1,174,367
August	815,242	923,438	1,020,317	838,922	1,190,552
September	803,139	950,188	976,220	773,024	981,052
October	795,539	997,295	935,166	795,687	1,013,980
November	739,605	1,016,738	906,521	757,029	918,313
December	864,420	1,110,088	935,084	821,330	1,025,647
Total	9,523,176	10,745,092	11,753,071	9,795,464	12,128,962

The quantity and value of petroleum produced in West Virginia from 1903 to 1912, inclusive, are shown in the following talbe:

Quantity and value of petroleum produced in West Virginia, 1903–1912.

Year.	Regular crude.			Lubricating crude.			Total.		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
	Barrels.			*Barrels.*			*Barrels.*		
1903	12,893,079	$20,499,996	$1.590	6,316	$16,536	$2.62	12,899,395	$20,516,532	$1.590
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
1907	9,089,839	15,834,714	1.740	5,457	17,714	3.25	9,095,296	15,852,428	1.743
1908	9,519,875	16,902,968	1.775	3,301	8,897	2.70	9,523,176	16,911,865	1.776
1909	10,742,026	17,634,335	1.642	3,066	7,948	2.59	10,745,092	17,642,283	1.642
1910	11,751,018	15,717,796	1.338	2,053	5,748	2.80	11,753,071	15,723,544	1.338
1911	9,792,324	12,757,861	1.302	3,140	9,432	3.00	9,795,464	12,767,293	1.303
1912	12,126,137	19,919,952	1.643	2,825	7,769	2.75	12,128,962	19,927,721	1.643

WELL RECORD.

The following tables give the well records for West Virginia from 1908 to 1912, inclusive:

Number of wells completed in West Virginia, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	89	101	85	98	115	113	119	136	134	117	124	116	1,347
1909	130	144	143	140	131	155	151	168	182	171	178	164	1,857
1910	146	123	122	146	153	157	148	129	137	132	108	115	1,616
1911	102	108	106	100	96	81	105	107	101	98	80	107	1,191
1912	96	80	119	113	116	134	148	171	185	167	162	166	1,657

Number of wells completed in West Virginia in 1912, by districts and months.[a]

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Total 1911
Brooke County	1	.....	2	2	2	.....	.....	.....	.....	.....	2	.....	9	3
Burning Springs	1	1	.....	2	2	2	4	2	.....	3	4	.....	21	31
Cabell County	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
Calhoun County	5	7	4	2	2	4	2	3	4	4	1	.....	38	33
Hancock County	.....	.....	1	.....	2	1	1	2	4	.....	.....	5	16	8
Kanawha County	4	11	24	34	38	55	67	55	57	50	38	53	486	(b)
Lincoln County	.....	5	1	7	4	9	.....	11	9	9	10	5	70	68
Mannington	27	17	16	24	22	19	32	22	26	39	26	28	298	280
Pleasants County	9	3	12	5	2	7	5	8	11	10	9	10	91	90
Ritchie County	10	8	14	7	7	6	10	11	12	10	17	9	121	170
Roane County	16	11	11	14	13	6	10	17	17	15	17	22	169	194
Sistersville	1	3	2	2	2	1	.....	3	.....	.....	.....	1	15	18
Wetzel and Tyler Counties	13	10	14	10	10	12	6	20	18	11	25	19	168	117
Wood County	5	.....	12	2	7	4	6	10	15	7	7	6	81	80
Miscellaneous	4	4	6	2	3	8	5	7	12	9	6	8	74	94
Total	96	80	119	113	116	134	148	171	185	167	162	166	1,657	1,191

[a] Including gas wells.

[b] Included in "Miscellaneous."

Number of oil wells and dry holes drilled in West Virginia in 1911, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Brooke County	..	1	..	...	..	...	..	...	..	...	...	...	1	1	..	...	...	...	..	...	..	...	..	...	1	2
Burning Springs	1	...	1	...	..	...	1	1	..	1	1	...	3	...	4	1	1	1	3	...	4	...	3	1	22	5
Cabell County	..	1	..	...	..	1	1	...	..	...	...	...	...	...	..	...	...	...	..	...	..	...	..	...	1	2
Calhoun County	..	...	..	...	..	...	1	...	..	1	2	...	...	...	3	...	1	1	1	...	3	...	..	...	11	2
Hancock County	..	...	..	...	..	...	..	...	..	...	1	...	...	...	1	...	1	...	2	...	3	...	..	...	8	...
Lincoln County	5	1	1	...	6	...	3	...	2	...	4	...	4	...	7	2	6	...	9	...	1	...	10	...	58	3
Mannington	14	4	9	5	9	4	9	3	7	...	4	2	11	6	5	1	7	5	10	3	4	4	9	2	98	39
Pleasants County	4	...	2	2	7	4	3	2	6	2	6	3	4	2	1	5	8	3	6	1	2	3	11	2	60	29
Ritchie County	6	4	10	2	6	4	8	2	10	2	6	5	11	4	8	10	8	...	4	7	10	1	6	4	93	45
Roane County	15	2	15	2	15	1	12	...	17	1	12	...	18	...	15	...	13	...	13	2	5	...	10	...	160	8
Sistersville	..	1	1	2	1	...	1	...	3	1	...	1	2	1	..	1	...	...	..	1	..	...	..	1	8	9
Wetzel and Tyler Counties	4	4	5	4	3	1	2	4	5	...	3	...	...	...	2	4	1	2	4	2	4	1	2	3	35	25
Wood County	4	...	2	4	4	5	3	1	4	2	5	1	2	1	4	3	4	3	5	1	8	3	4	7	49	31
Miscellaneous	..	1	1	3	1	1	1	1	2	...	...	...	4	5	1	1	...	4	1	...	2	...	5	2	18	18
Total	53	19	47	24	52	21	45	14	56	10	44	12	60	20	51	28	50	19	58	17	46	12	60	22	622	218

Number of oil wells and dry holes drilled in West Virginia in 1912, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Brooke County	1	...	..	...	1	1	1	1	2	...	...	...	...	...	...	...	...	...	..	...	...	2	...	..	5	4
Burning Springs	1	...	..	1	..	...	2	...	2	...	2	...	3	1	1	...	...	...	3	...	3	1	...	..	17	3
Calhoun County	1	3	3	3	3	1	1	1	1	...	2	1	1	1	3	...	1	1	2	1	1	...	...	..	19	12
Hancock County	..	...	..	...	..	1	..	...	..	2	...	1	1	...	1	1	2	2	..	...	...	...	2	3	5	11
Kanawha County	4	...	10	1	24	...	32	1	34	...	47	1	63	1	53	...	50	1	42	2	35	1	46	3	440	11
Lincoln County	..	...	5	...	1	...	7	...	4	...	7	1	...	...	8	1	7	...	8	...	9	...	5	..	61	1
Mannington	13	4	10	...	2	9	8	1	5	2	6	...	5	8	3	4	7	1	7	3	4	1	10	6	80	39
Pleasants County	4	5	3	...	9	3	3	2	1	1	5	2	4	1	5	3	8	2	3	7	9	...	5	5	59	31
Ritchie County	5	2	4	3	6	3	4	2	5	2	3	1	8	2	9	...	7	2	6	...	15	1	7	2	79	20
Roane County	16	...	10	...	9	2	10	2	12	...	6	...	9	...	13	3	16	1	13	1	14	2	19	2	147	13
Sistersville	..	1	2	1	1	1	1	1	..	2	1	...	...	...	1	2	...	...	..	...	...	...	1	..	7	8
Wetzel and Tyler Counties	4	1	2	3	7	4	4	4	1	1	6	4	1	2	9	4	5	2	2	3	10	5	8	7	59	40
Wood County	5	...	..	...	8	4	2	...	6	1	3	1	6	...	5	5	10	5	5	2	7	...	4	2	61	20
Miscellaneous	..	2	1	2	..	1	..	...	1	1	2	...	3	1	2	...	4	4	5	2	4	2	1	6	23	21
Total	54	18	50	14	71	30	75	15	74	12	90	11	103	18	113	23	117	21	96	21	111	15	108	36	1,062	234

Initial daily production of new wells completed in West Virginia in 1912, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Total 1911.
Brooke County	2	.....	5	5	7	......	......	.....	......	....	......	.....	19	3
Burning Springs	5	.....	.....	10	4	22	24	2	......	13	25	.....	105	144
Cabell County	.....	.....	.....	......	......	......	......	.....	......	.....	......	.....	......	5
Calhoun County	30	55	20	20	30	85	15	30	10	25	20	.....	340	295
Hancock County	.....	.....	.....	......	......	......	......	5	9	.....	......	7	21	29
Kanawha County	1,410	5,365	7,935	15,445	19,525	19,079	12,873	5,549	3,469	2,600	1,220	4,400	98,870	(*a*)
Lincoln County	.....	78	15	117	77	95	......	183	135	124	154	80	1,058	1,087
Mannington	138	130	80	74	27	77	95	25	106	458	55	736	2,001	2,180
Pleasants County	7	9	25	23	3	185	77	148	58	36	102	257	930	374
Ritchie County	25	44	99	18	65	13	81	61	72	19	156	73	726	1,661
Roane County	325	153	110	154	163	110	210	173	562	570	631	.....	3,161	3,243
Sistersville	.....	13	10	5	......	2	......	3	......	.....	......	5	38	56
Wetzel and Tyler Counties	32	55	246	40	5	177	5	160	85	12	267	170	1,254	605
Wood County	36	.....	32	14	14	21	98	19	28	21	26	9	318	337
Miscellaneous	.....	700	.....	......	10	60	50	25	52	23	40	3	963	424
Total	2,010	6,602	8,577	15,925	19,930	19,926	13,528	6,383	4,586	3,901	2,696	5,740	109,804	10,443

a Included in "Miscellaneous."

Total initial daily production of new wells in West Virginia, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Average.
1908	2,185	2,298	1,423	2,033	3,310	3,853	2,682	2,473	2,498	1,912	1,661	1,997	28,325	2,360
1909	1,682	1,781	2,221	2,337	1,795	2,656	3,014	3,812	3,615	7,362	4,048	9,141	43,464	3,622
1910	4,523	3,559	2,092	2,094	2,085	2,533	1,647	1,500	2,608	1,542	1,408	603	26,194	2,183
1911	813	938	773	869	991	767	1,015	834	700	865	1,008	870	10,443	870
1912	2,010	6,602	8,577	15,925	19,930	19,926	13,528	6,383	4,586	3,901	2,696	5,740	109,804	9,150

KENTUCKY.

DEVELOPMENT.

The influence of steadily rising prices stimulated drilling very greatly and aroused unusual interest in oil operations throughout the State. Efforts were persistent to extend the West Virginia field over into Lawrence County, Ky., with the result of developing several small wells with an average initial production of 10 barrels a day. This was increased by a well or two at 25 barrels. In October the Little Blaine Creek district in this county was yielding 100 barrels a day, and the wells are good stayers. Pipe-line facilities were afforded during the year.

The greatest interest in Kentucky came from finding a 200-barrel gusher on July 3 in Ohio County. The oil is of good quality and was obtained at 1,800 feet. In October two wells were obtained in Allen County at about the same depth. This stimulated much prospecting in Muhlenberg, Hopkins, Webster, and Logan counties, in the western part of the State.

In Morgan County, besides the project of piping gas to West Liberty, the finding of a well flowing 50 barrels a day of light-green oil from a depth of 2,000 feet aroused interest. The wells in Wolfe County were obtained at slight depths and active preparations were made to extend the drilling to the horizon of the Berea sandstone. The Wolfe field was extended 4 miles to Stillwell Creek.

PRODUCTION.

The decline in production which was quite evident in 1910 and 1911 changed to the slight increase of 2.52 per cent, or 11,910 barrels, in 1912, when the production of petroleum rose to 484,368 barrels, against 472,458 barrels in 1911.

Production of petroleum in Kentucky, by months, 1908–1912, in barrels.

Month.	1908	1909	1910	1911	1912
January	60,781	59,799	40,984	33,237	38,425
February	60,168	56,355	35,795	31,151	37,723
March	59,336	63,085	41,006	37,910	40,923
April	63,283	55,681	39,907	35,484	37,375
May	65,927	57,065	43,055	42,906	44,967
June	60,127	53,522	44,239	38,509	40,311
July	60,150	55,414	40,009	42,237	44,997
August	60,533	54,777	40,699	44,087	40,866
September	60,137	54,221	41,017	44,356	39,146
October	55,385	46,330	35,822	41,556	38,484
November	59,643	41,772	29,144	40,818	40,000
December	62,297	40,995	37,097	40,207	41,151
Total	727,767	639,016	468,774	472,458	484,368

Pipe-line runs in Kentucky in 1911 and 1912, by districts and months, in barrels.

1911.

Month ending—	Cooper.	Griffin.	Johnson Fork.	Mount Pisgah.	Parmleysville.	Slickford.	Steubenville.	Total, Wayne County.	Beaver Creek.	Campton.	Ragland.	Watson.	Williamsburg.	Total.
Jan. 28	3,615	......	1,228	5,444	7,928	2,146	3,273	23,634	906	5,111	1,247	....	216	31,114
Feb. 25	3,665	......	885	6,281	8,185	1,801	3,139	23,956	625	4,137	......	....	216	28,934
Mar. 25	3,620	......	985	6,596	7,818	2,061	3,034	24,114	945	4,228	......	....	216	29,503
Apr. 29	5,975	......	260	12,006	10,778	2,701	4,401	36,121	690	4,727	1,664	....	322	43,524
May 27	4,123	......	......	8,796	8,101	2,166	2,521	25,707	507	4,068	5,686	....	216	36,184
June 24	4,653	......	......	8,590	8,751	2,018	3,083	27,095	875	3,853	6,605	....	216	38,644
July 28	5,225	......	......	10,832	9,324	1,639	3,049	30,069	808	1,605	4,466	....	216	37,164
Aug. 26	4,967	......	......	12,352	13,349	2,495	3,587	36,750	942	6,873	4,636	....	322	49,523
Sept. 23	3,813	......	......	9,041	14,083	1,683	2,860	31,480	697	4,130	3,608	....	216	40,131
Oct. 28	5,102	......	......	10,242	14,727	2,245	3,094	35,410	1,371	4,631	4,182	....	323	45,917
Nov. 25	3,671	......	......	8,346	11,220	2,033	2,272	27,542	1,039	2,952	5,151	....	108	36,792
Dec. 30	5,701	4,022	......	9,146	11,834	1,541	2,936	35,180	1,097	4,817	4,988	68	215	46,365
Total	54,130	4,022	3,358	107,672	126,098	24,529	37,249	357,058	10,502	51,132	42,233	68	2,802	463,795

1912.

Month ending—	Cooper and Slickford.	Griffin (Denny).	Mount Pisgah (Sandusky).	Parmleysville.	Steubenville.	Total, Wayne County.	Beaver Creek.	Busseyville.	Campton.
Jan. 27	4,231	7,170	7,377	4,382	1,595	24,755	1,093	....	1,521
Feb. 24	4,125	9,023	7,390	4,096	2,147	26,781	904	....	1,024
Mar. 30	5,330	10,053	10,693	4,652	3,246	33,974	1,253	....	3,895
Apr. 27	4,388	8,994	7,518	3,991	1,890	26,781	844	....	2,570
May 25	4,278	10,920	6,980	4,057	2,630	28,865	751	....	3,144
June 29	4,687	16,004	8,453	4,616	2,839	36,599	1,367	....	3,185
July 27	3,793	14,380	5,805	3,589	2,028	29,595	1,017	....	2,281
Aug. 31	5,622	14,330	7,574	4,795	2,555	34,876	1,760	....	3,650
Sept. 28	3,653	11,149	4,507	2,818	1,950	24,077	1,514	....	2,443
Oct. 26	3,568	13,158	4,434	2,758	1,695	25,613	683	145	1,967
Nov. 30	4,436	15,793	5,227	3,941	2,299	31,696	1,589	1,173	2,953
Dec. 28	4,091	11,737	3,810	2,547	2,030	24,215	1,230	1,166	1,613
Total	52,202	142,711	79,768	46,242	26,904	347,827	14,005	2,484	30,246

Month ending—	Lewis.	Meadow Branch.	Page Hollow.	Ragland.	Stillwater.	Watson.	Williamsburg.	Total.
Jan. 27	....	223	831	2,634	....	622	404	32,083
Feb. 24	....	265	793	3,443	....	589	138	33,937
Mar. 30	....	353	....	4,533	....	262	....	44,270
Apr. 27	....	761	....	4,306	....	140	....	35,402
May 25	....	523	....	3,508	....	325	....	37,116
June 29	....	652	1,053	6,758	....	292	159	50,065
July 27	....	674	....	4,687	....	142	177	38,573
Aug. 31	....	448	....	4,558	558	517	....	46,367
Sept. 28	....	473	....	3,438	860	....	....	32,805
Oct. 26	....	564	....	4,583	917	....	....	34,472
Nov. 30	918	604	....	4,039	1,313	71	159	44,515
Dec. 28	1,698	511	835	4,274	625	....	....	36,167
Total	2,616	6,051	3,512	50,761	4,273	2,960	1,037	465,772

PRICES.

In the following table are given the dates of change and the changes in prices of the different grades of petroleum produced in Kentucky during the years 1911 and 1912:

Fluctuations in prices, per barrel, of Kentucky petroleum in 1911 and 1912.

1911			1912		
Date.	Somerset (light).	Ragland (heavy).	Date.	Somerset (light).	Ragland (heavy).
Jan. 1	$0.72	$0.45	Jan. 1	$0.79	$0.48
Sept. 16	.74	.45	Jan. 22	.81	....
Dec. 26	.79	.48	Jan. 29	.83	....
			Apr. 19	.86	.50
			June 5	.91	.53
			Oct. 29	.96	.56
			Nov. 8	1.00	.60
			Nov. 14	1.05	.65
			Nov. 18	1.07	....
			Nov. 23	1.10	....
			Dec. 9	1.12	....
			Dec. 14	1.15	....

In the following table are given the average monthly prices of Kentucky petroleum, per barrel of 42 gallons, in the years 1908 to 1912, inclusive:

Average monthly prices, per barrel, at wells, of Kentucky petroleum in 1908–1912.

Month.	Somerset (light).					Ragland (heavy).				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
January	$1.00	$1.00	$0.72	$0.72	$0.81	$0.75	$0.65	$0.46⅛	$0.45	$0.48
February	1.00	1.00	.72	.72	.83	.75	.65	.45	.45	.48
March	1.00	.97¾	.72	.72	.83	.75	.63⅞	.45	.45	.48
April	1.00	.90	.72	.72	.84½	.75	.60	.45	.45	.49
May	1.00	.81⅞	.72	.72	.86	.75	.60	.45	.45	.50
June	1.00	.79¼	.72	.72	.88½	.72¾	.59¼	.45	.45	.51½
July	1.00	.73½	.72	.72	.91	.65⅜	.52⅜	.45	.45	.53
August	1.00	.72	.72	.72	.91	.65	.50	.45	.45	.53
September	1.00	.72	.72	.73	.91	.65	.50	.45	.45	.53
October	1.00	.72	.72	.74	.93½	.65	.50	.45	.45	.54½
November	1.00	.72	.72	.74	1.03⅗	.65	.50	.45	.45	.60⅓
December	1.00	.72	.72	.75	1.12⅓	.65	.50	.45	.46	.65
Average	1.00	.819	.72	.727	.907	.699	.563	.451	.456	.528

WELL RECORD.

In the following tables are given the well records for Kentucky from 1908 to 1912, inclusive:

Number of wells completed in Kentucky, 1908–1912, by counties.

County.	Completed.					Dry.					Oil.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Bath	3	1					1				3				
Carter			1					1							
Cumberland					1										1
Floyd	1	1		3	4	1	1		1					2	4
Johnson			1					1							
Lawrence		1	6	1	33		1	4	1	12			2		20
Logan			8	1				1					7	1	
McLean		1					1								
Meade		1	1					1				1			
Menifee			1												
Morgan		2					2								
Wayne	175	157	99	121	119	59	71	38	27	44	116	86	61	94	75
Wolfe	21	7	4	2	11	5	2	4		2	16	5		1	9
Other				8	10				4	3				2	3
Total	200	171	121	136	178	[a] 65	[a] 79	[b] 50	[b] 33	[b] 61	135	92	70	100	112

[a] Including gas wells. [b] Not including gas wells.

Number of wells completed in Kentucky, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	13	15	20	16	21	18	18	17	15	20	11	16	200
1909	19	11	17	17	22	18	13	14	8	13	13	6	171
1910	4	10	3	11	13	18	17	9	9	11	9	7	121
1911	7	20	12	8	12	10	14	10	9	13	12	9	136
1912	13	6	19	11	16	15	8	18	37	10	16	9	178

Number of oil wells drilled in Kentucky, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	8	10	13	8	16	12	13	11	9	15	9	11	135
1909	10	9	9	12	13	11	8	8	3	3	2	4	92
1910	1	6	3	7	11	9	7	3	4	6	8	5	70
1911	6	14	7	6	11	10	9	8	4	10	9	6	100
1912	10	3	14	10	12	8	6	11	18	6	9	5	112

Number of dry holes drilled in Kentucky, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	5	5	7	8	5	6	5	6	6	5	2	5	[a] 65
1909	9	2	8	5	9	7	5	6	5	10	11	2	[a] 79
1910	3	4	......	4	2	9	10	6	5	5	1	1	[b] 50
1911	4	5	5	2	1	1	6	2	......	3	1	3	[b] 33
1912	3	1	5	1	3	7	2	7	17	4	7	4	[b] 61

[a] Including gas wells. [b] Not including gas wells.

Total and average initial daily production of new wells in Kentucky, 1908–1912, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Bath and Rowan	14	......	......	......	......	4.7	......	......	......	......
Cumberland	......	......	......	......	3	......	......	......	......	3.0
Floyd	......	......	......	45	35	......	......	......	22.5	8.8
Lawrence	......	......	17	......	148	......	......	8.5	......	7.4
Logan	......	......	65	10	......	......	......	9.3	10.0	......
Meade	......	25	......	......	......	......	25.0	......	......	......
Wayne	2,167	2,111	747	1,729	1,481	18.7	24.5	12.2	18.4	19.7
Wolfe	261	50	......	25	196	16.3	10.0	......	25.0	21.8
Other	......	......	......	13	80	......	......	......	6.5	26.7
Total	2,442	2,186	829	1,822	1,943	18.1	23.8	11.8	18.2	17.3

Total initial daily production of new wells in Kentucky, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	200	195	378	127	265	151	199	196	195	242	147	147	2,442
1909	214	128	215	100	277	177	155	502	78	10	105	225	2,186
1910	15	110	50	73	149	97	69	60	33	54	81	38	829
1911	17	93	101	167	176	89	195	227	358	129	125	145	1,822
1912	122	35	341	255	216	255	112	213	121	128	75	70	1,943

TENNESSEE.

In Tennessee drilling was active in many parts of the State, especially in the neighborhood of Franklin, where, in addition to a considerable yield of natural gas, there is some prospect of obtaining oil.

OHIO.

DEVELOPMENT.

Drilling for petroleum in the Ohio oil fields was very active during 1912, with good results in the deep "Clinton sand" in central Ohio, especially in Vinton, Hocking, Logan, Fairfield, Perry, Muskingum, Licking, Coshocton, Holmes, Wayne, Medina, and Lorain counties. In addition to a satisfactory yield of oil, large quantities of natural gas were obtained.

In the northwest corner of the State the decline continued in the production of oil of the Lima grade, with an occasional increase in production from a few deep wells.

PRODUCTION.

There was a slight increase in the production of Ohio in 1912, when the total reached 8,969,007 barrels, against 8,817,112 barrels in 1911, an increase of 143,900 barrels, or 1.63 per cent.

In the following tables are given the production of petroleum in Ohio, by months and districts, for the years 1911 and 1912:

Production of petroleum in Ohio in 1911 and 1912, by months and districts, in barrels.

Month.	Lima.	Southeastern Ohio.	Mecca-Belden.	Total.
1911.				
January	395,132	346,170	....	741,302
February	364,706	341,747	....	706,453
March	413,321	372,270	....	785,591
April	380,434	345,162	....	725,596
May	405,705	383,774	....	789,479
June	393,385	371,118	....	764,503
July	367,216	341,297	....	708,513
August	383,440	364,106	....	747,546
September	365,586	352,353	....	717,939
October	376,118	358,100	....	734,218
November	330,800	343,691	....	674,491
December	360,032	361,385	[a] 64	721,481
Total	4,535,875	4,281,173	64	8,817,112
1912.				
January	254,382	333,489	....	587,871
February	245,764	356,983	....	602,747
March	316,946	443,795	....	760,741
April	366,846	440,834	....	807,680
May	380,394	453,807	....	834,201
June	354,165	416,396	....	770,561
July	365,227	439,748	....	804,975
August	358,260	460,361	....	818,621
September	322,245	410,131	....	732,376
October	353,881	437,877	....	791,758
November	313,361	397,129	....	710,490
December	[b] 324,426	422,501	[a] 59	746,986
Total	[b] 3,955,897	5,013,051	59	8,969,007

[a] Separation by months not made. [b] Includes production of Michigan.

The quantity and value of petroleum produced in Ohio from 1903 to 1912, inclusive, by districts, are shown in the following table:

Quantity and value of petroleum produced in Ohio, 1903–1912, by districts, in barrels.

Year.	Lima.		Southeastern Ohio.		Mecca-Belden.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1907	7,993,057	7,425,480	4,214,298	7,343,943	93	465	12,207,448	14,769,888
1908	6,748,676	6,861,885	4,109,935	7,315,667	186	950	10,858,797	14,178,502
1909	5,915,357	5,451,497	4,717,069	7,771,555	367	2,325	10,632,793	13,225,377
1910	5,094,136	4,181,629	4,822,193	6,469,314	41	625	9,916,370	10,651,568
1911	4,535,875	3,888,119	4,281,173	5,590,457	64	966	8,817,112	9,479,542
1912	[a] 3,955,897	3,908,809	5,013,051	8,176,243	59	946	8,969,007	12,085,998

[a] Includes production of Michigan.

WELL RECORD.

Number of wells completed in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months.[a]

1911.

County.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Ashland (Lake, Mifflin, Milton, Mohican, Montgomery, and Vermilion districts)	2	1	3	3	6	6	13	5	13	16	15	17	100
Carroll (Norristown district)	5	5	3	2	1	3	6	1	3	2	2	3	36
Columbiana (Alliance district)	4	7	2	1	2	4	5	2	7	3	5	2	44
Coshocton (Bedford, Clay, Pike, and Washington districts)	1	2	...	5	4	...	...	...	1	...	2	2	17
Cuyahoga (Newburg and Rocky River districts)	...	...	...	...	...	...	...	...	...	1	1	...	2
Delaware (Harlem district)	...	...	1	...	...	...	...	...	...	...	...	...	1
Erie (Florence district)	...	...	...	...	...	...	...	...	1	...	...	...	1
Fairfield (Berne, Clear Fork, Greenfield, Pleasants, Rush Creek, Rushville, Upper Walnut, and Walnut districts)	6	5	30	6	9	11	8	9	5	9	14	3	115
Harrison (Cadiz, Plum Run, and Scio districts)	3	...	1	1	...	1	1	3	...	4	3	...	17
Hocking (Falls, Laurel, Marion, Keller, and Perry districts)	8	6	1	3	7	5	7	7	12	12	10	14	92
Holmes (Killbuck and Washington districts)	...	...	1	...	...	...	...	...	1	...	1	1	4
Jackson (Scioto district)	...	...	...	...	...	...	...	...	1	...	...	...	1
Jefferson (Steubenville district)	7	3	8	6	7	5	9	12	2	9	4	7	79
Knox (Clay, Gambier, College, and Pleasants districts)	5	...	7	...	2	2	1	...	2	11	7	7	44
Licking (Avondale, Black Hand, Buckeye, Burlington, Eden, Fallsburg, Granville, Hanover, Hebron, Hopewell, Jacksontown, Liberty, Licking, Madison, Mary Ann, Newton, Perry, Shell Beach, Thornport, Union, Washington, and McKean districts)	25	17	12	8	10	16	13	8	16	10	18	11	164
Lorain (Pittsfield, Russia, and Sheffield districts)	...	...	...	...	...	...	...	...	...	1	3	2	6
Medina (Harrisville, Homer, Litchfield, Medina, Pleasants, Westfield, and York districts)	1	1	2	...	2	...	3	2	...	2	1	...	14
Monroe (Barnesville, Graysville, Jackson Ridge, Jerusalem, Lewisville, Millers Run, Newcastle, Rinard Mills, and Woodsfield districts)	12	7	6	10	6	8	7	12	9	8	3	10	98
Morgan (Chester Hill district)	6	7	6	12	18	20	17	19	7	27	17	16	172
Muskingum (Fultonham, Hopewell, Monroe, Muskingum, and Newton districts)	...	4	...	1	1	5	2	4	6	2	2	1	28
Noble (Macksburg district)	8	12	14	14	11	14	19	15	13	15	16	12	163
Perry and Athens (Clay, Corning, Harrison, Marion, Monday Creek, Reading, and Thorn districts)	24	20	5	11	10	8	8	10	8	11	17	8	140
Richland (Monroe district)	...	2	...	...	...	...	...	...	...	...	...	1	3
Ross (Harper Station district)	...	...	...	...	...	...	...	1	...	...	...	...	1
Vinton (near Hue, Benton, Knox, and Litchfield districts)	1	...	...	...	...	...	1	...	...	2	1	3	8
Washington (Macksburg, Marietta, and New Matamoras districts)	20	22	19	31	32	42	29	23	35	17	29	25	324
Wayne (Clinton, Congress, Plain, and Wayne districts)	...	...	...	...	1	1	...	...	2	...	1	1	6
Total	138	121	121	114	129	151	149	133	144	162	172	146	1,680

[a] Including gas wells.

Number of wells completed in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months—Continued.

1912.

County.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Ashland (Greene, Hanover, Mifflin, Milton, Montgomery, Orange, Perry, and Vermilion districts)	2	...	5	8	4	12	17	10	23	18	18	14	131
Athens	...	...	2	1	...	...	1	3	...	3	...	...	10
Belmont	...	...	...	...	...	...	...	...	...	5	...	8	13
Carroll	...	...	...	...	...	...	...	3	2	1	4	1	11
Columbiana (Alliance district)	2	...	1	2	2	1	2	3	2	1	1	...	17
Coshocton (Pike and Virginia districts)	1	2	...	2	...	2	...	...	2	...	1	...	10
Cuyahoga (Cleveland, Independence, and Newburg districts)	...	2	1	2	1	2	4	1	4	...	1	1	19
Fairfield (Berne, Clear Fork, Liberty, Madison, Pleasants, Rush Creek, and Walnut districts)	5	4	...	4	3	3	6	5	10	5	6	9	60
Harrison (Cadiz, Plum Run, and Scio districts)	2	2	2	1	2	...	3	2	3	2	2	2	23
Hocking (Benton, Falls Gore, Good Hope, Laurel, Perry, and Starr districts)	6	9	5	8	12	9	12	18	16	16	10	8	129
Jefferson (Amsterdam and Steubenville districts)	5	2	6	2	1	9	10	5	7	4	5	1	57
Knox (Brown, Clinton, College, Howard, Monroe, Morgan, Pike, and Pleasants districts)	1	3	4	7	1	6	7	5	9	5	2	3	53
Lake (Mentor district)	...	...	...	...	...	...	...	...	...	...	...	1	1
Licking (Bowling Green, Eden, Granville, Hanover, Harrison, Hebron, Hopewell, Liberty, Licking, McKean, Mary Ann, Newton, Perry, St. Albans, Union, and Washington districts)	13	5	13	9	13	13	15	9	20	31	17	11	169
Lorain (Avon, Columbia, Grafton, Henrietta, Lagrange, Pittsfield, and Russia districts)	...	...	3	...	2	3	...	1	2	3	2	3	19
Madison	1	...	...	...	...	...	...	...	...	...	...	...	1
Medina (Chatham, Homer, Harrisville, Lafayette, Medina, and Westfield districts)	...	...	2	...	2	2	3	1	2	4	3	4	23
Monroe (Barnesville, Graysville, Jerusalem, Lewisville, Newcastle, Rinard Mills, and Woodsfield districts)	7	4	5	7	8	15	9	10	9	11	9	8	102
Morgan (Chester Hill district)	14	8	6	13	19	16	15	19	23	28	17	18	196
Muskingum (Cass, Hopewell, Madison Falls, Muskingum, and Washington districts)	5	2	1	1	2	...	3	5	4	3	1	3	30
Noble	4	...	5	3	4	6	3	7	2	3	3	3	43
Perry (Harrison, Hopewell, Pike, and Reading districts)	13	21	16	14	17	24	25	26	12	15	15	21	219
Richland (Madison, Monroe, Washington, and Worthington districts)	...	...	...	1	...	...	3	...	4	2	8	3	21
Summit (Coventry, Northfield, and Richfield districts)	...	...	...	...	1	1	...	...	1	...	...	...	3
Tuscarawas (Perry and Washington districts)	...	...	...	...	...	1	...	1	...	...	...	...	2
Vinton (Richland district)	...	4	...	...	1	...	...	...	...	...	...	...	5
Washington (Macksburg, Marietta, and New Matamoras districts)	8	14	18	24	28	29	34	26	33	34	29	26	303
Wayne (Chippewa, Clinton, Congress, East Union, Franklin, Plain, Wayne, and Wooster districts)	1	1	2	4	4	4	5	3	6	9	2	6	47
Total	90	83	97	113	127	158	177	163	196	203	156	154	1,717

Number of oil wells and dry holes drilled in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months.

1911.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Ashland (Lake, Jackson, Mifflin, Milton, Mohican, Montgomery, and Vermilion districts)	...	...	...	...	...	1	...	...	...	1	...	...	...	2	...	...	...	2	...	2	...	...	...	4	...	12
Carroll (Norristown district)	1	4	2	2	...	2	1	1	1	...	1	1	...	5	...	1	1	2	1	1	...	1	2	...	10	20
Columbiƨna (Alliance district)	1	3	2	5	1	1	...	1	...	2	2	2	2	3	1	1	2	5	...	3	2	3	1	1	14	30
Coshocton (Bedford, Pike, and Washington districts)	...	...	1	1	...	...	1	4	...	2	...	...	...	...	...	...	1	...	...	...	2	...	2	...	7	7
Cuyahoga (Newburg district)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...

Number of oil wells and dry holes drilled in central and southeastern Ohio fields in 1911 and 1912, by counties and months—Continued.

1911—Continued.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Delaware (Harlem district)	..	...	..	...	..	1	..	...	..	...	...	...	...	...	..	...	...	...	..	...	..	...	..	...	...	1
Fairfield (Berne, Clear Fork, Greenfield, Pleasants, Richland, and Walnut districts)	..	1	..	...	15	10	2	4	7	1	3	8	4	3	6	3	4	...	7	1	6	4	3	...	57	35
Harrison (Cadiz, Plum Run, and Scio districts)	2	1	..	...	1	..	1	...	..	...	...	1	1	...	2	1	...	...	2	1	1	...	..	...	10	4
Hocking (Falls, Laurel, Marion, and Perry districts)	..	2	..	...	..	1	2	...	4	1	2	...	2	1	5	1	7	3	1	2	4	1	11	...	38	12
Holmes (Killbuck district)	..	...	..	...	..	1	..	...	..	...	...	...	...	...	..	...	...	...	..	...	..	1	..	1	...	3
Jackson (Scioto district)	..	...	..	...	..	...	..	...	..	...	...	...	...	...	..	...	...	1	..	...	..	...	..	...	...	1
Jefferson (Steubenville district)	1	3	3	...	3	3	1	1	3	3	1	2	3	2	4	6	1	1	5	4	1	2	2	4	28	31
Knox (Clay, College, and Pleasants districts)	..	2	..	...	..	3	..	...	..	...	...	...	...	1	..	...	...	...	..	3	..	1	..	1	...	11
Licking (Avondale, Buckeye, Burlington, Eden, Fallsburg, Granville, Hebron, Hopewell, Jacksontown, Liberty, Licking, Madison, Newton, Perry, Thornport, Union, Washington, and McKean districts)	..	5	1	4	1	3	..	2	..	3	...	4	...	3	..	2	2	...	..	2	1	2	1	4	6	34
Lorain (Pittsfield, Russia, and Sheffield districts)	..	...	..	...	..	...	..	...	..	...	...	...	...	...	..	...	...	...	..	...	1	...	..	2	1	2
Medina (Homer, Litchfield, Westfield, and York districts)	1	...	..	...	..	1	..	...	..	1	...	...	...	1	..	1	...	...	..	...	..	...	..	...	1	4
Monroe (Barnesville, Graysville, Jackson Ridge, Jerusalem, Lewisville, Millers Run, Newcastle, Rinard Mills, and Woodsfield districts)	8	3	4	3	5	1	4	4	..	4	5	1	1	5	5	6	3	2	5	3	1	2	2	8	43	42
Morgan (Chester Hill district)	5	1	5	2	5	1	8	4	12	6	15	5	12	5	10	9	3	4	19	8	12	5	11	5	117	55
Muskingum (Hopewell, Monroe, and Newton districts)	..	...	2	1	..	...	..	...	..	1	...	4	1	1	1	3	2	2	1	...	2	...	..	...	9	12
Noble (Macksburg district)	5	3	8	4	11	3	9	4	5	5	9	5	9	10	5	9	8	5	7	6	11	5	8	3	95	62
Perry and Athens (Corning, Harrison, Monday Creek, Reading, and Thorn districts)	21	3	16	4	2	3	11	...	8	2	7	1	4	4	6	4	6	1	7	4	12	4	7	1	107	31
Richland (Monroe district)	..	...	..	...	..	...	..	...	..	...	...	...	...	...	..	...	...	...	..	...	..	...	..	1	...	1
Ross (Harper Station district)	..	...	..	...	..	...	..	...	..	...	...	...	...	...	1	...	...	...	..	...	..	...	..	...	1	...
Vinton (near Hue, Knox, and Litchfield districts)	..	1	..	...	..	...	..	...	..	...	...	...	1	...	..	...	...	...	2	...	..	...	1	1	4	2
Washington (Macksburg, Marietta, and New Matamoras districts)	16	4	15	6	13	6	21	8	25	6	26	15	17	10	15	6	26	8	9	8	15	13	17	8	215	98
Wayne (Clinton, Congress, Plain, and Wayne districts)	..	...	..	...	..	...	..	...	..	...	...	1	...	...	..	...	...	...	..	...	..	1	1	...	1	2
Total	61	36	59	32	57	41	61	33	65	38	71	50	57	56	61	53	66	36	67	48	71	45	69	44	765	512

Number of oil wells and dry holes drilled in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months—Continued.

1912.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Ashland (Greene, Hanover, Jackson, Mifflin, Milton, Montgomery, Orange, and Vermilion districts)		1						3		1		5		4		2		9		2		5		2		34
Athens						2								1	1	1			2	1					3	5
Belmont																			3	2			6	1	9	3
Carroll															2		1	1		1	2	2		1	5	5
Columbiana (Alliance district)	1	1				1		2	1	1	1			2	1	2		2		1		1			4	13
Coshocton (Pike and Virginia districts)	1		2				2				2						1	1			1				9	1
Cuyahoga (Cleveland, Independence, and Newburg districts)					1		2			1	1			2				1							4	4
Fairfield (Berne, Clear Fork, Liberty, Madison, Pleasants, Rush Creek, and Walnut districts)	4	1	3	1			1		2	1	2	1	2	3	1	1	3	5	1	1	1	3	5	2	25	19
Harrison (Cadiz, Plum Run, and Scio districts)		2		1			1		1	1			3		2		2			1	2			2	11	7
Hocking (Benton, Falls Gore, Good Hope, Laurel, Perry, and Starr districts)			7		3	1	7		11	1	2		8		11	3	8	1	7	3	4	2	6	1	74	12
Jefferson (Amsterdam, and Steubenville districts)	2	2			2	4	1	1	1		7	1	7	2	2	2	4	3		3	4			1	30	19
Knox (College, Howard, Monroe, Pike, and Pleasants districts)												1		4		1		3		3						12
Licking (Bowling Green, Eden, Granville, Hanover, Harrison, Hebron, Hopewell, Liberty, Licking, McKean, Mary Ann, Newton, Perry, St. Albans, Union, and Washington districts)	3	5	1		6	1	3	1	4	5	3	2	2	4	1	2	2	6	9	5	1	4	2		37	35
Lorain (Avon, Columbia, Grafton, Henrietta, Lagrange, Pittsfield, and Russia districts)						2			1	1		3				1		1		2		2		1	1	13
Madison		1																								1
Medina (Chatham, Homer, Harrisville, Lafayette, Medina, and Westfield districts)						1						1				1								2		5
Monroe (Barnesville, Graysville, Jerusalem, Lewisville, Newcastle, Rinard Mills, and Woodsfield districts)	3	4	2	2	3	2	5	2	4	2	13	2	7	1	5	4	7		8	3	6	2	7		70	24
Morgan (Chester Hill district)	10	4	3	5	4	2	9	4	9	10	11	5	13	2	11	8	12	11	20	8	6	11	10	8	118	78
Muskingum (Cass, Hopewell, Madison, Falls, Muskingum, and Washington districts)	3	2		2	1		1		2				3		1	4		3	3		1		3		18	11
Noble	2	2			1	4		3	2	2	5	1		3	4	2	1	1	2	1		1	2	1	19	21
Perry (Harrison, Hopewell, Pike, and Reading districts)	9	4	21		16		12	2	16	1	23		18	6	23	2	8	1	12	3	14		16	4	188	23
Richland (Madison, Monroe, and Washington districts)								1						1								2				4
Summit (Coventry and Richfield districts)										1								1								2

Number of oil wells and dry holes drilled in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months—Continued.

1912—Continued.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Tuscarawas (Perry and Washington districts)	..	...	..	...	..	...	..	...	..	...	...	1	...	...	..	1	...	...	..	...	..	...	..	...	...	2
Vinton (Richland district)	..	...	1	1	..	...	..	...	..	...	...	...	...	...	..	...	...	...	..	...	..	...	..	...	1	1
Washington (Macksburg, Marietta, and New Matamoras districts)	7	1	9	4	11	7	19	5	22	5	19	9	19	15	15	11	22	11	24	10	23	6	16	10	206	94
Wayne (Chippewa, Clinton, Congress, East Union, Franklin, Plain, Wayne, and Wooster districts)	..	1	..	1	..	1	2	2	3	...	...	...	4	...	1	1	...	4	3	1	..	...	1	1	14	12
Total	45	31	49	17	48	28	65	26	79	33	89	32	86	50	81	49	71	65	94	51	65	41	74	37	846	460

Initial daily production of new wells completed in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months, in barrels.

1911.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Carroll (Norristown district)	5	53	.....	3	5	3	.....	.....	5	1	.....	5	80
Columbiana (Alliance district)	1	2	2	.....	.....	23	12	3	10	.....	15	1	69
Coshocton (Bedford, Pike, and Washington districts)	.....	20	.....	5	.....	.....	.....	.....	15	.....	25	35	100
Cuyahoga (Newburg district)	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....	.....	10
Fairfield (Berne, Clear Fork, Greenfield, Pleasants, and Walnut districts)	.....	.....	345	20	247	15	60	70	60	105	48	70	1,040
Harrison (Cadiz, Plum Run, and Scio districts)	10	.....	2	2	.....	.....	3	5	.....	8	5	.....	35
Hocking (Falls, Laurel, Marion, and Perry districts)	.....	.....	.....	65	310	50	105	96	220	60	110	370	1,386
Jefferson (Steubenville district)	1	11	8	2	4	1	4	13	20	15	10	2	91
Licking (Avondale, Buckeye, Burlington, Eden, Fallsburg, Granville, Hebron, Hopewell, Jacksontown, Liberty, Licking, Madison, Newton, Perry, Thornport, Union, Washington, and McKean districts)	.....	3	15	.....	.....	.....	.....	.....	35	.....	15	75	143
Lorain (Russia district)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....	10
Medina (Litchfield district)	35	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35
Monroe (Barnesville, Graysville, Jackson Ridge, Jerusalem, Lewisville, Millers Run, Newcastle, Rinard Mills, and Woodsfield districts)	110	64	42	35	.....	24	10	42	27	28	2	9	393
Morgan (Chester Hill district)	50	75	100	105	154	125	136	279	60	136	161	107	1,488
Muskingum (Hopewell, Monroe, and Newton districts)	.....	105	.....	.....	.....	.....	5	3	8	2	105	.....	228
Noble (Macksburg district)	20	17	43	37	12	50	22	8	29	25	30	32	325
Perry and Athens (Corning, Harrison, Monday Creek, Reading, and Thorn districts)	519	535	6	195	242	195	125	125	166	405	908	260	3,681
Ross (Harper Station district)	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	5
Vinton (near Hue, Knox, and Litchfield districts)	.....	.....	.....	.....	.....	.....	5	.....	.....	70	.....	2	77
Washington (Macksburg, Marietta, and New Matamoras districts)	131	88	103	218	248	223	90	123	240	51	82	105	1,702
Wayne (Wooster district)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25	25
Total	882	973	666	687	1,222	709	577	772	895	916	1,526	1,098	10,923

Initial daily production of new wells completed in central and southeastern Ohio oil fields in 1911 and 1912, by counties and months, in barrels—Continued.

1912.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Athens	.....	.....	.....	.....	.....	.....	.....	2	.....	6	.....	.....	8
Belmont	.....	.....	.....	.....	.....	.....	.....	.....	.....	90	.....	463	553
Carroll	.....	.....	.....	.....	.....	.....	.....	5	5	.....	4	.....	14
Columbiana (Alliance district)	10	.....	.....	.....	5	3	.....	3	.....	.....	.....	.....	21
Coshocton (Pike and Virginia districts)	5	35	.....	12	.....	14	.....	.....	5	.....	15	.....	86
Cuyahoga (Cleveland, Independence, and Newburg districts)	.....	.....	10	25	.....	10	.....	.....	.....	.....	.....	.....	45
Fairfield (Berne, Clear Fork, Liberty, Madison, Pleasants, Rush Creek, and Walnut districts)	74	32	.....	10	35	18	110	20	40	5	25	125	494
Harrison (Scio and Plum Run districts)	.....	.....	.....	5	10	.....	15	15	10	.....	4	.....	59
Hocking (Benton, Falls Gore, Good Hope, Laurel, Perry, and Starr districts)	.....	255	95	178	476	45	350	359	203	540	220	265	2,986
Jefferson (Amsterdam and Steubenville districts)	17	.....	8	1	3	25	24	18	18	.....	21	.....	135
Licking (Bowling Green, Eden, Granville, Hanover, Hebron, Hopewell, Liberty, Licking, McKean, Mary Ann, Newton, Perry, St. Albans, Union, and Washington districts)	45	25	94	40	51	122	85	50	45	107	10	60	734
Lorain (Russia district)	.....	.....	.....	.....	10	.....	.....	.....	.....	.....	.....	.....	10
Monroe (Barnesville, Graysville, Lewisville, Newcastle, Rinard Mills, and Woodsfield districts)	7	18	11	24	62	100	76	15	355	31	47	38	784
Morgan (Chester Hill district)	86	26	50	40	18	44	58	107	79	136	70	67	781
Muskingum (Cass, Hopewell, Madison Falls, Muskingum, and Washington districts)	70	.....	25	150	10	.....	42	60	.....	9	2	25	393
Noble	6	.....	10	.....	9	22	.....	31	2	6	.....	7	93
Perry (Harrison, Hopewell, Pike, and Reading districts)	1,385	3,115	1,615	1,235	1,390	1,555	1,015	1,719	170	1,021	425	472	15,117
Vinton	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
Washington (Macksburg, Marietta, and New Matamoras district)	32	66	74	124	155	109	102	84	107	118	163	156	1,290
Wayne (Franklin, Wayne, and Wooster districts)	.....	.....	.....	100	75	.....	200	30	.....	130	.....	50	585
Total	1,737	3,577	1,992	1,944	2,309	2,067	2,077	2,518	1,039	2,199	1,006	1,728	24,193

Total initial daily production of new wells in southeastern Ohio oil field, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Average.
1908	675	347	172	541	798	1,050	625	1,649	2,774	2,413	2,113	1,174	14,331	1,194
1909	2,054	2,490	1,739	1,794	2,490	3,652	2,629	2,131	1,737	2,206	1,971	1,259	26,152	2,179
1910	1,319	1,440	2,388	2,747	2,314	2,065	1,296	872	1,045	1,135	775	642	18,038	1,503
1911	847	835	651	687	1,222	699	567	767	840	856	1,376	968	10,315	860
1912	1,692	3,512	1,907	1,759	2,214	1,912	1,722	2,328	964	1,896	981	1,518	22,405	1,867

LIMA-INDIANA OIL FIELD.

PRODUCTION.

The decline in production which has been continuous in this field since 1904 amounted to 20.95 per cent in 1912. This is all the more remarkable, since the rate of decrease usually becomes less with increasing age of the field. The best example of this is in Pennsylvania and New York. The anomalous condition in Lima, Ohio, and especially in Indiana, is doubtless due to the lower grade of the oil, which has caused the producers to abandon the wells at an earlier stage than in Pennsylvania.

In the following tables will be found the production of the Lima-Indiana field, by States and months, for the years 1911 and 1912:

Production of petroleum in the Lima-Indiana field in 1911 and 1912, by months, in barrels.

Month.	1911.			Month.	1912.		
	Lima, Ohio.	Indiana.	Total.		Lima, Ohio.	Indiana.	Total.
January	395,132	146,582	541,714	January	254,382	64,403	318,785
February	364,706	135,064	499,770	February	245,764	62,991	308,755
March	413,321	355,552	768,873	March	316,946	81,148	398,094
April	380,434	133,947	514,381	April	366,846	92,965	459,811
May	405,705	139,302	545,007	May	380,394	101,102	481,496
June	393,385	132,096	525,481	June	354,165	85,819	439,984
July	367,216	120,737	487,953	July	365,227	90,011	455,238
August	383,440	122,416	505,856	August	358,260	86,492	444,752
September	365,586	114,109	479,695	September	322,245	78,432	400,677
October	376,118	107,317	483,435	October	353,881	83,634	437,515
November	330,800	89,007	419,807	November	313,361	69,733	383,094
December	360,032	99,160	459,192	December	[a] 324,426	73,279	397,705
Total	4,535,875	1,695,289	6,231,164	Total	[a] 3,955,997	970,009	4,925,906

[a] Includes production of Michigan.

In the following table will be found the production of the Lima-Indiana field from 1903 to 1912, 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-Indiana field, 1903–1912.

Year.	Production, in barrels.	Per centage of total production.	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
1903	24,080,264	23.97	721,438		3.09	
1904	24,689,184	21.09	608,920		2.53	
1905	22,294,171	16.55		2,395,013		9.70
1906	17,554,661	13.88		4,739,510		21.26
1907	13,121,094	7.90		4,433,567		25.26
1908	10,032,305	5.62		3,088,789		23.54
1909	8,211,443	4.48		1,820,862		18.15
1910	7,253,861	3.46		957,582		11.66
1911	6,231,164	2.83		1,022,697		14.10
1912	[a] 4,925,906	2.22		1,305,258		20.95

[a] Includes production of Michigan.

Production and value of petroleum in the Lima-Indiana field, 1908–1912, in barrels.

Year.	North Lima, Ohio.		South Lima, Ohio.		Indiana.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	5,430,124	$5,574,400	1,318,552	$1,287,485	3,283,629	$3,203,883	10,032,305	$10,065,768
1909	4,761,065	4,434,277	1,154,292	1,017,220	2,296,086	1,997,610	8,211,443	7,449,107
1910	4,131,060	3,431,618	963,076	750,011	2,159,725	1,568,475	7,253,861	5,750,104
1911	3,676,397	3,221,308	859,478	666,811	1,695,289	1,228,835	6,231,164	5,116,954
1912	[a]3,237,926	3,237,849	717,971	670,960	970,009	885,975	4,925,906	4,794,784

[a] Includes production of Michigan.

PIPE-LINE RUNS IN LIMA-INDIANA OIL FIELD.

Pipe-line runs in the Lima-Indiana oil field in 1912, by months, in barrels.

Month.	Buckeye pipe line.	Other Ohio.	Indiana pipe line.	Other Indiana.	Total.
January	188,717	65,665	45,355	19,048	318,785
February	182,946	62,818	41,879	21,112	308,755
March	229,845	87,101	59,056	22,092	398,094
April	262,325	104,521	71,417	21,548	459,811
May	276,078	104,316	78,666	22,436	481,496
June	252,928	101,237	66,980	18,839	439,984
July	263,981	101,246	71,335	18,676	455,238
August	257,578	100,682	67,069	19,423	444,752
September	231,015	91,230	62,649	15,783	400,677
October	254,144	99,737	66,222	17,412	437,515
November	220,209	93,152	54,426	15,307	383,094
December	225,146	[a] 99,980	54,868	18,411	397,705
Total	2,844,912	[a] 1,110,985	739,922	230,087	4,925,906

[a] Includes production of Michigan.

Pipe-line runs and deliveries of Lima-Indiana oil, by months, in barrels, in 1912, and stocks at end of each month.

Month.	Runs.	Deliveries.	Stocks.
Dec. 31, 1911			3,194,985
January	318,785	503,806	3,009,964
February	308,755	292,617	3,026,102
March	398,094	377,539	3,046,657
April	459,811	435,192	3,071,276
May	481,496	997,635	2,555,137
June	439,984	407,254	2,587,867
July	455,238	809,024	2,234,081
August	444,752	281,357	2,397,476
September	400,677	261,603	2,536,550
October	437,515	737,646	2,236,419
November	383,094	372,827	2,246,686
December	[a] 397,705	224,850	2,419,541
Total	[a] 4,925,906	5,701,350	

[a] Includes production of Michigan.

PRICES OF 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 1911 and 1912. The dates are those on which changes in prices were made.

Fluctuations in prices of Lima (Ohio) and Indiana petroleum in 1911 and 1912, per barrel.

Date.	1911			Date.	1912		
	North Lima.	South Lima and Indiana.	Princeton, Ind.		North Lima.	South Lima and Indiana.	Princeton, Ind.
Jan. 1	$0.82	$0.77	$0.60	Jan. 1	$0.84	$0.79	$0.67
May 2	.82	.77	.63	Jan. 2	.87	.82	.70
June 14	.82	.77	.65	Jan. 6	.89	.84	.72
Sept. 15	.84	.79	.67	Jan. 24	.92	.87	....
				Feb. 1	.95	.90	.75
				Mar. 4	.98	.93	.81
				Apr. 24	1.00	.95	.83
				May 20	1.02	.97	....
				May 24	....	....	.85
				July 25	1.04	.99	.87
				Oct. 28	1.07	1.02	....
				Nov. 9	1.09	1.04	.89
				Nov. 15	1.11	1.06	.91
				Nov. 25	1.13	1.08	.93
				Dec. 2	1.16	1.11	.96
				Dec. 9	1.19	1.14	.99
				Dec. 16	1.22	1.17	1.02
				Dec. 23	1.25	1.20	1.05

In the following table are given the average monthly prices of Lima (Ohio) and Indiana petroleum, per barrel of 42 gallons each, in the years 1910 to 1912:

Average monthly prices of Ohio and Indiana petroleum in 1910, 1911, and 1912, per barrel.

Month.	1910			1911			1912		
	North Lima.	South Lima and Indiana.	Princeton, Ind.	North Lima.	South Lima and Indiana.	Princeton, Ind.	North Lima.	South Lima and Indiana.	Princeton, Ind.
January	$0.84	$0.79	$0.60	$0.82	$0.77	$0.60	$0.89	$0.84	$0.72
February	.84	.79	.60	.82	.77	.60	.95	.90	.75
March	.84	.79	.60	.82	.77	.60	.98	.93	.80
April	.84	.79	.60	.82	.77	.60	.98	.93	.81
May	.84	.79	.60	.82	.77	.63	1.01	.96	.83
June	$.82\frac{3}{4}$	$.77\frac{3}{4}$	.60	.82	.77	.64	1.02	.97	.85
July	.82	.77	.60	.82	.77	.65	1.02	.97	.85
August	.82	.77	.60	.82	.77	.65	1.04	.99	.87
September	.82	.77	.60	.83	.78	.66	1.04	.99	.87
October	.82	.77	.60	.84	.79	.67	1.04	.99	.87
November	.82	.77	.60	.84	.79	.67	1.10	1.05	.90
December	.82	.77	.60	.84	.79	.67	1.21	1.16	1.01
Average	.829	.779	.60	.826	.776	.637	1.023	.973	.844
Average of North Lima, South Lima, and Indiana	.804			.801			.998		

In the following table will be found the highest, lowest, and average prices of Lima (Ohio) oil for the last 10 years:

Highest, lowest, and average prices of Lima (Ohio) petroleum, 1903–1912, per barrel.

Year.	Highest.	Lowest.	Average.	Year.	Highest.	Lowest.	Average.
1903	a $1.38	b $1.06	$1.165	1908	a $1.04	b $0.89	$1.001
1904	a 1.36	b .95	1.104	1909	a 1.04	b .79	.906
1905	a 1.01	b .81	.888	1910	a .84	b .77	.804
1906	a .98	b .85	.911	1911	a .84	b .77	.801
1907	a .94	b .85	.909	1912	a 1.25	b .79	.998

a North Lima. b South Lima.

WELL RECORD.

In the following tables are given the well records for the Lima (Ohio) oil field from 1908 to 1912, inclusive:

Number of wells completed in the Lima (Ohio) district, 1908–1912, by counties.

County.	Completed.					Dry.					Oil.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Allen	61	79	13	21	56	1	4	1	.....	2	60	75	12	21	54
Auglaize	8	15	22	18	11	.....	4	5	4	4	8	11	17	12	7
Hancock	92	111	125	113	116	9	5	8	2	7	83	106	114	104	101
Hardin	.....	.....	5	2	.....	.....	.....	.....	.....	.....	.....	.....	2	2	.....
Henry	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
Lucas	34	21	7	22	21	4	.....	.....	1	2	30	21	7	21	18
Mercer	8	6	5	12	12	1	1	1	2	1	7	5	4	9	11
Ottawa	44	57	25	18	9	2	4	1	3	2	42	53	23	14	7
Putnam	.....	.....	1	2	.....	.....	.....	.....	.....	.....	.....	.....	1	2	.....
Sandusky	162	116	71	58	62	12	9	5	2	8	150	107	64	56	53
Seneca	81	83	54	44	40	21	12	7	8	9	60	71	47	35	29
Van Wert	108	83	20	24	21	4	8	2	1	1	104	75	18	23	19
Wood	229	282	217	191	196	17	29	26	9	18	212	253	189	179	177
Wyandot	19	9	5	2	4	7	.....	1	.....	.....	12	9	3	2	4
Miscellaneous	2	9	2	.....	3	2	9	.....	.....	1	.....	.....	.....	.....	2
Total	848	872	572	527	551	a 80	a 85	b 57	b 32	b 55	768	787	501	480	482

a Including gas wells. b Not including gas wells.

Number of wells completed in the Lima (Ohio) district, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	60	26	46	49	62	66	88	88	98	95	84	86	848
1909	98	59	78	86	70	92	72	78	71	64	63	41	872
1910	29	27	31	46	55	57	59	56	54	44	69	45	572
1911	45	48	40	40	44	48	42	46	50	44	47	33	527
1912	18	20	28	34	50	49	48	53	66	48	71	66	551

Number of oil wells drilled in Lima (Ohio) district, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	52	24	37	43	56	59	79	85	88	89	79	77	768
1909	89	55	67	80	64	85	68	71	66	58	49	35	787
1910	24	24	26	40	46	50	52	51	48	38	63	39	501
1911	40	42	38	38	39	41	39	42	48	41	42	30	480
1912	15	17	22	31	43	44	43	46	54	43	62	62	482

Number of dry holes drilled in the Lima (Ohio) district, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	8	2	9	6	6	7	9	3	10	6	5	9	a 80
1909	9	4	11	6	6	7	4	7	5	6	14	6	a 85
1910	5	2	4	4	6	6	7	5	5	4	5	4	b 57
1911	3	4	1	......	4	5	4	3	......	2	4	2	b 32
1912	1	1	4	3	5	5	5	7	10	5	7	2	b 55

a Including gas wells. b Not including gas wells.

Total and average initial daily production of new wells in the Lima (Ohio) district, 1908–1912, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Allen	694	708	110	171	699	11.6	9.4	9.2	8.1	12.9
Auglaize	75	138	306	174	47	9.4	12.5	18.0	14.5	6.7
Hancock	1,042	1,253	1,505	1,546	1,379	12.6	11.8	13.2	14.9	13.7
Hardin	....	....	13	25	....	....	....	6.5	12.5	....
Henry	....	5	....	....	....	....	5.0	....	....	....
Lucas	327	203	116	412	172	10.9	9.7	16.6	19.6	9.5
Mercer	55	35	65	60	111	7.9	7.0	16.3	6.7	10.1
Ottawa	336	450	183	108	36	8.0	8.5	8.0	7.7	5.1
Putnam	....	....	3	12	....	....	....	3.0	6.0	....
Sandusky	822	561	422	312	266	5.5	5.2	6.6	5.6	5.0
Seneca	800	582	737	341	1,041	13.3	8.2	15.7	9.7	35.9
Van Wert	1,268	639	192	369	272	12.2	8.5	10.7	16.0	14.3
Wood	3,067	3,423	3,003	2,836	3,153	14.5	13.5	15.9	15.8	17.8
Wyandot	235	121	90	15	37	19.6	13.4	30.0	7.5	9.3
Miscellaneous	....	....	....	....	16	....	....	....	....	8.0
Total	8,721	8,118	6,745	6,381	7,229	11.4	10.3	13.5	13.3	15.0

Total initial daily production of new wells in the Lima (Ohio) district, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	886	267	338	499	452	464	680	862	944	1,443	990	896	8,721
1909	1,067	767	567	678	480	900	606	853	626	718	513	343	8,118
1910	377	425	500	530	565	447	684	735	794	441	723	524	6,745
1911	508	599	323	483	460	559	498	630	470	793	465	593	6,381
1912	192	221	983	440	619	767	643	781	743	463	839	538	7,229

In the following tables are given the number of oil wells abandoned in the Lima-Indiana oil field from June, 1905, to December 31, 1912, inclusive:

Number of oil wells abandoned in Indiana and in the Lima (Ohio) oil field from June, 1905, to December, 1912, by months.

Month.	1905	1906	1907	1908	1909	1910	1911	1912	Total.
January	....	54	45	75	149	61	62	59	505
February	....	74	83	59	108	66	21	34	445
March	....	27	49	129	237	221	114	28	805
April	....	47	129	198	98	140	31	86	729
May	....	100	194	358	204	157	233	83	1,329
June	28	82	143	207	347	146	118	122	1,193
July	53	50	111	191	157	176	141	75	954
August	54	147	170	228	322	126	122	102	1,271
September	19	87	157	195	267	294	79	117	1,215
October	158	139	181	144	201	80	137	66	1,106
November	53	139	177	155	172	100	160	158	1,114
December	66	117	62	220	156	128	41	80	870
Total, Indiana	431	1,063	1,501	2,159	2,418	1,695	1,259	1,010	11,536
Total, Lima, Ohio	674	1,059	1,357	1,135	1,127	1,500	1,142	856	8,850
Total, Lima-Indiana	1,105	2,122	2,858	3,294	3,545	3,195	2,401	1,866	20,386

Number of oil wells abandoned in the Lima-Indiana oil field, June, 1905, to Dec. 31, 1912, by counties.

Lima, Ohio.		Indiana.	
County.	Number of wells.	County.	Number of wells.
Allen	1,889	Adams	611
Auglaize	773	Blackford	1,243
Darke	4	Delaware	1,219
Hancock	1,177	Gibson	1
Lucas	342	Grant	3,642
Mercer	280	Hamilton	9
Ottawa	100	Huntington	677
Putnam	20	Jay	452
Sandusky	714	Madison	87
Seneca	117	Marion	15
Shelby	8	Miami	49
Van Wert	550	Randolph	206
Wood	2,672	Wabash	16
Wyandot	204	Wells	3,309
Total	8,850	Total	11,536

INDIANA.

DEVELOPMENT.

In Indiana the decline which has been noticeable for several years continued in 1912, not only in the heavy-oil region of the northeastern portion of the State, but in Pike and neighboring counties in the southwest.

PRODUCTION.

Indiana's production in 1912 only reached 970,009 barrels. In 1911, 1,695,289 barrels of petroleum were produced, a decrease of 725,280 barrels, or 42.78 per cent, in 1912.

Production and value of petroleum in Indiana, 1903–1912, in barrels.

Year.	Quantity.	Value.	Price per barrel.
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	.86
1906	7,673,477	6,770,066	.88
1907	5,128,037	4,536,930	.88
1908	3,283,629	3,203,883	.98
1909	2,296,086	1,997,610	.87
1910	2,159,725	1,568,475	.73
1911	1,695,289	1,228,835	.74
1912	970,009	885,975	.91

Production of petroleum in Indiana, 1908–1912, by months, in barrels.

Month.	1908	1909	1910	1911	1912
January	323,620	202,055	143,481	146,582	64,403
February	262,189	182,914	136,388	135,064	62,991
March	296,478	221,455	163,588	355,552	81,148
April	302,416	211,265	161,865	133,947	92,965
May	302,290	212,575	178,582	139,302	101,102
June	292,156	211,981	292,521	132,096	85,819
July	289,040	205,182	219,210	120,737	90,011
August	269,667	198,306	200,681	122,416	86,492
September	259,162	184,207	179,536	114,109	78,432
October	241,468	172,505	169,338	107,317	83,634
November	219,348	170,871	159,878	89,007	69,733
December	225,795	122,770	154,657	99,160	73,279
Total	3,283,629	2,296,086	2,159,725	1,695,289	970,009

WELL RECORD.

In the following tables is given the well record for Indiana from 1908 to 1912, inclusive:

Number of wells completed in Indiana, 1908–1912, by counties.

County.	Completed.					Dry.					Oil.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Adams	15	14	13	2	6	2	3	1	1	.....	13	11	12	1	6
Blackford	40	23	7	2	4	9	4	2	.....	2	31	19	5	2	2
Cass	.....	3	.....	.....	.....	.....	2	.....	.....	.....	.....	1	.....	.....	.....
Daviess	.....	1	1	7	2	.....	.....	.....	2	.....	.....	1	1	.....	1
Delaware	29	13	10	15	22	14	5	.....	5	7	15	8	9	10	15
Dubois	.....	.....	5	.....	.....	.....	.....	4	.....	.....	.....	.....	1	.....	.....
Gibson	10	8	9	1	.....	3	6	7	1	.....	7	2	2	.....	.....
Grant	90	37	2	.....	2	7	2	1	.....	1	83	35	1	.....	1
Huntington	17	15	3	.....	.....	2	3	.....	.....	.....	15	12	3	.....	.....
Jay	107	63	34	13	20	25	17	10	3	4	82	46	21	9	14
Knox	.....	.....	4	7	5	.....	.....	3	6	4	.....	.....	1	1	1
Madison	2	1	.....	3	.....	.....	.....	.....	3	.....	2	1	.....	.....	.....
Martin	.....	.....	2	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....	.....
Miami	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Pike	.....	65	215	40	6	.....	27	25	11	1	.....	38	179	27	5
Pulaski	.....	4	.....	.....	.....	.....	3	.....	.....	.....	.....	1	.....	.....	.....
Randolph	5	5	20	4	4	1	1	7	.....	.....	4	4	13	4	4
Sullivan	.....	.....	3	.....	2	.....	.....	.....	.....	.....	.....	.....	3	.....	2
Vigo	.....	2	1	.....	1	.....	1	1	.....	.....	.....	1	.....	.....	1
Warrick	.....	.....	3	1	.....	.....	.....	3	1	.....	.....	.....	.....	.....	.....
Wells	70	39	33	17	6	4	.....	.....	.....	.....	66	39	32	17	6
Miscellaneous	17	11	1	5	9	15	11	1	2	1	2	.....	.....	3	7
Total	402	305	366	117	89	a 82	a 86	b 66	b 35	b 20	320	219	284	74	65

a Including gas wells. b Not including gas wells.

Number of wells completed in Indiana, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	35	23	31	21	29	35	35	39	47	38	33	36	402
1909	30	16	18	24	26	36	27	27	19	29	16	37	305
1910	18	33	29	27	25	38	38	41	35	26	36	20	366
1911	14	10	10	8	8	10	11	11	8	6	15	6	117
1912	5	5	3	8	4	5	10	10	11	12	8	8	89

Number of oil wells drilled in Indiana, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	23	14	24	16	22	28	28	32	46	32	28	27	320
1909	21	9	16	20	19	27	19	21	13	16	11	27	219
1910	9	27	26	21	20	34	34	32	28	21	19	13	284
1911	10	6	9	5	6	7	6	7	5	4	3	6	74
1912	2	3	2	3	4	4	7	8	8	9	8	7	65

Number of dry holes drilled in Indiana, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	12	9	7	5	7	7	7	7	1	6	5	9	a 82
1909	9	7	2	4	7	9	8	6	6	13	5	10	a 86
1910	3	4	3	5	4	2	4	6	7	5	16	7	b 66
1911	4	3	1	3	2	2	5	4	2	2	7	.....	b 35
1912	2	1	1	5	.....	.....	3	2	3	2	.....	1	b 20

a Including gas wells. b Not including gas wells.

Total and average initial daily production of new wells in Indiana, 1908–1912, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Adams	177	58	73	10	103	13.6	5.3	6.1	10.0	17.2
Blackford	264	140	75	5	7	8.5	7.4	15.0	2.5	3.5
Cass		2					2.0			
Daviess		20	5		10		20.0	5.0		10.0
Delaware	312	142	232	325	425	20.8	17.8	25.8	32.5	28.3
Dubois			15					15.0		
Gibson	75	35	20			10.7	17.5	10.0		
Grant	749	167	1		5	9.0	4.8	1.0		5.0
Huntington	154	77	40			10.3	6.4	13.3		
Jay	900	378	203	90	204	11.0	8.2	9.7	10.0	14.6
Knox			10	5	3			10.0	5.0	3.0
Madison	15	40				7.5	40.0			
Martin			5					5.0		
Miami										
Pike		2,385	7,453	439	150		62.7	41.6	16.3	30.0
Pulaski		5					5.0			
Randolph	35	130	207	26	35	8.8	32.5	15.9	6.5	8.8
Sullivan			25		15			8.3		7.5
Vigo		20			30		20.0			30.0
Warrick										
Wells	537	264	300	181	31	8.1	6.8	9.4	10.6	5.2
Miscellaneous	40			15	65	20.0			5.0	9.3
Total	3,258	3,863	8,664	1,096	1,083	10.2	17.6	30.5	14.8	16.7

Total initial daily production of new wells in Indiana, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	258	135	225	144	262	335	201	322	563	301	241	271	3,258
1909	308	59	200	241	281	298	467	287	381	445	114	782	3,863
1910	488	885	820	714	746	1,745	676	1,159	400	480	290	261	8,664
1911	142	53	129	73	66	77	107	155	75	85	52	82	1,096
1912	75	60	30	50	85	57	47	82	148	172	187	90	1,083

ILLINOIS OIL FIELD.

PRODUCTION AND DEVELOPMENT.

The quantity of oil produced in 1912 declined to 28,601,308 barrels from 31,317,038 barrels in 1911, or 8.67 per cent. This was a somewhat higher rate of decline than in 1911 (5.51 per cent). It is, however, too soon to speak of a definite rate of decline for Illinois. The maximum product was 33,686,238 barrels in 1908 and, after a drop in the following year to 30,898,339 barrels, the further addition of new territory brought the product back to 33,143,362 barrels in 1910—almost the maximum. The decline will of course continue if no further great extensions of producing territory are developed, but it should be noted that the extensions to the south in Lawrence County have developed deep territory with good staying quality, in which, after the first drop in production, the settled yield may be expected to decline at a low rate. Meantime the probable areas are large in Illinois where wildcatting is more than ordinarily worth while. Further, the State profits by a State Geological Survey of such energy and so well equipped for economic work that it has already been of great value in extending the oil resources, and this factor will undoubtedly increase the ultimate yield of the State. Illinois shared in the general advance in prices for oil in 1912, the average price for the year rising from 63 cents to 85.1 cents per barrel, and making the total value for the year $24,332,605, or 23.3 per cent greater than the value for the larger product of 1911.

Chief interest in field extension centered in Wabash County, the logical extension of the deep field in Lawrence County. In August a well good for 600 barrels a day was drilled on the Adam Biehl farm near Allendale, Wabash Township, Wabash County. This caused a great rush of capital and the drilling of over 40 wells before the end of the year, 13 of these wells yielding each over 100 barrels or more a day, but 20 were dry. This large percentage of dry holes called attention to the analogy of the Carlyle and Sandoval pools, and enthusiasm abated.

The average initial daily production of the new wells drilled in Illinois in 1912 increased to 67 barrels, compared with 63 barrels in 1911, owing to the larger proportion of drilling being done in Lawrence County.

Production of petroleum in Illinois, 1908–1912, by months, in barrels.

Month.	1908	1909	1910	1911	1912
January	2,703,973	2,668,607	2,640,303	2,578,579	2,241,867
February	2,572,115	2,510,548	2,353,684	2,373,229	2,262,440
March	2,825,491	2,757,794	2,865,055	2,790,515	2,369,428
April	3,249,690	2,562,215	2,776,800	2,560,963	2,351,693
May	3,223,515	2,829,277	2,860,760	2,731,965	2,535,039
June	3,081,848	2,670,549	2,746,620	2,634,521	2,503,038
July	2,693,288	2,728,857	3,029,787	2,740,654	2,698,582
August	2,808,667	2,719,958	3,007,151	2,770,946	2,519,651
September	2,675,385	1,902,197	2,850,119	2,615,120	2,366,712
October	2,709,913	2,560,072	2,768,750	2,638,927	2,424,472
November	2,479,926	2,497,847	2,629,132	2,400,670	2,174,856
December	2,662,427	2,490,418	2,615,201	2,480,949	2,153,530
Total	33,686,238	30,898,339	33,143,362	31,317,038	28,601,308

Production and value of petroleum in Illinois, 1906–1912, in barrels.

Year.	Ohio Oil Co.	Other lines.	Total quantity.	Total value.
1906	4,385,471	11,579	4,397,050	$3,274,818
1907	23,733,790	548,183	24,281,973	16,432,947
1908	31,972,634	1,713,604	33,686,238	22,649,561
1909	27,640,773	3,257,566	30,898,339	19,788,864
1910	27,751,090	5,392,272	33,143,362	19,669,383
1911	25,987,480	5,329,558	31,317,038	19,734,339
1912	23,137,234	5,464,074	28,601,308	24,332,605

Production of petroleum in Illinois in 1909–1912, by kinds, in barrels.

Year.	Light.	Heavy.	Total.
1909	28,049,468	2,848,871	30,898,339
1910	30,444,279	2,699,083	33,143,362
1911	29,103,220	2,213,818	31,317,038
1912	27,133,839	1,467,469	28,601,308

PIPE-LINE RUNS, DELIVERIES, AND STOCKS.

The following tables show the runs, deliveries, and stocks of the Ohio Oil Co. during the years 1908–1912, by months:

Pipe-line runs, deliveries, and stocks of the Ohio Oil Co. in Illinois, 1908–1912, by months, in barrels.

PIPE-LINE RUNS.

Month.	1908	1909	1910	1911	1912
January	2,497,359	2,494,492	2,220,842	2,137,674	1,853,266
February	2,464,914	2,358,198	1,976,637	1,968,429	1,853,379
March	2,591,911	2,568,392	2.377,012	2,349,208	1,949,945
April	3,089,417	2,388,309	2,306,336	2,138,500	1,916,071
May	3,084,816	2,536,413	2,374,134	2,264,925	2,084,743
June	2,965,786	2,365,956	2,274,501	2,177,280	2,083,087
July	2,579,977	2,413,218	2,569,830	2,265,374	2,230,164
August	2,690,931	2,411,483	2,528,532	2,312,973	1,996,824
September	2,555,871	1,595,934	2,409,232	2,154,693	1,871,325
October	2,582,561	2,228,269	2,334,659	2,172,457	1,901,119
November	2,356,386	2,149,372	2,211,286	1,977,073	1,668,306
December	2,512,705	2,130,737	2,168,089	2,068,894	1,594,700
Total	31,972,634	27,640,773	27,751,090	25,987,480	23,002,929

DELIVERIES.[a]

Month.	1908	1909	1910	1911	1912
January	1,720,631	324,887	1,226,379	933,861	1,350,621
February	1,882,978	869,212	842,135	838,566	1,387,078
March	1,010,459	721,519	882,209	1,218,111	1,532,428
April	1,476,192	891,423	936,706	1,022,936	1,420,013
May	1,869,461	903,838	946,346	1,132,231	1,301,727
June	1,846,947	1,077,383	1,156,895	1,174,211	1,302,537
July	2,012,288	1,176,410	1,332,242	1,231,534	1,327,329
August	1,774,354	1,052,431	1,229,479	1,206,244	1,306,563
September	1,488,283	849,533	1,135,323	1,252,988	1,359,968
October	1,394,983	938,860	1,245,778	1,352,605	1,401,807
November	1,284,304	1,120,751	997,805	1,304,663	1,230,357
December	1,789,158	685,585	1,036,260	1,454,394	1,206,516
Total	19,550,038	10,611,832	12,967,557	14,122,344	16,126,944

STOCKS.[b]

Month.	1908	1909	1910	1911	1912
January	14,129,954	25,876,529	28,355,182	26,252,274	18,393,303
February	15,069,278	26,203,238	28,356,243	25,643,012	17,706,835
March	15,975,633	26,630,509	28,373,855	24,005,215	17,279,112
April	17,420,534	26,856,675	28,593,365	24,013,861	17,001,576
May	19,077,020	27,593,494	29,025,647	24,138,187	16,636,329
June	20,456,387	27,899,220	29,106,098	23,195,749	16,235,353
July	21,036,143	27,627,086	29,198,965	22,714,129	15,689,994
August	22,267,197	27,683,334	29,177,382	22,265,928	14,682,823
September	23,485,690	28,399,427	28,879,676	21,904,719	13,949,064
October	24,396,787	28,535,636	28,492,136	21,359,482	13,039,507
November	24,905,168	28,373,985	28,086,619	20,211,934	12,307,725
December	25,252,468	28,671,543	27,348,358	19,131,678	11,591,427

[a] These deliveries are to trade only. Deliveries to other pipe lines are also made.
[b] Stocks 1910, 1911, and 1912 include some Indiana petroleum of Illinois grade.

The following table shows the quantity of petroleum shipped by railroad from the Illinois oil field, 1906 to 1912, by months:

Shipments of petroleum by railroad in tank cars from Illinois oil field, in barrels, 1906–1912, by months.

Month.	1906 [a]	1907 [b]	1908 [c]	1909 [d]	1910 [e]	1911 [f]	1912 [g]
January	60,134	8,701	91,807	144,511	220,856	228,404	232,522
February	51,358	14,598	71,170	111,407	217,917	224,856	172,106
March	16,009	23,947	132,300	152,056	263,056	254,927	216,156
April	35,539	42,249	118,074	109,872	257,292	347,530	211,809
May	160,121	158,227	84,290	157,783	283,285	333,324	232,043
June	358,039	166,644	122,317	183,432	285,095	329,621	214,860
July	515,956	322,622	107,688	158,642	276,533	311,681	211,025
August	534,821	223,134	70,171	166,943	277,317	297,784	281,991
September	368,625	70,555	83,042	173,509	253,788	238,917	210,974
October	162,547	56,570	102,163	200,067	213,217	292,004	249,263
November	48,747	56,080	138,147	198,044	287,750	263,627	222,866
December	30,843	66,692	126,967	185,166	234,819	285,082	219,034
Total	2,342,739	[h] 1,210,019	[h] 1,248,136	[h] 1,941,432	[h] 3,070,925	[h] 3,407,757	[h] 2,674,649

[a] Calculations made on the basis of 7.16 pounds to the gallon. Shipments equivalent to 704,508,489 pounds were made from Bridgeport, Oilfield, and Stoy. The railroads which shipped crude petroleum from Illinois were the Vandalia, the Baltimore & Ohio, the Cincinnati, Hamilton & Dayton, and the Indianapolis Southern.

[b] Shipments equivalent to 361,358,693 pounds were made from Duncansville, Lawrenceville, Stoy, Robinson, Bridgeport, Oilfield, and Casey. The railroads which shipped crude petroleum from Illinois were the Vandalia, the Baltimore & Ohio, the Cincinnati, Hamilton & Dayton, the Indianapolis Southern, and the Cleveland, Cincinnati, Chicago & St. Louis.

[c] Shipments equivalent to 371,903,668 pounds were made from Duncansville, Lawrenceville, Stoy, Robinson, Bridgeport, Sparta, and Casey. The railroads which shipped crude petroleum from Illinois were the Vandalia, the Baltimore & Ohio, the Illinois Southern, the Indianapolis Southern, and the Cleveland, Cincinnati, Chicago & St. Louis.

[d] Shipments equivalent to 577,346,934 pounds were made from Duncansville, Flat Rock, Lawrenceville, Stoy, Robinson, Bridgeport, Casey, and Sparta, the same railroads shipping in 1909 as in 1908.

[e] Shipments equivalent to 912,998,391 pounds were made from Duncansville, Flat Rock, Lawrenceville, Stoy, Sandoval, Bridgeport, Casey, and Sparta, the same railroads shipping in 1910 as in 1908 and 1909.

[f] Shipments equivalent to 1,012,885,440 pounds were made from Duncansville, Lawrenceville, Flat Rock, Stoy, Bridgeport, Sandoval, Casey, and Sparta, the same railroads shipping in 1911 as in 1910.

[g] Shipments equivalent to 776,481,591 pounds were made from Duncansville, Lawrenceville, Flat Rock, Stoy, Robinson, Bridgeport, Sandoval, and Casey, the same railroads shipping in 1912 as in 1911, 1910, 1909, and 1908.

[h] Calculations made according to specific gravity of the oil, ranging from 296.476 to 321.17 pounds to the barrel.

PRICES.

In the following table are given the dates of change and the changes in prices at wells of the different grades of petroleum produced in Illinois during the years 1909–1912:

Fluctuation in prices, per barrel, of Illinois petroleum in 1909–1912.

Date.	Above 30° B.	Below 30° B.	Date.	Above 30° B.	Below 30° B.	Date.	Above 30° B.	Below 30° B.
1909.			1912.			1912—Con.		
Jan. 1	$0.68	$0.60	Jan. 1	$0.67	$0.57	Nov. 15	$0.94	$0.91
June 26	.65	.57	Jan. 2	.70	.60	Nov. 25	.96	.93
July 16	.62	.54	Jan. 6	.72	.62	Dec. 2	.99	.96
Oct. 21	.60	.52	Jan. 24	.75	.65	Dec. 9	1.02	.99
			Feb. 1	.78	.68	Dec. 16	1.05	1.02
1910.			Mar. 4	.81	.71	Dec. 20	....	1.05
Jan. 1	.60	.52	Apr. 24	.83	.73	Dec. 23	1.08	1.08
			May 24	.85	.75			
1911.			June 13	....	.77			
Jan. 1	.60	.52	June 27	....	.79			
May 2	.63	.55	July 25	.87	.82			
June 14	.65	.55	Sept. 12	....	.84			
Sept. 15	.67	.55	Oct. 28	.90	.87			
Sept. 19	.67	.57	Nov. 9	.92	.89			

In the following table are given the average monthly prices paid for Illinois petroleum at wells in Illinois from 1908 to 1912, inclusive:

Average monthly prices of Illinois petroleum, 1908–1912, per barrel.

Month.	1908		1909		1910		1911		1912	
	Above 30° B.	Below 30° B.	Above 30° B.	Below 30° B.	Above 30° B.	Below 30° B.	Above 30° B.	Below 30° B.	Above 30° B	Below 30° B
January	$0.68	$0.60	$0.68	$0.60	$0.60	$0.52	$0.60	$0.52	$0.72	$0.62
February	.68	.60	.68	.60	.60	.52	.60	.52	.78	.68
March	.68	.60	.68	.60	.60	.52	.60	.52	.81	.71
April	.68	.60	.68	.60	.60	.52	.60	.52	.81	.71
May	.68	.60	.68	.60	.60	.52	.63	.55	.84	.74
June	.68	.60	.67½	.59½	.60	.52	.64	.55	.85	.76
July	.68	.60	.63⅜	.55⅜	.60	.52	.65	.55	.85	.80
August	.68	.60	.62	.54	.60	.52	.65	.55	.87	.82
September	.68	.60	.62	.54	.60	.52	.66	.56	.87	.83
October	.68	.60	.61¼	.53¼	.60	.52	.67	.57	.87	.84
November	.68	.60	.60	.52	.60	.52	.67	.57	.93	.90
December	.68	.60	.60	.52	.60	.52	.67	.57	1.04	1.02
Average	.68	.60	.646	.566	.60	.52	.637	.546	.853	.786

WELL RECORD.

In the following tables is given the well record for Illinois from 1908 to 1912, inclusive:

Number of wells completed in Illinois, 1908–1912, by counties.

County.	Completed.					Dry.					Oil.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Bond	.....	.....	7	10	.....	.....	.....	5	9	.....	.....	.....	1	.....	.....
Clark	385	181	112	72	62	87	47	28	25	12	298	134	80	45	50
Clinton	.....	.....	3	172	48	.....	.....	3	49	13	.....	.....	.....	123	35
Coles	9	12	5	2	6	1	3	1	.....	5	8	9	4	2	1
Crawford	2,322	2,093	1,210	481	414	336	355	214	93	96	1,986	1,738	950	369	310
Cumberland	42	33	17	13	50	11	10	2	7	8	31	23	13	6	42
Edgar	9	6	2	1	.....	2	4	1	1	.....	7	2	.....	.....	.....
Hancock	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....
Jackson	.....	3	2	.....	6	.....	2	2	.....	4	.....	1	.....	.....	1
Jasper	.....	18	8	5	1	.....	11	4	2	1	.....	7	4	3	.....
Lawrence	762	724	689	523	586	78	56	79	38	77	684	668	594	466	495
Macoupin	.....	9	2	2	1	.....	8	2	.....	.....	.....	1	.....	2	1
Madison	.....	2	1	1	4	.....	1	1	1	4	.....	1	.....	.....	.....
Marion	.....	23	60	55	26	.....	17	26	11	4	.....	6	34	44	22
Randolph	.....	12	.....	.....	1	.....	10	.....	.....	1	.....	2	.....	.....	.....
Saline	.....	2	1	.....	.....	.....	1	1	.....	.....	.....	1	.....	.....	.....
Wabash	.....	.....	.....	.....	42	.....	.....	.....	.....	20	.....	.....	.....	.....	22
Miscellaneous	45	33	29	28	13	40	33	24	27	12	5	.....	.....	1	1
Total	3,574	3,151	2,149	1,365	1,260	[a]555	[a]558	[b]393	[b]263	[b]257	3,019	2,593	1,681	1,061	980

[a] Including gas wells.

[b] Not including gas wells.

Number of wells completed in Illinois, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	303	157	187	197	264	390	474	417	344	290	273	278	3,574
1909	213	224	216	263	321	342	346	303	282	242	223	176	3,151
1910	111	158	128	157	192	211	172	245	234	198	177	166	2,149
1911	105	89	70	81	117	147	127	150	135	107	129	108	1,365
1912	81	71	54	74	91	122	123	126	104	146	139	129	1,260

Number of oil wells drilled in Illinois, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	248	135	150	164	229	236	409	462	295	239	226	226	3,019
1909	172	177	171	225	276	289	296	246	232	192	173	144	2,593
1910	94	115	99	116	149	161	129	198	186	168	138	128	1,681
1911	83	65	56	66	85	105	97	119	101	91	104	89	1,061
1912	74	53	44	54	66	96	77	95	88	124	107	102	980

Number of dry holes drilled in Illinois, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	55	22	37	33	35	54	65	55	49	51	47	52	[a] 555
1909	41	47	45	38	45	53	50	57	50	48	52	32	[a] 558
1910	9	36	24	31	35	44	37	40	42	29	36	30	[b] 393
1911	16	16	10	13	31	37	24	25	34	16	23	18	[b] 263
1912	7	15	8	17	21	24	44	30	13	21	31	26	[b] 257

[a] Including gas wells. [b] Not including gas wells.

Total and average initial daily production of new wells in Illinois, 1908–1912, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Bond			25					25.0		
Clark	6,953	3,219	1,802	771	1,178	23.3	24.0	22.5	17.1	23.6
Clinton				11,681	1,127				95.0	32.2
Coles	122	95	65	10	5	15.3	10.6	16.3	5.0	5.0
Crawford	46,694	44,379	26,382	9,802	7,175	23.5	25.5	27.8	26.6	23.1
Cumberland	303	558	162	100	800	9.8	24.3	12.5	16.7	19.0
Edgar	45	10				6.4	5.0			
Hancock			5					5.0		
Jackson		3			3		3.0			3.0
Jasper		50	40	20			7.1	10.0	6.7	
Lawrence	24,793	41,056	61,015	40,432	51,975	36.2	61.5	102.7	86.8	105.0
Macoupin		5		7	3		5.0		3.5	3.0
Madison		10					10.0			
Marion		223	3,760	4,025	610		37.2	110.6	91.5	27.7
Randolph		145					72.5			
Saline		3					3.0			
Miscellaneous	50			3	2,810	10.0			3.0	12.2
Total	78,960	89,756	93,256	66,851	65,686	26.2	34.6	55.5	63.0	67.0

Total initial daily production of new wells in Illinois, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	6,144	3,329	4,133	4,285	6,628	9,856	9,475	8,322	7,848	6,091	6,242	6,607	78,960
1909	5,060	4,833	5,018	5,237	7,681	9,050	9,820	8,661	8,324	8,904	9,628	7,540	89,756
1910	5,331	6,840	5,593	7,260	8,091	9,267	6,386	10,042	8,419	10,133	8,832	7,062	93,256
1911	5,677	3,512	3,909	5,587	5,132	5,850	9,058	7,535	6,551	4,782	5,826	3,432	66,851
1912	3,894	4,367	2,232	3,768	4,013	10,761	6,879	6,114	4,679	7,367	7,104	4,508	65,686

MID-CONTINENT OIL FIELD.

PRODUCTION.

The output of the Mid-Continent field as a whole decreased in 1912 by more than 1,000,000 barrels, while the total value of the product showed a marked increase, due to the rapid rise in the price of oil during the year. The decline in production was due to the decrease in Oklahoma and Kansas, which was not compensated by the increase in Texas and the Caddo field, though these sections showed a gain over 1911.

Production and value of petroleum in the Mid-Continent field, 1906–1912, by States, in barrels.

Year.	Kansas and Oklahoma.		Northern Texas.		Caddo, La.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906..	21,718,648	$9,615,198	1,117,905	$740,542	3,358	$2,183	22,839,911	$10,357,923
1907..	45,933,649	18,478,658	912,618	721,577	50,000	38,850	46,896,267	19,239,085
1908..	47,600,546	18,441,538	723,264	479,072	499,937	214,048	48,823,747	19,134,658
1909..	49,122,982	17,920,623	681,940	393,732	1,028,818	549,081	50,833,740	18,863,436
1910..	53,157,386	20,367,423	969,403	505,396	5,090,793	2,290,857	59,217,582	23,163,676
1911..	57,348,456	27,060,523	2,251,193	1,213,960	6,995,828	3,653,725	66,595,477	31,928,208
1912..	53,019,867	35,768,302	5,275,529	4,112,826	7,177,949	5,419,541	65,473,345	45,300,669

Production of petroleum in the Mid-Continent field in 1911 and 1912, by months, in barrels.

Month.	1911					1912				
	Kansas.	Oklahoma.	Northern Texas.	Caddo, La.	Total.	Kansas.	Oklahoma.	Northern Texas.	Caddo, La.	Total.
Jan...	90,735	4,257,613	133,726	437,546	4,919,620	100,228	3,992,225	312,319	550,691	4,955,463
Feb...	88,894	4,124,124	121,837	348,683	4,683,538	108,160	3,836,382	304,397	646,488	4,895,427
Mar...	107,551	6,364,165	133,543	475,387	7,080,646	115,833	4,075,506	383,966	583,518	5,158,823
Apr...	96,325	5,293,826	131,772	430,159	5,952,082	120,297	3,929,944	394,327	700,594	5,145,162
May ..	101,632	4,938,354	128,052	574,203	5,742,241	131,757	4,288,801	469,802	648,826	5,539,186
June..	103,967	4,679,055	123,998	677,403	5,584,423	129,488	4,012,952	427,967	617,267	5,187,674
July ..	98,464	4,551,829	127,098	711,012	5,488,403	141,777	4,364,329	458,701	592,223	5,557,030
Aug...	112,951	4,503,521	170,524	599,157	5,386,153	148,783	4,619,251	454,533	583,805	5,806,372
Sept..	113,553	4,418,832	202,937	731,306	5,466,638	144,672	4,342,560	465,039	593,422	5,545,693
Oct...	119,705	4,473,220	296,187	791,868	5,680,980	152,915	4,861,929	535,919	562,616	6,113,379
Nov...	131,188	4,222,738	346,093	652,675	5,352,694	131,844	4,429,295	529,783	550,887	5,641,809
Dec...	113,854	4,242,360	335,426	566,429	5,258,069	167,042	4,673,897	538,776	547,612	5,927,327
Total	1,278,819	56,069,637	2,251,193	6,995,828	66,595,477	1,592,796	51,427,071	5,275,529	7,177,949	65,473,345

In the table following is shown the production and increase and decrease, with percentages, of petroleum in the Mid-Continent field since 1889.

Production and increase and decrease, with percentages, of petroleum in the Mid-Continent oil field, 1889–1912, by States, in barrels.

Year.	Kansas.	Oklahoma.	Northern Texas.[a]	Caddo, La.	Total.	Percentage of total production.	Increase.	Percentage of increase.
1889....	500	....	....	....	500	....	....	....
1890....	1,200	....	....	....	1,200	....	700	140.00
1891....	1,400	30	....	....	1,430	....	230	19.17
1892....	5,000	80	....	....	5,080	....	3,650	255.24
1893....	18,000	10	....	....	18,010	0.04	12,930	254.53
1894....	40,000	130	....	....	40,130	.08	22,120	122.82
1895....	44,430	37	....	....	44,467	.08	4,337	10.81
1896....	113,571	170	1,400	....	115,141	.19	70,674	158.93
1897....	81,098	625	65,925	....	147,648	.24	32,507	28.23
1898....	71,980	....	544,620	....	616,600	1.11	468,952	317.62
1899....	69,700	....	668,483	....	738,183	1.29	121,583	19.72
1900....	74,714	6,472	[b] 836,039	....	917,225	1.44	179,042	24.25
1901....	179,151	10,000	[b] 800,545	....	989,696	1.43	72,471	7.90
1902....	331,749	37,100	617,871	....	986,720	1.12	[c] 2,976	[c] .30
1903....	932,214	138,911	501,960	....	1,573,085	1.57	586,365	59.42
1904....	4,250,779	1,366,748	569,102	....	6,186,629	5.28	4,613,544	293.28
1905....	[d] 12,013,495	([e])	520,282	....	12,533,777	9.30	6,347,148	102.60
1906....	[d] 21,718,648	([e])	1,117,905	3,358	22,839,911	18.05	10,306,136	82.23
1907....	2,409,521	43,524,128	912,618	50,000	46,896,267	28.23	24,056,356	105.33
1908....	1,801,781	45,798,765	723,264	499,937	48,823,747	27.35	1,927,480	4.11
1909....	1,263,764	47,859,218	681,940	1,028,818	50,833,740	27.75	2,009,993	4.12
1910....	1,128,668	52,028,718	969,403	5,090,793	59,217,582	28.26	8,383,842	16.49
1911....	1,278,819	56,069,637	2,251,193	6,995,828	66,595,477	30.21	7,377,895	12.46
1912....	1,592,796	51,427,071	5,275,529	7,177,949	65,473,345	29.48	[c] 1,122,132	[c] 1.68

[a] Includes counties of Navarro, Jack, McLennan, and Marion.
[b] Includes a small production in southern Texas.
[c] Decrease.
[d] Includes the production of Oklahoma.
[e] Included in the production of Kansas.

PRICES.

In the following tables are given the prices paid by the Prairie Oil & Gas Co. for petroleum of different grades in Kansas and Oklahoma during 1908 to 1912, also the average monthly price during the years 1908 to 1912:

Range of prices paid per barrel for petroleum by the Prairie Oil & Gas Co. in Kansas and Oklahoma, 1908 to 1912.

Date.	32° B. and above.	31½° to 32° B.	31° to 31½° B.	30½° to 31° B.	30° to 30½° B.	Heavy.
1908.						
Jan. 1..........	$0.41	$0.38	$0.35	$0.32	$0.29	$0.28
1909.						
Jan. 1..........	$0.41					.28
June 30..........	.38					.28
July 22..........	.35					.28

Date.	Above 30° B.	Below 30° B.
1910.		
Jan. 1..........	$0.35	$0.28
Mar. 17..........	.38	.30
Sept. 2..........	.40	.30
Sept. 20..........	.40	.40
Nov. 14..........	.42	.42
	All grades.	
1911.		
Jan. 2..........	$0.44	
May 2..........	.46	
June 14..........	.48	
Sept. 15..........	.50	
1912.		
Jan. 2..........	.53	
Jan. 15..........	.55	
Jan. 26..........	.57	
Feb. 5..........	.60	
Apr. 10..........	.62	
Apr. 16..........	.64	
May 7..........	.66	
May 17..........	.68	
July 16..........	.70	
Nov. 7..........	.73	
Nov. 27..........	.76	
Dec. 11..........	.78	
Dec. 16..........	.80	
Dec. 24..........	.83	

Average monthly price of Kansas and Oklahoma petroleum, per barrel of 42 gallons, 1908–1912, by months.

Month.	1908				1909		1910		1911	1912
	Kansas.		Oklahoma.		Above 30° B.	Below 30° B.	Above 30° B.	Below 30° B.	All grades.	All grades.
	Light.	Heavy.	Light.	Heavy.						
January	$0.41	$0.308	$0.41	$0.325	$0.41	$0.28	$0.350	$0.280	$0.44	$0.54
February	.41	.306	.41	.324	.41	.28	.350	.280	.44	.60
March	.41	.297	.41	.326	.41	.28	.364	.290	.44	.60
April	.41	.302	.41	.321	.41	.28	.380	.300	.44	.62
May	.41	.308	.41	.320	.41	.28	.380	.300	.46	.67
June	.41	.297	.41	.320	.41	.28	.380	.300	.48	.68
July	.41	.307	.41	.317	.37	.28	.380	.300	.48	.69
August	.41	.312	.41	.322	.35	.28	.380	.300	.48	.70
September	.41	.300	.41	.322	.35	.28	.400	.343	.50	.70
October	.41	.310	.41	.326	.35	.28	.400	.400	.50	.70
November	.41	.303	.41	.326	.35	.28	.411	.411	.50	.73
December	.41	.302	.41	.312	.35	.28	.420	.420	.50	.79
Average	.41	.304	.41	.322	.381	.28	.383	.328	.471	.668

KANSAS.

Production.—In Kansas drilling was active in Allen, Neosho, Chautauqua, and Montgomery counties, with a significant increase in the total output from 1,278,819 barrels in 1911 to 1,592,796 barrels in 1912, or 24.55 per cent.

Production of petroleum in Kansas, 1908–1912, in barrels.

	1908	1909	1910	1911	1912
Quantity piped from wells in Kansas to refineries	492,966	466,298	388,013	307,750	367,878
Rail shipments in Kansas	149,056	52,261	21,590	28,122	6,624
Quantity piped from other wells in Kansas and sold	1,159,759	745,205	719,065	942,947	1,218,294
Total sales in Kansas	1,801,781	1,263,764	1,128,668	1,278,819	1,592,796
Total value	$746,695	$491,633	$444,763	$608,756	$1,095,698

Well record.—The following tables give the well record for Kansas from 1908 to 1912, inclusive:

Number of wells completed in Kansas, 1908–1912, by counties.

County.	Completed.[a]					Oil.					Dry.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Allen	192	151	78	59	58	22	16	13	30	50	37	35	14	10	6
Anderson	9	1													
Chautauqua	24	31	60	82	222	16	23	42	64	182	3	3	14	11	28
Elk		9	1	4			7							4	
Franklin	2	7	3		18	1		1		18	1	1			
Labette		11	3	1	2			1		2		3			
Miami	6														
Montgomery	97	127	79	118	365	1	5	16	60	202	17	22	7	22	47
Neosho	118	100	87	59	115	30	18	9	16	62	34	17	17	22	23
Wilson	87	113	108	94	156			1	2	18	21	24	27	27	52
Woodson		2			7					1					3
Miscellaneous	31	6	9	1	6	2		2		1	14	1	3		1
Total	566	558	428	418	949	72	69	85	172	536	127	106	82	96	160

[a] Including gas wells.

Number of wells completed in Kansas, 1908–1912, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	37	45	48	32	47	59	45	31	53	62	54	53	566
1909	54	38	63	39	45	49	36	36	39	55	58	46	558
1910	45	48	42	40	34	29	36	25	30	47	28	24	428
1911	29	20	36	27	43	53	41	23	41	40	26	39	418
1912	9	27	27	46	75	72	77	115	106	138	155	102	949

a Including gas wells.

Number of oil wells drilled in Kansas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	2	5	2	5	7	8	11	9	3	4	10	6	72
1909	3	3	11	9	12	8	5	2	4	5	3	4	69
1910	......	5	3	4	5	2	8	7	12	14	11	14	85
1911	7	5	16	7	21	14	22	23	13	20	11	13	172
1912	4	11	10	23	37	46	60	80	56	63	81	65	536

Number of dry holes drilled in Kansas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	16	7	9	5	8	19	7	5	14	17	8	12	127
1909	14	8	11	7	6	8	9	7	6	13	12	5	106
1910	9	8	12	10	7	4	5	2	7	9	5	4	82
1911	8	5	7	7	10	10	9	9	2	7	15	7	96
1912	2	7	9	9	12	8	7	10	18	29	34	15	160

Total and average initial daily production of new wells in Kansas, 1908–1912, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Allen	365	251	210	353	632	16.6	15.7	16.2	11.8	12.6
Chautauqua	305	475	1,100	1,355	2,963	19.1	20.7	26.2	21.2	16.3
Elk	....	110	....	....	....	....	15.7	....	....	....
Franklin	8	....	5	....	155	8.0	....	5.0	....	8.6
Labette	....	....	20	....	15	....	....	20.0	....	7.5
Montgomery	15	113	382	1,300	2,522	15.0	22.6	23.9	21.7	12.5
Neosho	446	360	130	208	693	14.9	20.0	14.4	13.0	11.2
Wilson	....	....	10	55	255	....	....	10.0	27.5	14.2
Woodson	....	....	....	....	5	....	....	....	....	5.0
Miscellaneous	20	....	40	....	5	10.0	....	20.0	....	5.0
Total	1,159	1,309	1,897	3,271	7,245	16.1	19.0	22.3	19.0	13.5

Total initial daily production of new wells in Kansas, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	65	100	40	85	105	120	170	138	55	80	96	105	1,159
1909	50	45	225	166	220	130	98	55	85	65	70	100	1,309
1910	......	95	65	95	170	40	235	200	257	305	210	225	1,897
1911	155	90	304	161	438	255	285	363	265	380	265	310	3,271
1912	65	173	213	390	352	714	834	940	507	842	1,185	1,030	7,245

OKLAHOMA.

General conditions.—The decline in stocks in Oklahoma, which began at the close of 1911, continued throughout 1912, with corresponding increase in prices and activity in drilling. In April, A. Malarkey, in deepening an old well southwest of Cleveland, Pawnee County, obtained a good flow. Similar drilling by the Paova, Gypsy, Milliken, and other oil companies was successful in obtaining wells yielding from 75 to 1,500 barrels a day from the Cleveland sand, which is thought by some to be near the Bartlesville sand. An oil pool of even greater interest was developed by the drilling of a well 10 miles east of Cushing, in Creek County, by Slick & Jones, which yielded 150 barrels a day in a sand found at 2,181 feet. Two miles east of this Wrightsman & Jones drilled into the sand at 2,185 feet and obtained a gas well yielding 5,000,000 cubic feet a day. This stimulated drilling which has developed a pool rivaling the old Glenn pool in interest. In addition to two developments in Osage and Kay counties, the shallow sand of Nowata County was extended considerably to the west. Additional developments of natural gas were made in the neighborhood of Poteau; and additional gas wells obtained in the vicinity of Duncan, in Stephens County, gave further interest to that locality. The outlook at the end of 1912 was for very active wildcatting in many portions of the State, as well as much greater development of the proved areas.

Production.—Oklahoma's production of petroleum in 1911 was 56,069,637 barrels; in 1912 it was 51,427,071 barrels, a decrease of 4,642,566 barrels, or 8.28 per cent.

The following table shows the production and sales of petroleum in Oklahoma from 1908 to 1912:

Production of petroleum in Oklahoma, 1908–1912, in barrels.

	1908	1909	1910	1911	1912
Quantity shipped from Glenn pool and sold	20,494,313	18,946,740	19,236,914	13,880,118	10,405,518
Quantity piped from other wells in Oklahoma and sold	25,012,423	28,330,313	32,124,072	41,783,947	40,732,128
Rail shipments (outside Glenn pool) in Oklahoma	292,029	582,165	667,732	405,572	189,425
Total sales in Oklahoma	45,798,765	47,859,218	52,028,718	56,069,637	51,427,071
Total value	$17,694,843	$17,428,990	$19,922,660	$26,451,767	$34,672,604

Production of petroleum in Oklahoma in 1911 and 1912, by months, in barrels.

1911.

Month.	Runs from wells.		Shipped by rail and fuel consumption not included in pipe-line runs.	Total.
	Gulf, Prairie, and Texas companies' pipe lines.	Alluwe, Chelsea, Cherokee, Muskogee, National Refining, Nowata, and other lines to refineries.		
January	3,726,838	515,444	15,331	4,257,613
February	3,633,803	476,687	13,634	4,124,124
March	5,842,843	509,860	11,462	6,364,165
April	4,733,703	534,008	26,115	5,293,826
May	4,341,955	553,663	42,736	4,938,354
June	4,123,521	528,303	27,231	4,679,055
July	4,023,889	491,119	36,821	4,551,829
August	3,977,151	505,343	21,027	4,503,521
September	3,906,140	490,767	21,925	4,418,832
October	3,999,435	471,350	2,435	4,473,220
November	3,753,933	466,349	2,456	4,222,738
December	3,759,377	478,270	4,713	4,242,360
Total	49,822,588	[a] 6,021,163	225,886	56,069,637

1912.

Month.	Gulf, Prairie, and Texas companies' pipe lines.	Alluwe, Chelsea, Cherokee, Muskogee, National Refining, Nowata, and other lines to refineries.	Shipped by rail and fuel consumption not included in pipe-line runs.	Total.
January	3,477,588	480,335	34,302	3,992,225
February	3,328,570	486,518	21,294	3,836,382
March	3,547,455	505,791	22,260	4,075,506
April	3,408,534	493,341	28,069	3,929,944
May	3,722,122	528,055	38,624	4,288,801
June	3,462,517	528,213	22,222	4,012,952
July	3,815,577	523,939	24,813	4,364,329
August	4,041,753	555,784	21,714	4,619,251
September	3,781,135	545,454	15,971	4,342,560
October	4,243,964	594,144	23,821	4,861,929
November	3,835,125	577,959	16,211	4,429,295
December	4,061,952	582,734	29,211	4,673,897
Total	44,726,292	[a] 6,402,267	298,512	51,427,071

[a] Quantity run by other lines averaged.

Osage County.—The following table gives a statement of the quantity of petroleum produced by the Indian Territory Illuminating Oil Co. and its sublessees from wells in Osage County from 1903 to 1912, inclusive:

Production of petroleum by the Indian Territory Illuminating Oil Co. and its sublessees from Jan. 1, 1903, to Dec. 31, 1912.

Year	Barrels.	Year	Barrels.
1903	56,905	1908	4,961,147
1904	652,479	1909	4,516,524
1905	3,421,478	1910	5,892,970
1906	5,219,106	1911	11,707,676
1907	5,143,971	1912	8,169,158

Total production of petroleum and value of royalty oil and gas from wells in Osage County during the year 1911.

Received by—	Total quantity produced.	Amount received by Osage Nation for royalty of one-eighth of production.
	Barrels.	
Prairie Oil & Gas Co	10,197,717	$602,317
Gulf Pipe Line Co	636,373	37,752
Uncle Sam Oil Co	66,898	4,024
Southwestern Refining Co	41,635	3,033
The Texas Co	757,380	43,824
Groves, Stearns & Fisher	125	7
Finance Oil Co	1,500	82
Indian Territory Illuminating Oil Co	903	51
Barnsdall Oil Co	5,145	309
Total	11,707,676	691,399
Royalty received by Osage Nation for gas		3,489
Grand total		694,888

Total production and value of royalty oil and gas from wells in Osage County during the year 1912.

Received by—	Total quantity produced.	Amount received by Osage Nation for royalty of one-eighth of production.
	Barrels.	
Prairie Oil & Gas Co	6,631,390	$550,162
Gulf Pipe Line Co	492,595	40,866
Uncle Sam Oil Co	94,714	7,858
Southwestern Refining Co	136,261	11,305
The Texas Co	809,501	67,158
Indian Territory Illuminating Oil Co	853	71
Barnsdall Oil Co	3,844	319
Total	8,169,158	677,739
Royalty received by Osage Nation for gas		3,895
Total amount received by Osage Nation for oil and gas		681,634

In the following table is shown the number of wells owned in Osage County by the Indian Territory Illuminating Oil Co. and its sublessees from 1903 to 1912, inclusive:

Oil and gas wells in Osage County, 1903–1912.

Total wells to—	Completed.	Productive.	Gas.	Dry.[a]
Jan. 1, 1903	30	17	2	11
Dec. 31, 1904	361	243	21	97
June 10, 1905	544	355	34	155
Dec. 31, 1905	704	462	45	197
June 10, 1906	862	569	55	238
Dec. 31, 1906	1,080	716	66	298
June 30, 1907	1,155	779	67	309
Dec. 31, 1907	1,277	837	71	369
Dec. 31, 1908	1,422	936	78	408
Dec. 31, 1909	1,574	1,027	81	466
Dec. 31, 1910	1,735	1,175	82	478
Dec. 31, 1911	2,233	1,562	90	581
Dec. 31, 1912	2,682	1,887	112	683

[a] Wells which have been exhausted and abandoned in addition to wells that were dry when drilled in.

Glenn pool.—In the table following is given the production of petroleum in the Glenn pool (Creek County) for the last five years.

Estimated production and sales of petroleum from Glenn pool, 1908–1912, by months, in barrels.

Month.	1908	1909	1910	1911	1912
January	1,796,461	1,362,602	1,745,206	1,099,192	882,385
February	1,897,054	1,410,878	1,543,660	967,924	867,566
March	2,098,411	1,543,463	1,974,514	2,584,464	924,144
April	1,968,761	1,467,179	1,674,709	1,570,947	898,527
May	1,630,111	1,590,730	1,676,366	1,069,863	927,182
June	1,051,045	1,809,989	1,573,578	958,519	816,028
July	1,914,134	1,856,524	1,557,869	965,122	880,906
August	1,770,819	1,699,486	1,609,702	981,946	927,675
September	1,639,252	1,670,167	1,593,986	937,886	794,958
October	1,832,033	1,602,988	1,521,794	969,247	921,736
November	1,404,234	1,539,342	1,400,118	864,519	768,254
December	1,491,998	1,393,392	1,365,412	910,489	886,157
Total	20,494,313	18,946,740	19,236,914	13,880,118	10,495,518

Well record.—The following table gives the well record for Oklahoma for 1911 and 1912, by districts and pools:

Well record in Oklahoma in 1911 and 1912, by districts and pools.

District and pool.	1911					1912				
	Wells completed.			Initial daily production.		Wells completed.			Initial daily production.	
	Total.[a]	Oil.	Dry.	Total.	Average per well.	Total.[a]	Oil.	Dry.	Total.	Average per well.
				Bbls.	*Bbls.*				*Bbls.*	*Bbls.*
Cherokee, deep sand	1,074	806	114	30,135	37.4	2,370	1,963	230	63,719	32.4
Bartlesville	188	165	15	4,955	30.3	584	499	45	11,716	23.5
Bird Creek	265	233	23	10,495	45.0	821	697	92	27,880	40.0
Copan-Ramsey	282	216	45	5,890	27.3	573	482	50	10,972	22.8
Hogshooter	339	192	31	8,795	45.8	392	285	43	13,151	46.1
Cherokee, shallow sand	1,576	1,381	109	70,221	50.8	1,417	1,242	113	23,236	18.7
Alluwe	98	93	4	1,674	18.0	594	544	47	7,460	13.7
Chelsea	138	124	11	1,935	15.6					
Coodys Bluff	56	54	2	928	17.2	......	......	......	......	......
Delaware-Childers	650	597	43	54,266	90.9	236	209	21	3,355	16.1
Dewey	339	290	15	7,558	26.1	536	481	26	12,306	25.6
Nowata	149	88	25	1,202	13.7	51	8	19	115	14.4
Ochelata	50	42	6	975	23.2	......	......	......	......	......
Salt Creek	96	93	3	1,683	18.1	......	......	......	......	......
Cleveland	165	129	31	22,100	171.3	253	196	46	33,903	173.0
Creek	746	536	175	49,879	93.1	1,346	852	344	77,588	91.1
Bald Hill	46	28	14	2,715	96.9	82	56	23	2,860	51.1
Beggs-Preston	43	21	15	4,065	193.6	67	36	27	4,860	135.0
Cushing	......	......	......	......	......	79	68	2	15,465	227.4
Glenn Pool	46	37	9	4,650	125.7	228	159	41	9,815	61.7
Haskell	3	1	1	300	300.0	......	......	......	......	......
Keystone	8	5	3	190	38.0	......	......	......	......	......
Morris-Okmulgee	114	78	23	6,970	89.4	219	122	74	15,056	123.4
Mounds	......	......	......	......	......	29	11	17	865	78.6
Muskogee	117	81	34	6,965	86.0	38	12	24	293	24.4
Sapulpa	44	30	14	3,225	107.5	48	33	11	1,495	45.3
Schulter	......	......	......	......	......	134	90	30	12,910	143.4
Taneha	133	117	14	8,191	70.0	112	91	19	2,609	28.7
Tulsa	132	98	28	11,204	114.3	310	174	76	11,360	65.3
Turley	37	33	4	1,310	39.7	......	......	......	......	......
Wagoner	23	7	16	94	13.4	......	......	......	......	......
Osage	494	438	40	89,660	204.7	489	417	54	25,400	60.9
Ponca City	......	......	......	......	......	58	31	20	4,790	154.5
Miscellaneous	32	4	20	338	84.5	60	11	36	250	22.7
Total	4,087	3,294	489	262,333	79.6	5,993	4,712	843	228,886	48.6

[a] Including gas wells.

Number of wells completed in Oklahoma, 1908–1912, by districts.

District.	Completed.[a]					Oil.					Dry.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Cherokee, deep	690	652	802	1,074	2,370	605	519	627	806	1,963	53	62	61	114	230
Cherokee, shallow	1,281	1,724	1,830	1,576	1,417	1,180	1,535	1,665	1,381	1,242	94	169	152	109	113
Creek	683	733	837	746	1,346	525	582	657	536	852	106	114	142	175	344
Cleveland	22	28	13	165	253	14	23	10	129	196	7	3	2	31	46
Osage	153	108	239	494	489	129	75	206	438	417	16	15	25	40	54
Ponca City	.....	.....	.....	.....	58	.....	.....	.....	.....	31	.....	.....	.....	.....	20
Miscellaneous	15	34	56	32	60	5	8	23	4	11	8	17	26	20	36
Total	2,844	3,279	3,777	4,087	5,993	2,458	2,742	3,188	3,294	4,712	284	380	408	489	843

a Including gas wells.

Number of wells completed in Oklahoma, 1908–1912, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	194	162	165	194	229	208	224	282	246	263	325	352	2,844
1909	310	288	345	388	374	279	243	239	205	198	200	210	3,279
1910	262	313	325	348	377	378	274	269	306	329	343	253	3,777
1911	290	309	375	479	436	364	313	275	301	275	367	303	4,087
1912	180	366	361	508	501	636	566	526	527	592	654	576	5,993

a Including gas wells.

Number of oil wells drilled in Oklahoma in 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	155	143	136	161	200	178	199	236	207	239	287	317	2,458
1909	271	260	296	330	309	223	203	202	180	167	147	154	2,742
1910	208	240	271	293	321	311	237	248	242	292	310	215	3,188
1911	245	278	329	393	356	265	225	217	240	222	294	230	3,294
1912	135	269	288	388	386	495	458	430	427	456	506	474	4,712

Number of dry holes drilled in Oklahoma, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	23	11	21	24	22	25	18	38	28	21	25	28	284
1909	33	22	38	51	53	48	31	28	14	17	21	24	380
1910	25	48	41	41	36	40	31	17	50	28	28	23	408
1911	30	16	27	56	56	64	46	35	32	32	45	50	489
1912	28	61	46	77	77	86	70	62	70	97	100	69	843

Total and average initial daily production of new wells in Oklahoma, 1908–1912, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Cherokee, deep	36,561	34,130	28,903	30,135	63,719	60.4	65.8	46.1	37.4	32.5
Cherokee, shallow	80,923	90,864	85,147	70,221	23,236	68.6	59.2	51.1	50.8	18.7
Creek	76,722	68,710	76,485	49,879	77,588	146.1	118.1	116.4	93.1	91.1
Cleveland	455	1,865	713	22,100	33,903	32.5	81.1	71.3	171.3	173.0
Osage	19,377	10,205	35,060	89,660	25,400	150.2	136.1	170.2	204.7	60.9
Ponca City	....	....	....	....	4,790	....	....	....	....	154.5
Miscellaneous	114	680	330	338	250	22.8	85.0	14.3	84.5	22.7
Total	214,152	206,454	226,638	262,333	228,886	87.1	75.3	71.1	79.6	48.6

Total initial daily production of new wells in Oklahoma, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	16,475	17,550	10,865	13,018	16,045	15,860	14,695	18,834	17,198	24,915	25,377	23,320	214,152
1909	21,745	21,820	21,220	20,910	21,020	18,120	16,350	15,480	14,190	11,683	12,225	11,691	206,454
1910	15,840	17,785	20,915	18,932	19,545	26,378	14,915	16,680	18,998	18,585	17,915	20,150	226,638
1911	23,366	23,615	40,539	30,440	28,190	23,970	16,255	12,121	14,709	18,165	17,223	13,740	262,333
1912	9,448	13,807	12,281	17,329	10,993	17,617	18,507	24,635	22,096	27,519	27,599	27,055	228,886

GULF OIL FIELD.

CONDITIONS.

For 12 years the Gulf coast region has been of importance in the oil industry, because of furnishing a peculiar asphaltic oil, which has some of the characteristics of Russian oil. The oil occurs in connection with salt domes, thus far peculiar to the Gulf region. This condition finds its nearest analogue in the accumulations of oil associated with igneous masses near the Gulf coast in Mexico. The Gulf oil served first an important purpose in developing a satisfactory fuel supply for railroads and for manufacturing enterprises in the Gulf region. Then it was found practicable to refine it. Later, when the advent of Oklahoma oil by pipe lines to the Gulf coast brought an oil superior for refining, the Gulf oil took the initiative in furnishing the asphaltic oil residues which have been an essential element in the great development of good roads.

PRODUCTION.

Production of these Gulf oils was sensationally great in the first part of the last decade—in one year the product was over one-fourth of the oil supply of the United States. Then came a decline unusually, even alarmingly, sudden. It greatly discouraged development work. Fortunately the course of the field is now less erratic, and the combined product for Louisiana and Texas was, in 1912, 8,545,018 barrels, a decline of 22.32 per cent from 1911. This is a sufficiently satisfactory condition to admit of continued exploitation of the region. In fact, there is probability of finding new domes, with a consequent increase in production—as was the case in 1911. The usual statistical tables follow.

Production of petroleum in the Gulf field in 1911 and 1912, by months, in barrels.

Month.	1911			1912		
	Coastal Texas.	Coastal Louisiana.	Total.	Coastal Texas.	Coastal Louisiana.	Total.
January	719,658	361,268	1,080,926	552,107	165,831	717,938
February	598,737	681,407	1,280,144	555,497	186,345	741,842
March	642,955	641,020	1,283,975	620,837	163,893	784,730
April	647,974	356,730	1,004,704	592,677	159,906	752,583
May	662,811	322,264	985,075	552,391	155,375	707,766
June	617,501	231,109	848,610	539,930	144,280	684,210
July	612,345	210,156	822,501	539,020	174,892	713,912
August	594,898	182,608	777,506	519,809	180,835	700,644
September	559,787	191,075	750,862	526,915	148,138	675,053
October	558,752	199,569	758,321	511,058	159,474	670,532
November	519,812	151,966	671,778	472,490	211,851	684,341
December	540,051	195,420	735,471	476,797	234,670	711,467
Total	7,275,281	3,724,592	10,999,873	6,459,528	2,085,490	8,545,018

Production and value of petroleum produced in the Gulf field, 1903–1912, by States, in barrels.

Year.	Coastal Texas.		Coastal Louisiana.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	17,453,612	$7,002,165	917,771	$416,228	18,371,383	$7,418,392
1904	21,672,311	7,743,860	2,958,958	1,073,594	24,631,269	8,817,454
1905	27,615,907	7,190,658	8,910,416	1,601,325	36,526,323	8,791,983
1906	11,449,992	5,825,036	9,074,170	3,555,655	20,524,162	9,380,691
1907	11,410,078	9,680,286	4,950,221	4,024,183	16,360,299	13,704,469
1908	10,483,200	6,221,636	5,288,937	3,287,446	15,772,137	9,509,082
1909	8,852,527	6,399,318	1,030,713	1,474,089	9,883,240	7,873,407
1910	7,929,863	6,100,359	1,750,602	1,283,212	9,680,465	7,383,571
1911	7,275,281	5,340,592	3,724,592	2,015,089	10,999,873	7,355,681
1912	6,459,528	4,739,887	2,085,490	1,604,286	8,545,018	6,344,173

Production of petroleum in the Gulf field, 1889–1912, 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	50					
1897	50					
1898	1,450		1,400		2,800.00	
1899	530			920		63.45
1900	0			530		100.00
1901	3,593,113	5.18	3,593,113			
1902	18,014,404	20.29	14,421,291		401.36	
1903	18,371,383	18.29	356,979		1.98	
1904	24,631,269	21.03	6,259,886		34.07	
1905	36,526,323	27.11	11,895,054		48.29	
1906	20,524,162	16.23		16,002,161		43.81
1907	16,360,299	9.85		4,163,863		20.29
1908	15,772,137	8.83		588,162		3.60
1909	10,883,240	5.94		4,888,897		30.00
1910	9,680,465	4.62		1,202,775		11.05
1911	10,999,873	4.99	1,319,408		13.63	
1912	8,545,018	3.85		2,454,855		22.32

TEXAS.

GENERAL CONDITIONS.

To express the statistical condition of the oil industry in Texas and connect the developments of the last two years with a reasonable view of the future oil possibilities of the State, it would be fair to say that if the legislators of that great Commonwealth could by any means be induced to provide for an adequate geologic survey of the State—such a survey as has proved so beneficial in Illinois, Ohio, Kansas, Kentucky, New York, and New Jersey—or if the attention of the governing powers could be fruitfully directed to the object lesson of the beneficial geologic cooperation between the young neighboring State of Oklahoma and the United States Geological Survey, Texas would soon rank next to California as an oil producer.

The time is opportune for an oil survey of Texas—a public examination by the officials of the State rather than by the corporations of the State. This will probably be obvious when it is considered that a comparatively accidental development in north Texas during the last two years of oil territory, none too promising in the beginning, yielded in 1912 a total of 5,275,529 barrels—almost as much as the old producers in the Gulf region and 45 per cent of the total production of the State. When it is further considered that oil indications have been recognized and spasmodic efforts at drilling have been attempted on the lands of citizens in 50 or more counties of the State and that oil has been found on lands belonging to the State, it seems still more obvious that a general investigation might be profitable to the State at large and might so direct future private development as to minimize wasteful effort and give the citizens themselves the greatest gain from their own property at the least sacrifice to outside corporations.

PRODUCTION.

In 1912 interest centered in the high-grade oils found in the Electra field, in Wichita County, and the Petrolia field, in Clay County, on the northern edge of the State. Developments in the Electra field were very satisfactory during the year, and not only led to wildcatting in the adjacent counties, but stimulated activity in distant counties, which resulted in a good outlook for an oil and gas field at Trickham, in Coleman County. At Burkburnett, on the northern edge of Wichita County, a good well was brought in by the Corsicana Oil Co., and the development of a considerable field is probable. These developments also stimulated much drilling in the adjoining counties of Oklahoma.

The output for the State increased from 9,526,474 barrels in 1911 to 11,735,057 barrels in 1912, an increase of 2,208,583 barrels, or 23.18 per cent.

Production and value of petroleum in northern and coastal Texas, 1903–1912, in barrels.

Year.	Northern Texas.		Coastal Texas.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1903	501,960	$515,314	17,453,612	$7,002,165	17,955,572	$7,517,479
1904	569,102	412,360	21,672,311	7,743,860	22,241,413	8,152,220
1905	520,282	361,604	27,615,907	7,190,658	28,136,187	7,552,262
1906	1,117,905	740,542	11,449,992	5,825,036	12,567,897	6,565,578
1907	912,618	721,577	11,410,078	9,680,286	12,322,696	10,401,863
1908	723,264	479,072	10,483,200	6,221,636	11,206,464	6,700,708
1909	681,940	393,732	8,852,527	6,399,318	9,534,467	6,793,050
1910	969,403	505,396	7,929,863	6,100,359	8,899,266	6,605,755
1911	2,251,193	1,213,960	7,275,281	5,340,592	9,526,474	6,554,552
1912	5,275,529	4,112,826	6,459,528	4,739,887	11,735,057	8,852,713

In the following table will be found the production of petroleum in Texas, by districts and months, for the years 1911 and 1912:

Production of petroleum in Texas, 1911–12, by districts and months, in barrels.

1911.

Month.	Northern Texas.						Coastal Texas.	
	Corsicana.	Henrietta.	Powell.	Marion County.	Electra.	Total.[a]	Batson.	Humble.
January	10,047	18,378	33,655	71,365	....	133,726	95,320	194,724
February	9,012	16,196	30,312	66,036	....	121,837	86,881	193,973
March	10,502	15,385	33,961	73,414	....	133,543	84,754	221,215
April	9,766	12,946	30,653	71,826	6,300	131,772	92,625	210,829
May	10,954	13,222	32,940	63,523	7,132	128,052	85,129	222,397
June	9,731	13,500	31,511	59,733	9,240	123,998	81,985	225,016
July	10,377	13,839	31,437	57,945	13,217	127,098	82,807	218,149
August	10,749	15,044	30,650	51,551	62,248	170,524	87,805	212,594
September	10,032	13,563	30,449	46,962	101,649	202,937	84,296	194,453
October	12,259	12,884	30,791	43,032	196,939	296,187	83,208	187,136
November	11,781	11,150	27,739	35,657	259,485	346,093	79,431	161,522
December	13,316	12,858	28,957	36,645	243,369	335,426	79,252	184,212
Total	128,526	168,965	373,055	677,689	899,579	2,251,193	1,023,493	2,426,220

Month.	Coastal Texas—Continued.						Total.
	Matagorda County.[b]	Saratoga.	Sourlake.	Spindletop.	Other.	Total.[c]	
January	118,806	83,962	130,068	96,091	687	719,658	853,384
February	47,600	64,387	116,386	88,539	971	598,737	720,574
March	44,137	79,008	123,625	89,859	357	642,955	776,498
April	48,175	76,767	122,382	96,485	711	647,974	779,746
May	49,737	76,980	122,811	104,920	837	662,811	790,869
June	40,232	77,820	114,444	77,772	232	617,501	741,493
July	47,472	72,752	110,682	80,251	232	612,345	739,442
August	42,212	74,410	111,823	65,822	232	594,898	765,424
September	30,765	76,446	106,450	67,143	234	559,787	762,729
October	34,420	78,710	105,150	69,894	234	558,752	854,935
November	31,182	77,138	103,150	65,489	1,900	519,812	865,907
December	27,090	87,397	97,909	63,674	517	540,051	875,473
Total	561,828	925,777	1,364,880	965,939	7,144	7,275,281	9,526,474

1912.

Month.	Northern Texas.							Coastal Texas.
	Corsicana.	Henrietta.	Powell.	Electra.	Marion County.	Other.[d]	Total.	Batson.
January	16,473	12,758	21,826	225,264	35,724	274	312,319	77,397
February	30,088	12,213	20,770	206,340	34,685	301	304,397	69,976
March	22,277	13,999	21,393	290,415	35,580	302	383,966	78,339
April	24,040	14,275	21,713	300,154	33,839	306	394,327	76,695
May	20,309	16,689	21,892	377,143	33,467	302	469,802	71,527
June	17,545	16,929	20,146	342,186	30,859	302	427,967	73,095
July	20,944	16,210	22,584	369,575	29,084	304	458,701	66,654
August	17,652	15,840	19,944	373,123	27,669	305	454,533	70,107
September	16,143	18,157	19,991	384,807	25,639	302	465,039	67,929
October	17,034	21,679	20,306	450,549	26,046	305	535,919	68,409
November	15,286	18,362	19,876	450,856	25,098	305	529,783	62,671
December	15,491	20,310	20,799	456,692	25,180	304	538,776	61,764
Total	233,282	197,421	251,240	4,227,104	362,870	3,612	5,275,529	844,563

[a] Includes South Bosque and Brown County.
[b] Includes Potters Point and Markham.
[c] Includes Dayton and Hoskins Mound, and Duval County.
[d] Includes small production in South Bosque, and Brown, McCulloch, and McMullen counties.

Production of petroleum in Texas, 1911–12, by districts and months, in barrels—Contd.

1912—Continued.

Month.	Coastal Texas—Continued.							Total.
	Humble.	Matagorda County.	Saratoga.	Sourlake.	Spindletop.	Other.[a]	Total.	
January	180,417	32,393	88,474	107,228	61,176	5,022	552,107	864,426
February	164,522	68,813	90,019	95,330	61,939	4,898	555,497	859,894
March	186,815	89,844	92,735	104,015	64,029	5,060	620,837	1,004,803
April	166,953	80,890	85,886	102,972	74,861	4,420	592,677	987,004
May	174,039	52,862	87,067	98,812	63,420	4,664	552,391	1,022,193
June	156,489	59,212	87,628	90,352	68,212	4,942	539,930	967,897
July	168,763	48,948	80,163	99,949	70,004	4,539	539,020	997,721
August	147,353	40,446	94,133	96,481	66,317	4,972	519,809	974,342
September	132,775	37,663	118,046	96,650	68,921	4,931	526,915	991,954
October	122,828	38,057	109,382	96,087	72,431	3,864	511,058	1,046,977
November	115,014	30,868	92,093	92,060	74,127	5,657	472,490	1,002,273
December	113,955	33,296	91,029	95,172	77,479	4,102	476,797	1,015,573
Total	1,829,923	613,292	1,116,655	1,175,108	822,916	57,071	6,459,528	11,735,057

[a] Includes Dayton, Goose Creek, and Duval and Brewster counties.

The production of petroleum in Texas from 1902 to 1912, inclusive, has been as follows:

Production of petroleum in Texas, 1902–1912, by districts, in barrels.

Year.	Northern Texas.						Coastal Texas.		
	Corsicana.	Henrietta.	Powell.	Marion County.	Electra.	Total.[a]	Batson.	Dayton.	Humble.
1902	571,059		46,812			617,871			
1903	401,817		100,143			501,960	4,518		
1904	374,318	65,455	129,329			569,252	10,904,737		
1905	311,554	75,592	132,866			520,282	3,774,841	60,294	15,594,310
1906	332,622	111,072	673,221			1,117,905	2,289,507	92,850	3,571,445
1907	226,311	83,260	596,897			912,618	2,164,453	108,038	2,929,640
1908	211,117	85,963	421,659			723,264	1,593,570	39,901	3,778,521
1909	180,764	113,485	383,137			681,940	1,206,214	17,647	3,237,060
1910	137,331	126,531	450,188	251,717		969,403	1,113,767	9,582	2,495,511
1911	128,526	168,965	373,055	677,689	899,579	2,251,193	1,023,493	4,344	2,426,220
1912	233,282	197,421	251,240	362,870	4,227,104	5,275,529	844,563	12,151	1,829,923

Year.	Coastal Texas—Continued.						Total.
	Matagorda County.	Saratoga.	Sourlake.	Spindletop.	Other.	Total.	
1902		44,838		17,420,949		17,465,787	18,083,658
1903		8,848,159		8,600,905	[b] 30	17,453,612	17,955,572
1904	151,936	739,239	6,442,357	3,433,842	[b] 50	21,672,161	22,241,413
1905	46,471	3,125,028	3,362,153	1,652,780	[b] 30	27,615,907	28,136,189
1906	3,600	2,182,057	2,156,010	1,077,492	77,031	11,449,992	12,567,897
1907	1,573	2,130,928	2,353,940	1,699,943	21,563	11,410,078	12,322,696
1908	62,640	1,634,786	1,595,060	1,747,537	31,185	10,483,200	11,206,464
1909	29,103	1,183,559	1,703,798	1,388,107	87,039	8,852,527	9,534,467
1910	455,999	1,024,348	1,518,723	1,182,436	129,497	7,929,863	8,899,266
1911	561,828	925,777	1,364,880	965,939	2,800	7,275,281	9,526,474
1912	613,292	1,116,655	1,175,108	822,916	44,920	6,459,528	11,735,057

[a] Includes other districts of northern Texas. [b] Bexar County.

The following table gives a statement of the production and value of petroleum at wells in Texas in 1911 and 1912, by districts:

Production and value of petroleum in Texas, 1911 and 1912, by districts, in barrels.

District.	1911			1912		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Northern Texas:						
Corsicana	128,526	$74,439	$0.579	233,282	$149,393	$0.640
Henrietta	168,965	92,046	.545	197,421	134,681	.682
Powell	373,055	186,528	.500	251,240	193,439	.769
Marion County	677,689	365,067	.539	362,870	290,974	.802
Electra	899,579	492,175	.547	4,227,104	3,340,828	.790
Coastal Texas:						
Batson	1,023,493	704,788	.688	844,563	625,812	.741
Dayton	4,344	2,946	.678	12,151	8,473	.697
Humble	2,426,220	1,864,598	.768	1,829,923	1,313,229	.718
Matagorda	561,828	305,588	.543	613,292	406,032	.662
Saratoga	925,777	739,247	.798	1,116,655	827,847	.741
Sourlake	1,364,880	995,807	.729	1,175,108	874,897	.745
Spindletop	965,939	724,978	.750	822,916	654,778	.796
Other Texas	6,179	6,345	1.027	[a] 48,532	32,330	.666
Total	9,526,474	6,554,552	.688	11,735,057	8,852,713	.754

[a] Includes South Bosque and small production in McCulloch and McLennan counties in northern Texas, and Goose Creek and Duval and Brewster counties in coastal Texas.

PRICES.

In the following table are given the fluctuation in prices per barrel for the various grades of petroleum produced in northern Texas in 1910, 1911, and 1912:

Fluctuation in prices per barrel of petroleum in northern Texas, 1910, 1911, and 1912.

Corsicana (light).		Henrietta.		Powell (heavy).		Electra.	
1910.		1910.		1910.		1912.	
Jan. 1	$0.70	Jan. 1	$0.53	Jan. 1	$0.53	Jan. 1	$0.50
May 23	.60	Mar. 16	.55	Mar. 16	.55	Feb. 1	.55
Sept. 1	.58			Sept. 1	.53	Apr. 16	.60
Nov. 16	.55	1911.		Nov. 16	.50	May 20	.65
		Jan. 1	.55			July 18	.70
1911.				1911.		Nov. 14	.75
Jan. 1	.58	1912.		Jan. 1	.50	Dec. 14	.80
		Jan. 1	.50			Dec. 26	.88
1912.		Feb. 1	.55	1912.			
Jan. 1	.50	Apr. 16	.60	Jan. 1	.50		
Feb. 1	.55	May 20	.65	Mar. 1	.55		
Apr. 16	.60	July 18	.70	Sept. 10	.60		
May 20	.65	Nov. 14	.75	Oct. 25	.65		
July 18	.70	Dec. 14	.80	Dec. 14	.70		
Nov. 14	.75	Dec. 26	.88				
Dec. 14	.80						
Dec. 26	.88						

The average monthly prices per barrel of petroleum at wells in northern Texas in the years 1910 to 1912, inclusive, were as follows:

Average monthly prices per barrel of petroleum in northern Texas, 1910–1912.

Month.	Corsicana (light).			Henrietta.		
	1910	1911	1912	1910	1911	1912
January	$0.70	$0.58	$0.50	$0.53	$0.55	$0.50–$0.57
February	.70	.58	.55	.53	.55	.55– .60
March	.70	.58	.55	.54	$0.55– .59	.55– .60
April	.70	.58	.55	.55	.55	.55– .65
May	.67	.58	.60	.55	.55	.60– .68
June	.60	.58	.65	.55	.54– .55	.65– .68
July	.60	.58	.65	.55	.53– .55	.65– .75
August	.60	.58	.70	.55	.50– .55	.70– .75
September	.58	.58	.70	.55	.51– .55	.70– .75
October	.58	.58	.70	.55	.52– .55	.70– .75
November	.56½	.58	.70	.55	.52– .55	.70– .80
December	.55	.58	.75	.55	.52– .55	.75– .88
Average	.629	.58	.634	.546	.545	.682

Month.	Powell (heavy).			Electra.		Potters Point.		
	1910	1911	1912	1911	1912	1910	1911	1912
January	$0.53	$0.50	$0.50	....	$0.50–$0.57	....	$0.44	$0.67
February	.53	.50	.50	....	.55– .60	....	.44	.72
March	.54	.50	.55	....	.55– .60	....	.47	.72
April	.55	.50	.55	$0.55	.55– .65	....	.50	.75
May	.55	.50	.55	.55	.60– .68	....	.54	.75
June	.55	.50	.55	.55	.65– .68	....	.58	.77
July	.55	.50	.55	.55	.65– .75	$0.38	.60	.80
August	.55	.50	.55	$0.49– .55	.70– .75	.40	.60	.80
September	.53	.50	.59	.49– .55	.70– .75	.40	.61	.80
October	.53	.50	.61	.51– .55	.70– .75	.40	.62	.80
November	.51½	.50	.65	.53– .55	.70– .80	.41	.62	.82
December	.50	.50	.68	.53– .55	.75– .88	.42	.62	.88
Average	.535	.50	.569	.547	.790	.408+	.553	.773

The average monthly prices per barrel of petroleum at wells in coastal Texas in the years 1910 to 1912, inclusive, were as follows:

Average monthly prices per barrel of petroleum in coastal Texas, 1910–1912.

Month.	Batson.			Dayton.		
	1910	1911	1912	1910	1911	1912
January	$0.75–$0.79	$0.72–$0.73	$0.65–$0.72½	....	$0.70	$0.67
February	.75– .80	.72– .72	.70– .75	$0.72	.70	.70
March	.75– .80	.72– .71	.75	.72	.70	.70
April	.75– .80	.72– .70	.75	.72	.70	.70
May	.75– .80	.72– .69	.75	.72	.70	.70
June	.75– .80	.70– .69	.75	.72	....	.70
July	.75– .80	.66– .68	.75	.70	....	.70
August	.72– .79	.65– .68	.75	....	....	.70
September	.72– .79	.65– .67	.75	.70	....	.70
October	.72– .79	.65– .67	.75	.70	....	....
November	.72– .79	.65– .66	.75	.70	.60	.70
December	.72– .79	.65– .66	.75	.70	.60	.70
Average	.765–	.688	.741	.711+	.678	.697

Average monthly prices per barrel of petroleum in coastal Texas, 1910–1912—Continued.

Month.	Humble.			Saratoga.		
	1910	1911	1912	1910	1911	1912
January	$0.75–$0.80	$0.65–$0.78	$0.65 –$0.72½	$0.75–$0.82	$0.70–$0.77	$0.65 –$0.72½
February	.75– .80	.67– .77	.67½– .75	.75– .83	.69– .75	.67½– .75
March	.75– .80	.67– .76	.67½– .75	.75– .84	.70– .75	.67½– .75
April	.75– .80	.67– .76	.67½– .75	.75– .83	.69– .75	.67½– .75
May	.75– .80	.67– .77	.67½– .75	.75– .83	.69– .75	.67½– .75
June	.75– .80	.67– .77	.67½– .75	.75– .82	.70– .75	.67½– .75
July	.72– .79	.66– .75	.75	.70– .79	.66– .75	.75
August	.72– .79	.65– .72	.75	.72– .77	.65– .74	.75
September	.72– .79	.65– .72	.75	.72– .77	.65– .75	.75
October	.72– .79	.65– .72	.75	.72– .76	.65– .74	.75
November	.72– .79	.65– .72	.75	.72– .79	.65– .74	.75
December	.72– .79	.65– .72	.75	.72– .75	.65– .74	.75
Average	.773–	.768	.718	.771–	.798	.741

Month.	Sourlake.			Spindletop.		
	1910	1911	1912	1910	1911	1912
January	$0.77–$0.84	$0.72–$0.78	$0.65 –$0.67½	$0.80–$0.82	$0.70–$0.79	$0.70–$0.80
February	.77– .84	.72– .80	.67½– .72	.80– .82	.72– .79	.72– .80
March	.77– .84	.72– .80	.67½– .75	.80– .82	.72– .78	.75– .80
April	.77– .83	.72– .80	.67½– .75	.80– .83	.72– .76	.75– .80
May	.77– .83	.72– .78	.67½– .75	.80– .83	.72– .76	.80
June	.77– .83	.71– .75	.67½– .75	.80– .83	.72– .76	.80
July	.75– .80	.66– .75	.75	.77– .83	.71– .74	.80
August	.72– .80	.65– .75	.75	.77– .83	.70– .74	.80
September	.72– .81	.65– .75	.75	.77– .83	.70– .74	.80
October	.72– .79	.65– .75	.75	.77– .82	.70– .73	.80
November	.72– .76	.65– .75	.75	.77– .82	.70– .73	.80
December	.72– .76	.65– .75	.75	.77– .82	.70– .73	.80
Average	.793–	.729	.745	.813+	.750	.796

WELL RECORD IN NORTHERN TEXAS.

The following tables give the well record in northern Texas from 1908 to 1912, inclusive:

Number of wells completed in northern Texas, 1908–1912, by districts.

District.	Completed.					Oil.					Dry.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Corsicana	13	5	27	39	24	8	4	17	20	17	5	1	10	19	7
Electra				53	326				51	259				1	66
Henrietta	26	46	72	19	20	19	20	35	7	6	7	15	37	9	10
Marion County				15	10				6	3				9	7
Powell	42	118	91			30	87	56			12	28	35		
South Bosque		2					1					1			
Other		4			54		4			14					34
Total	81	175	190	126	434	57	116	108	84	299	24	45	a 82	38	124

a Including gas wells.

Number of wells completed in northern Texas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	3	8	6	11	5	7	5	6	5	10	7	8	81
1909	6	4	......	8	22	20	21	11	19	14	31	13	[a] 175
1910	([b])	26	19	29	15	20	22	12	21	8	12	6	190
1911	9	15	10	22	3	......	10	6	9	7	14	21	126
1912	4	24	31	44	49	31	32	53	32	55	42	37	434

[a] South Bosque not reported by months. [b] No record.

Number of oil wells drilled in northern Texas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	2	7	5	7	4	4	3	4	2	7	6	6	57
1909	......	2	......	4	18	15	17	7	12	10	20	6	[a] 116
1910	([b])	20	13	20	10	12	8	6	11	2	5	1	108
1911	2	7	4	13	1	......	7	3	9	7	12	19	84
1912	4	21	22	33	38	12	20	34	22	44	22	27	299

[a] South Bosque not reported by months. [b] No record.

Number of dry holes drilled in northern Texas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	1	1	1	4	1	3	2	2	3	3	1	2	24
1909	6	2	......	4	4	5	4	4	7	4	11	7	59
1910	([a])	6	6	9	5	8	14	6	10	6	7	5	[b] 82
1911	7	8	5	8	2	......	2	3	......	......	1	2	38
1912	......	3	8	8	11	19	12	18	8	10	19	8	124

[a] No record. [b] Includes gas wells.

Total and average initial daily production of new wells in northern Texas, 1908–1912, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Corsicana	41	25	54	107	108	5.1	6.2	3.2	5.4	6.4
Electra	....	....	....	15,550	26,932	....	....	....	304.9	104.0
Henrietta	718	484	1,331	69	315	37.8	24.2	38.0	9.9	52.5
Marion County	....	....	....	3,454	198	....	....	....	575.7	66.0
Powell	368	668	298	....	....	12.3	7.8	5.3	....	....
Other	....	....	....	....	660	....	....	....	....	47.1
Total	1,127	1,177	1,683	19,180	28,213	19.8	10.8	15.6	228.3	94.3

Total initial daily production of new wells in northern Texas, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	10	22	177	30	17	17	34	135	155	230	205	95	1,127
1909	0	50	0	45	117	133	227	73	74	154	248	56	1,177
1910	([a])	210	77	83	43	1,044	54	26	50	9	62	25	1,683
1911	4	3,265	12	567	200	......	428	450	2,300	2,209	5,250	4,495	19,180
1912	650	3,395	3,185	2,004	2,955	755	1,909	2,462	2,250	5,006	1,678	1,764	28,213

[a] No record.

WELL RECORD IN COASTAL TEXAS.

The following tables give the well record in coastal Texas from 1908 to 1912, inclusive:

Number of wells completed in coastal Texas, 1908–1912, by districts.

District.	Completed.[a]					Oil.					Dry.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Batson	53	51	65	36	30	43	40	51	23	23	10	11	14	10	7
Dayton	8	4	.....	.....	.....	2	0	.....	.....	.....	6	4	.....	.....	.....
Goose Creek	5	7	3	5	26	2	5	1	1	17	3	2	2	4	9
Hoskins Mound[b]	8	2	4	.....	.....	2	1	2	.....	.....	6	1	2	.....	.....
Humble	281	201	160	170	117	201	129	115	122	90	73	64	45	40	27
Markham	10	2	16	41	48	5	2	9	27	31	5	.....	7	9	17
Mission	5	.....	.....	.....	.....	3	.....	.....	.....	.....	2	.....	.....	.....	.....
Piedras Pintas	.....	12	1	.....	.....	.....	2	1	.....	.....	.....	10	.....	.....	.....
Saratoga	44	31	37	56	102	40	27	30	45	91	4	4	7	10	11
Sourlake	81	146	95	101	62	72	116	83	76	54	8	29	12	21	8
Spindletop	108	82	100	93	77	82	46	73	58	47	26	36	27	23	30
Total	603	538	481	502	462	452	368	365	352	353	143	161	116	117	109

[a] Including gas wells. [b] Includes West Columbia.

Number of wells completed in coastal Texas, 1908–1912, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	47	69	66	49	57	44	34	33	47	50	49	58	603
1909	48	51	54	49	52	35	45	52	45	37	38	32	538
1910	55	38	52	40	50	37	46	38	32	30	34	29	481
1911	41	46	46	44	41	76	51	41	33	25	29	29	502
1912	21	49	43	58	37	35	31	39	37	46	39	27	462

[a] Including gas wells.

Number of oil wells drilled in coastal Texas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	36	53	48	41	45	21	20	22	35	44	42	45	452
1909	30	40	36	33	36	24	35	35	30	21	30	18	368
1910	41	22	43	29	30	26	35	28	25	29	31	26	365
1911	26	35	29	30	31	58	40	24	19	16	20	24	352
1912	13	41	35	45	24	25	23	30	27	38	34	18	353

Number of dry holes drilled in coastal Texas, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	10	16	16	8	10	23	12	10	12	6	7	13	143
1909	18	11	18	16	16	11	10	17	15	16	8	14	170
1910	14	16	9	11	20	11	11	10	7	1	3	3	116
1911	15	10	17	14	10	17	11	.....	.....	9	9	5	117
1912	8	8	8	13	13	10	8	9	10	8	5	9	109

Total and average initial daily production of new wells in coastal Texas, 1908–1912, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Batson	2,806	2,179	2,328	606	829	65.2	54.0	45.6	26.3	36.0
Dayton	90	....	....	....	....	45.0	....	....	....	....
Goose Creek	500	54	100	250	3,005	250.0	11.0	100.0	250.0	176.8
Hoskins Mound	....	20	4,500	....	....	....	20.0	2,250.0	....	....
Humble	46,260	8,645	7,502	4,597	5,615	230.1	67.0	65.2	37.6	62.3
Markham	2,700	175	22,100	13,275	10,040	540.0	87.0	2,455.5	491.7	323.8
Piedras Pintas	....	175	150	....	....	....	87.0	150.0	....	....
Saratoga	5,135	3,590	2,137	2,309	9,350	128.4	13.3	71.2	51.3	102.7
Sourlake	7,376	12,737	16,388	4,463	1,530	102.4	11.0	197.4	58.7	28.3
Spindletop	9,385	5,725	8,078	7,240	2,713	114.4	12.4	110.7	124.8	57.7
Total	74,252	33,300	63,283	32,740	33,082	166.1	89.7	173.5	93.0	93.7

Total initial daily production of new wells in coastal Texas, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	6,200	6,040	6,045	5,100	4,565	5,435	5,835	5,485	6,865	6,117	9,020	7,545	74,252
1909	2,180	4,160	3,155	2,577	3,090	2,520	4,615	3,285	2,955	1,459	2,334	970	33,300
1910	3,048	3,135	1,150	5,540	2,935	4,457	8,570	3,940	3,500	4,590	13,835	8,583	63,283
1911	5,970	5,890	2,115	6,380	1,561	3,455	2,708	935	1,355	772	619	980	32,740
1912	935	5,495	3,359	3,435	875	1,805	5,265	2,038	6,055	1,080	1,259	1,481	33,082

SHIPMENTS.

In the following table is given the shipments of petroleum by railroad in tank cars from the different stations of Texas during the year 1912:

Quantity of petroleum shipped by railroad in tank cars from the oil fields of Texas, at the stations named, by months, during the year 1912, in barrels.

Month.	Electra.	Beaumont, Guffey.	Corsicana.	Danbury, Markham, Christine, Noledo.	Houston (Trice).	Humble.	Saratoga.	Sourlake.	Petrolia.	Total.
January	35,712	158,269	4,905	12,206	129,446	109,715	1,396	9,440	7,345	468,434
February	24,324	95,118	4,905	22,940	107,094	51,579	450	15,358	8,540	330,308
March	59,464	113,527	4,905	24,309	71,185	60,943	1,673	7,830	9,049	352,885
April	35,560	109,308	4,905	27,860	50,072	60,356	450	18,941	3,938	311,390
May	98,265	136,840	4,905	16,792	61,616	50,737	450	32,191	3,105	404,901
June	35,063	122,149	4,905	29,095	90,889	53,337	....	29,854	300	365,592
July	21,959	105,453	4,905	17,360	118,665	54,635	676	23,239	....	346,892
August	14,439	101,445	4,906	10,680	111,970	60,333	1,351	....	....	305,124
September	17,164	69,808	4,906	13,928	115,122	45,744	2,252	8,305	....	227,229
October	18,570	130,320	4,906	12,384	104,225	50,156	1,126	15,212	....	336,899
November	13,115	57,840	4,906	7,588	85,200	44,385	1,802	71,007	....	285,843
December	19,029	59,513	4,906	8,480	82,323	18,300	1,808	110,090	....	304,449
Total	392,664	1,259,590	58,865	203,622	1,127,807	660,220	13,434	341,467	32,277	4,089,946

EXPORTS.

The following tables, furnished by the Bureau of Foreign and Domestic Commerce, Department of Commerce, give 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 calendar year 1911, by months, in gallons.

Month.	Crude.		Naphtha.		Illuminating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	2,759,937	$60,272	54,765	$8,612	5,722,258	$301,595
February	215,000	20,425	24,243	3,491	4,995,755	209,087
March	892,182	14,869	26,567	4,219	3 600,870	242,192
April			130,213	15,067	7,206,496	394,267
May	280,715	21,113	1,307,551	98,457	10,763 507	569,041
June	443,334	7,389	74,822	7,268	5,797,360	261,362
July	2,748,205	70,611	160,977	23,361	7,701,889	407,254
August	882,226	18,016	2,207,574	161,704	7,607,919	419,599
September			577,101	47,731	5,725,142	307,540
October	199,870	18,355	168,987	26,846	4,711,770	352,050
November			15,310	1,443	4,447,298	224,843
December	997,251	37,751	191,678	27,788	7,767,988	448,542
Total	9,418,720	268,801	4,939,788	425,987	76,048,252	4,137,372

Month.	Lubricating and paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	132,754	$25,413	6,273,643	$189,824	14,943,357	$585,716
February	32,873	5,333	998,604	23,776	6,266,475	262,112
March	124,745	24,879	5,772,498	176,134	10,416,862	462,293
April	134,942	24,485	3,666,521	134,221	11,138,172	568,040
May	89,218	14,652	2,890,722	90,402	15,331,713	793,665
June	20,265	4,714	3,404,095	110,469	9,739,876	390,902
July	136,575	27,451	1,930,058	67,543	12,677,704	596,220
August	140,960	26,471	7,264,914	254,272	18,103,593	880,062
September	67,752	13,533	2,679,252	75,133	9,049,247	443,937
October	128,064	24,793	5,173,747	170,089	10,382,438	592,133
November	63,175	12,733	1,240,309	43,215	5,766,092	282,234
December	116,234	23,469	3,335,945	117,273	12,409,096	654,823
Total	1,187,557	227,926	44,630,308	1,452,051	136,224,625	6,512,137

Exports to foreign countries of crude and refined petroleum from all ports of Texas in calendar year 1912, by months, in gallons.

Month.	Crude.		Naphtha.		Illuminating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	622,691	$15,101	1,097,921	$133,104	7,522,107	$443,654
February	13,500	270	171,246	28,174	5,536,320	337,417
March	150	8	9,348	1,045	6,915,316	336,275
April	239,720	20,365	995,048	70,977	2,714,857	190,429
May	1,666,139	54,157	2,250,321	165,564	13,102,353	708,009
June	104,076	2,304	1,114,595	103,684	9,362,613	503,347
July	350	14	7,545	996	5,577,996	270,641
August	13,458	269	1,865,764	174,940	6,887,311	421,475
September	16,000	480	69,035	10,716	3,787,339	238,648
October	949,939	34,647	165,100	12,663	3,885,041	159,799
November			103,021	16,415	2,682,067	188,436
December	20,000	950	650,991	103,381	4,919,090	307,577
Total	3,646,023	128,565	8,499,935	821,659	72,892,410	4,105,707

Exports to foreign countries of crude and refined petroleum from all parts of Texas in calendar year 1912, by months, in gallons—Continued.

Month.	Lubricating and paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
January	72,689	$15,264	2,947,512	$99,061	12,262,920	$706,184
February	90,115	18,103	2,874,936	106,493	8,686,117	490,457
March	83,920	16,064	2,696,108	94,404	9,704,842	447,796
April	91,675	18,619	3,675,459	127,118	7,716,759	427,508
May	102,550	21,368	5,500,776	192,527	22,622,139	1,141,625
June	105,846	21,693	3,197,470	109,055	13,884,600	740,083
July	105,019	20,721	6,811,539	231,173	12,502,449	523,545
August	119,107	24,357	3,524,452	122,060	12,410,092	743,101
September	209,196	41,710	6,972,043	233,994	11,053,613	525,548
October	140,546	28,036	4,548,133	143,586	9,688,759	378,731
November	88,316	18,782	5,926,507	192,214	8,799,911	415,847
December	78,512	15,201	8,061,966	268,834	13,730,559	695,943
Total	1,287,491	259,918	56,736,901	1,920,519	143,062,760	7,236,368

Exports of crude and refined petroleum from Texas, by customs districts, in calendar year 1911, in gallons.

Customs district.	Crude, including all natural oils.		Naphtha.		Illuminating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Corpus Christi	81,750	$2,423	329,632	$32,383	8,610	$466
Brazos de Santiago			2,522	433	4,899	468
Galveston	726	44	39,241	5,137	735,400	40,484
Sabine	9,336,244	266,334	4,473,890	375,541	75,235,186	4,087,665
Paso del Norte			29,967	3,933	33,356	4,362
Saluria			64,536	8,560	30,801	3,927
Total	9,418,720	268,801	4,939,788	425,987	76,048,252	4,137,372

Customs district.	Lubricating and heavy paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Corpus Christi	57,054	$7,468	43,526	$1,442	520,572	$44,182
Brazos de Santiago	19	16			7,440	917
Galveston	784,215	152,488	29.640	1,593	1,589,222	199,746
Sabine	279,614	50,217	44,557,142	1,449,016	133,882,076	6.228,773
Paso del Norte	11,573	4,077			74,896	12,372
Saluria	55,082	13,660			150,419	26,147
Total	1,187,557	227,926	44,630,308	1,452,051	136,224,625	6,512,137

Exports of crude and refined petroleum from Texas, by customs districts, in calendar year 1912, in gallons.

Customs district.	Crude, including all natural oils.		Naphtha.		Illuminating.	
	Quantiity.	Value.	Quantity.	Value.	Quantity.	Value.
Corpus Christi	35,825	$1,193	28,178	$2,752	34	$2
Brazos de Santiago			3,534	630	393	40
Galveston	16,000	480	30,485	3,273		
Sabine	3,594,048	126,884	8,382,773	807,496	72,821,829	4,095,861
Paso del Norte	150	8	47,643	6,393	46,791	5,454
Saluria			7,322	1,115	23,363	4,350
Total	3,646,023	128,565	8,499,935	821,659	72,892,410	4,105,707

Exports of crude and refined petroleum from Texas, by customs districts, in calendar year 1912, in gallons—Continued.

Customs district.	Lubricating and heavy paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Corpus Christi	72,990	$9,569	38,702	$1,004	175,729	$14,520
Brazos de Santiago	4,565	1,598			8,492	2,268
Galveston	679,010	137,002	270	41	725,765	140,796
Sabine	415,986	82,903	56,693,479	1,919,081	141,908,115	7,032,225
Paso del Norte	18,761	5,836			113,345	17,691
Saluria	96,179	23,010	4,450	393	131,314	28,868
Total	1,287,491	259,918	56,736,901	1,920,519	143,062,760	7,236,368

LOUISIANA.

DEVELOPMENT.

In Louisiana many large gushers were obtained in the Caddo field, but their yield was not sufficient to prevent a decline in production. A well drilled at Pine Prairie, south of Alexandria, gave 1,200 barrels of oil a day for a short time and led to much drilling, which has not yet resulted in further production. The oil is intermediate in character between the light oils of the Caddo field and the asphaltic oils of the Gulf coast. Vinton continues to be of interest. Several large wells were brought in during the year.

PRODUCTION.

In 1912 Louisiana produced 9,263,439 barrels of petroleum, a decrease of 1,456,981 barrels, or 13.59 per cent, from the preceding year, when the production was 10,720,420 barrels.

The following table shows the production of petroleum in Louisiana in 1911 and 1912, by districts and months:

Production of petroleum in Louisiana in 1911 and 1912, by districts and months, in barrels.

1911.

Month.	Jennings.	Welsh.	Anse la Butte.	Caddo.	Vinton.	Total.
January	128,196	1,440	2,167	437,546	229,465	798,814
February	111,221	1,487	1,857	348,683	566,842	1,030,090
March	121,330	2,214	2,627	475,387	514,849	1,116,407
April	100,697	1,993	3,560	430,159	250,480	786,889
May	94,050	2,843	4,643	574,203	220,728	896,467
June	83,585	2,823	5,597	677,403	139,104	908,512
July	82,158	3,012	2,321	711,012	122,665	921,168
August	80,459	3,032	6,810	599,157	92,307	781,765
September	82,486	2,800	10,758	731,306	95,031	922,381
October	101,037	2,087	12,321	791,868	84,124	991,437
November	72,641	2,085	2,786	652,675	74,454	804,641
December	122,317	2,085	6,964	566,429	64,054	761,849
Total	1,180,177	27,901	62,411	6,995,828	2,454,103	10,720,420

Production of petroleum in Louisiana in 1911 and 1912, by districts and months, in barrels—Continued.

1912.

Month.	Jennings.	Welsh.	Anse la Butte.	Caddo.	Vinton.	Total.
January	89,226	1,845	1,700	550,691	73,060	716,522
February	117,952	1,845	2,109	646,488	64,439	832,833
March	94,049	1,845	2,119	583,518	65,880	747,411
April	97,033	1,845	2,119	700,594	58,909	860,500
May	80,738	1,845	2,119	648,826	70,673	804,201
June	87,809	1,845	2,119	617,267	52,507	761,547
July	102,816	1,845	2,119	592,223	68,112	767,115
August	101,254	1,845	2,119	583,805	75,617	764,640
September	85,510	1,845	2,119	593,422	58,664	741,560
October	84,102	1,845	2,119	562,616	71,408	722,090
November	83,449	1,845	2,119	550,887	124,438	762,738
December	81,773	1,845	2,120	547,612	148,932	782,282
Total	1,105,711	22,140	25,000	7,177,949	932,639	9,263,439

Production and value of petroleum in Louisiana in 1911 and 1912, by districts, in barrels.

District.	1911			1912		
	Production.	Value.	Price per barrel.	Production.	Value.	Price per barrel.
Coastal Louisiana:						
Jennings	1,180,177	$781,762	$0.662	1,105,711	$968,392	$0.876
Welsh	27,901	23,793	.852	22,140	18,655	.843
Anse la Butte	62,411	47,557	.762	25,000	19,605	.784
Vinton	2,454,103	1,161,977	.473	932,639	597,633	.641
Caddo	6,995,828	3,653,725	.522	7,177,949	5,419,541	.755
Total	10,720,420	5,668,814	.529	9,263,439	7,023,827	.758

Production of petroleum in Louisiana, 1902–1912, by districts, in barrels.

Year.	Coastal Louisiana.				Caddo.	Total.
	Jennings.	Welsh.	Anse la Butte.	Vinton.		
1902	548,617					548,617
1903	892,609	25,162				917,771
1904	2,923,066	35,892				2,958,958
1905	8,891,416	10,000	9,000			8,910,416
1906	9,025,174	23,996	25,000		3,358	9,077,528
1907	4,842,520	47,316	60,385		50,000	5,000,221
1908	5,111,577	31,555	145,805		499,937	5,788,874
1909	1,966,614	26,169	37,930		1,028,818	3,059,531
1910	1,625,159	54,724	44,018	26,701	5,090,793	6,841,395
1911	1,180,177	27,901	62,411	2,454,103	6,995,828	10,720,420
1912	1,105,711	22,140	25,000	932,639	7,177,949	9,263,439

Production of Caddo field, 1906–1912, in barrels.

Year.	Caddo, La.	Marion County, Tex.	Total.
1906	3,358	....	3,358
1907	50,000	....	50,000
1908	499,937	....	499,937
1909	1,028,818	....	1,028,818
1910	5,090,793	251,717	5,342,510
1911	6,995,828	677,689	7,673,517
1912	7,177,949	362,870	7,540,819
Total	20,846,683	1,292,276	22,138,959

PRICES.

In the following table are given the prices paid for petroleum at wells in Louisiana in the years 1910 to 1912, inclusive:

Average monthly price of petroleum per barrel at wells in Louisiana, 1910–1912, by districts.

Month.	Jennings.			Caddo.			Vinton.		
	1910	1911	1912	1910	1911	1912	1910	1911	1912
January	$0.74–0.76	$0.62–0.70	$0.625–0.75	$0.59–0.60	$0.42–0.46	$0.40–0.69	.....	$0.40–0.50	$0.500–0.625
February	.74– .76	.60– .70	.625– .80	.59– .60	.44– .45	.40– .72	.....	.41– .48	.560– .625
March	.72– .77	.61– .70	.625– .85	.59– .60	.44– .50	.40– .72	.....	.40– .49	.560– .625
April	.75– .87	.63– .70	.625– .85	.53– .60	.44– .50	.40– .75	.....	.42– .51	.625– .650
May	.75– .87	.60– .70	.625– .85	.38– .56	.44– .55	.40– .77	.....	.39– .51	.625– .650
June	.75– .87	.60– .70	.625– .90	.38– .44	.50– .60	.40– .77	.....	.50– .52	.625– .700
July	.70– .74	.55– .70	.625– .90	.38– .42	.50– .60	.55– .80	.....	.52– .56	.625– .700
August	.70– .74	.55– .70	.625– .90	.38– .42	.40– .60	.55– .80	.....	.52– .52	.625– .700
September	.70– .71	.59– .70	.625– .90	.38– .40	.40– .62	.60– .80	.....	.52– .52	.625– .750
October	.65– .70	.60– .70	.625– .92	.40	.40– .62	.60– .80	.....	.51– .52	.625– .750
November	.67– .72	.60– .70	.625– .92	.40– .42	.40– .62	.60– .83	.....	.51– .53	.625– .750
December	.67– .73	.64– .70	.625– .92	.42– .42½	.40– .62	.60– .91	.....	.52– .53	.625– .750
Average	.731	.662	.876	.450+	.522	.755	$0.50	.473	.641

WELL RECORD.

In the following tables are given the well record for Louisiana for the years 1908 to 1912, inclusive:

Number of wells completed in Louisiana, 1908–1912, by districts.

District.	Completed.					Oil.					Dry.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Caddo	58	121	[a]226	341	353	43	69	124	246	239	9	33	54	63	62
Coastal Louisiana:															
Anse la Butte	16	9	4	1	7	7	5	3	....	3	9	4	1	1	4
Jennings	142	51	22	5	33	104	28	16	4	24	38	23	6	1	9
Pine Prairie	....	....	....	....	6	....	....	....	....	1	....	....	....	....	5
Vinton	....	....	11	96	38	....	....	8	54	31	....	....	3	27	7
Welsh	....	2	5	10	....	....	1	5	5	....	....	1	....	3	....
Total	216	183	268	453	437	154	103	156	309	298	56	61	64	95	87

[a] Includes Marion County, Tex.

Number of wells completed in Louisiana, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	11	26	18	25	24	13	9	23	18	20	14	15	216
1909	20	13	19	17	20	15	27	11	15	6	10	10	183
1910	16	14	22	24	18	22	21	33	26	15	25	32	268
1911	32	51	64	33	52	38	39	42	32	20	25	25	453
1912	17	31	22	21	34	46	37	43	57	44	51	34	437

Number of oil wells drilled in Louisiana, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	7	16	13	21	16	10	8	14	15	14	8	12	154
1909	14	5	13	8	13	9	12	9	5	4	6	5	103
1910	7	4	8	5	12	16	20	19	17	15	16	17	156
1911	20	33	49	26	39	29	27	18	21	14	16	17	309
1912	12	19	19	14	30	28	25	28	34	27	37	25	298

Number of dry holes drilled in Louisiana, 1908–1912, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	4	10	5	4	8	3	1	9	3	6	6	3	62
1909	6	8	6	9	7	6	15	2	10	2	4	5	80
1910	9	10	14	19	6	6	1	14	9	......	9	15	64
1911	12	15	12	6	9	6	9	8	3	4	5	6	95
1912	2	8	1	6	4	11	7	6	15	15	8	4	87

Total and average initial daily production of new wells in Louisiana, 1908–1912, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1908	1909	1910	1911	1912	1908	1909	1910	1911	1912
Caddo	14,355	8,750	[a]139,945	169,123	84,098	333.8	127.0	1,128.6	687.5	351.9
Coastal Louisiana:										
Anse la Butte	5,200	955	735	....	590	742.8	191.0	245.0	....	196.7
Jennings	84,620	11,745	3,230	480	5,905	813.6	419.0	201.9	120.0	246.0
Pine Prairie	....	....	....	....	1,050	....	....	....	....	1,050.0
Vinton	....	....	11,100	73,550	17,975	....	1,387.5	....	1,362.0	579.8
Welsh	....	....	165	115	....	....	....	33.0	23.0	....
Total	104,175	21,450	155,175	243,268	109,618	676.4	210.3	994.7	787.3	432.5

[a] Includes Marion County, Tex.

Total initial daily production of new wells in Louisiana, 1908–1912, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	2,010	10,160	19,330	15,255	21,945	2,165	3,390	3,770	10,400	8,195	1,990	5,565	104,175
1909	3,900	865	2,260	4,730	1,250	1,560	1,720	570	640	160	2,625	1,170	21,450
1910	1,750	1,345	5,320	3,520	11,040	20,650	8,270	12,245	33,560	30,840	16,215	10,420	155,175
1911	35,275	29,325	17,110	38,595	62,150	6,980	5,405	4,505	23,465	4,886	5,292	10,280	243,268
1912	10,855	5,257	10,070	18,300	11,447	3,583	4,931	3,391	17,605	5,600	13,631	4,948	109,618

SHIPMENTS.

The following table gives a statement of shipments of petroleum from stations on the line of the Louisiana Western Railroad and of the Kansas City Southern Railway in Louisiana during the year 1912, by months:

Rail shipments of petroleum from stations on the lines of the Louisiana Western Railroad and the Kansas City Southern Railway in Louisiana in 1912, in barrels.

Month.	Anse la Butte.	Caddo oil.				Jennings oil.			Vinton.	Total.
		Lewis.	Mooringsport.	Oil City.	Vivian.	Egan.	Jennings.	Mermenton.		
January	....	46,986	6,437	68,266	15,306	2,786	2,816	3,173	....	145,770
February	....	42,973	71,754	57,430	9,550	774	6,878	995	....	190,354
March	465	47,097	3,319	105,162	10,610	3,405	11,520	727	25,386	207,691
April	....	38,086	6,205	68,467	12,062	3,250	6,262	943	40,410	175,685
May	1,210	37,763	235	44,299	6,551	4,798	4,873	1,715	32,909	134,353
June	2,017	29,006	....	42,335	4,394	2,012	1,398	677	28,030	109,869
July	1,776	36,830	380	61,218	3,980	8,927	2,150	2,046	35,010	152,317
August	....	55,644	190	60,645	4,157	12,387	1,850	4,593	27,942	167,408
September	611	37,148	....	26,538	4,843	17,662	3,302	1,987	28,111	120,202
October	1,043	53,275	190	33,504	3,509	10,209	4,613	1,851	27,092	135,286
November	464	51,100	....	28,323	2,346	2,756	2,800	3,410	19,919	111,118
December	....	61,216	374	50,414	854	6,456	1,304	4,199	27,958	152,775
Total	7,586	537,124	89,084	646,601	78,162	75,422	49,766	26,316	292,767	1,802,828

NOTE.—These are the official figures, calculation being made on the basis of 310.8 pounds of crude petroleum to a barrel of 42 gallons.

CALIFORNIA OIL FIELD.

GENERAL CONDITIONS.

The total output increased from 81,134,391 barrels in 1911 to 86,450,767 barrels in 1912, or 6.55 per cent. Consumption, however, increased 18.8 per cent. Stocks increased from 44,240,118 barrels at the end of 1911 to 47,552,392 barrels at the end of 1912, when consumption had nearly equaled production. The average price received was 45.4 cents per barrel in 1912, against 47.7 cents in 1911. This slight decline is to be attributed not to the statistical condition so much as to the expiration of old contracts made at the rates formerly prevailing.

The features of particular interest during the year were the development of large wells at unusual depth in La Habra Valley field, the continued development of large gushers in the valley fields, and the decline in the old Santa Maria field. Some good producers in the Midway and other valley fields were injured by an influx of water. The Coalinga territory was extended by the development of good wells to the south, and its value was enhanced by the increased utilization of natural gas, including the enterprise for piping natural gas from the valley fields to Los Angeles, and by the increased amount of gasoline obtained by compressing natural gas. Progress was also made, especially in the Midway field, in cracking crude oils to obtain greater yields of gasoline.

Among trade features of interest should be noted the purchase of 10,000,000 barrels of surplus crude oil from the independent agency of the Union Oil Co. and the withdrawal of the Standard Oil Co. from the purchase of oils heavier than 18° Baumé.

PETROLEUM RESERVES IN CALIFORNIA.

During the course of the year two reserves of public lands were established to assure the Navy a supply of oil in case of need. These reserves are in the Elk Hills and the Buena Vista Hills, Kern County. The public lands within these areas have been withdrawn from all forms of entry during the last three years, and in 1912 a special reservation for naval purposes was made.

PRODUCTION.

The following table shows the production and value of petroleum in California in 1911 and 1912, by districts and counties:

Production and value of petroleum in California in 1911 and 1912, by districts and counties, in barrels.

District and county.	1911			1912		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Coastal and southern:						
Los Angeles County—						
Los Angeles city	397,424	$268,574	$0.676	344,789	$211,896	$0.615
Newhall						
Puente						
Salt Lake-Sherman						
Whittier						
Orange County—						
Fullerton	16,247,804	10,281,176	.633	15,863,404	9,775,105	.616
Ventura County—						
Santa Paula						
Santa Barbara County—						
Lompoc						
Santa Maria						
Summerland	63,238	45,458	.719	65,376	44,295	.677
San Luis Obispo County Santa Clara County	20,462	12,072	.590	20,123	11,977	.595
San Joaquin Valley:						
Fresno County—						
Coalinga	18,483,751	9,100,371	.492	19,911,820	8,768,303	.441
Kern County—						
Lost Hills	....	....	....	1,367,359	652,927	.477
Kern River	13,225,713	4,922,735	.372	12,558,439	5,399,914	.422
McKittrick [a]	5,149,226	1,798,279	.349	5,881,996	2,350,096	.399
Midway	21,196,475	9,830,922	.464	23,928,368	9,713,362	.405
Sunset	6,350,298	2,459,493	.387	6,509,093	2,285,713	.351
Total	45,921,712	19,011,429	.414	50,245,255	20,402,012	.406
Grand total	81,134,391	38,719,080	.477	86,450,767	39,213,588	.454

Note: In the printed table, one brace joins Newhall through Santa Maria to the figures on the Fullerton line (16,247,804 etc.). A second brace joins San Luis Obispo County and Santa Clara County.

[a] Includes Lost Hills.

The following table shows the production of petroleum in California, by counties, from 1903 to 1912, inclusive:

Production of petroleum in California, 1903–1912, by counties, in barrels.

Year.	Fresno.	Kern.	Los Angeles.	Orange.	Santa Barbara.	Ventura.	San Mateo.	Santa Clara.	Total.
1903	2,138,058	18,077,900	2,087,627	1,413,782	306,066	348,295	5,137	5,607	24,382,472
1904	5,114,958	19,608,045	2,102,892	1,473,335	789,006	517,770	1,500	41,928	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	14,520,854	3,449,119	2,032,637	4,774,361	299,124	a 31,464		33,098,598
1907	8,871,723	15,652,156	3,477,235	2,604,982	8,708,077	357,094	a 77,108		39,748,375
1908	10,386,168	18,132,893	4,692,495	3,358,714	7,816,682	379,044	a 88,741		44,854,737
1909	14,795,459	23,831,768	16,774,195				a 70,179		55,471,601
1910	18,387,750	37,896,727	16,665,678				b 60,405		73,010,560
1911	18,483,751	45,921,712	16,708,466				b 20,462		81,134,391
1912	19,911,820	50,245,255	16,273,569				b 20,123		86,450,767

a Includes oil produced in San Luis Obispo County.
b Production of Santa Clara and San Luis Obispo Counties.

Production of petroleum in California in 1911 and 1912, by districts and counties, with increase or decrease and percentage thereof, in barrels.

District and county.	1911	1912	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
Coastal and southern:						
Los Angeles County—						
Los Angeles city	397,424	344,789		52,635		13.24
Newhall						
Puente						
Salt Lake-Sherman						
Whittier						
Orange County—						
Fullerton	16,247,804	15,863,404		384,400		2.37
Ventura County—						
Santa Paula						
Santa Barbara County—						
Lompoc						
Santa Maria						
Summerland	63,238	65,376	2,138		3.38	
San Luis Obispo County						
Santa Clara County	20,462	20,123		339		1.66
San Joaquin Valley:						
Fresno County—						
Coalinga	18,483,751	19,911,820	1,428,069		7.73	
Kern County—						
Lost Hills a						
Kern River	13,225,713	12,558,439		667,274		5.05
McKittrick b	5,149,226	7,249,355	2,100,129		40.79	
Midway	21,196,475	23,928,368	2,731,893		12.89	
Sunset	6,350,298	6,509,093	158,795		2.50	
Total	45,921,712	50,245,255	4,323,543		9.42	
Grand Total	81,134,391	86,450,767	5,147,744		6.34	

a Included in McKittrick. b Includes Lost Hills.

Production and value of petroleum in California, 1908–1912, by districts, in barrels.

Year.	Coastal and southern.		San Joaquin Valley.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	16,335,676	$9,296,743	28,519,061	$14,136,759	44,854,737	$23,433,502
1909	16,844 374	9,737,616	38,627,227	21,019,097	55,471,601	30,756,713
1910	16,726,083	10,532,080	56,284,477	25,217,393	73,010,560	35,749,473
1911	16,728,928	10,607,280	64,405,463	28,111,800	81,134,391	38,719,080
1912	16,293,692	10,043,273	70,157,075	29,170,315	86,450,767	39,213,588

FIELD REPORT.

The field report for California for 1911 and 1912 is shown in the following table:

Field report for California in 1911 and 1912, by counties and districts.

1911.

County and district.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Fresno County	794	192	22	30	956	32,165	12,745	44,910
Kern County:								
Kern River	1,668	153	6	34	1,787	14,889	1,871	16,760
McKittrick	231	24	7	9	246	40,183	1,888	42,071
Midway	408	333	21	49	692	32,352	26,427	58,779
Sunset	243	94	7	7	330	17,493	12,844	30,337
Devils Den Lost Hills	2	24	4	6	20	6,980	880	7,860
Los Angeles County:								
Los Angeles city	427	10	......	24	413	318	25	343
Newhall-Puente	135	2	6	4	133	5,642	4,990	10,632
Salt Lake-Sherman	276	15	5	3	288	12,420	3,023	15,443
Whittier	121	5	1	17	109	5,088	154	5,242
Orange County	290	36	......	36	290	11,807	6,383	18,190
San Luis Obispo County	11	1	5	9	3	3,565	2,661	6,226
San Mateo County	4	......	......	......	4	......	......	......
Santa Clara County	5	1	......	2	4	56	6,000	6,056
Santa Barbara County:								
Lompoc-Santa Maria	241	19	11	5	255	93,291	36,839	130,130
Summerland	120	42	......	1	161	11	13	24
Ventura County	245	19	5	9	255	44,369	92,570	136,939
Miscellaneous	2	......	4	1	1	5,380	28,239	33,619
Total	5,223	970	104	246	5,947	a326,009	237,552	563,561

a Includes 37,827 acres reported as oil locations.

1912.

Fresno County	956	142	11	56	1,042	63,137	13,032	76,169
Kern County:								
Devils Den Lost Hills	20	51	4	15	56	17,521	2,280	19,801
Kern River	1,787	94	1	68	1,813	12,162	3,737	15,899
McKittrick	246	71	16	20	297	38,811	1,878	40,689
Midway	692	202	20	92	802	23,865	27,351	51,216
Sunset	330	82	6	32	380	16,033	11,855	27,888
Los Angeles County:								
Los Angeles city	413	1	......	19	395	505	426	931
Newhall-Puente	133	......	1	31	102	4,981	4,015	8,996
Salt Lake-Sherman	288	21	3	5	304	12,634	4,057	16,691
Whittier	109	13	1	4	118	5,566	184	5,750
Orange County	290	19	1	11	298	11,324	10,816	22,140
San Luis Obispo County	3	1	2	......	4	13,524	1,178	14,702
San Mateo County	4	......	......	......	4	......	......	......
Santa Clara County	4	......	......	......	4	50	6,000	6,050
Santa Barbara County:								
Lompoc-Santa Maria	255	23	2	29	249	82,708	34,696	117,404
Summerland	161	......	......	9	152	11	20	31
Ventura County	255	55	......	11	299	27,118	78,546	105,664
Miscellaneous	1	1	3	......	2	4,952	8,855	13,807
Total	5,947	776	71	402	6,320	334,902	208,926	543,828

COLORADO OIL FIELD.

PRODUCTION.

Colorado has petroleum resources of considerable promise which are as yet practically undeveloped. But the actual production came, as in previous years, from the Florence field in Fremont County and the Boulder field in Boulder County, with experimental results from other fields. Both the Florence and the Boulder fields are old, well along in what would be expected to be a period of decline. Paradoxically, however, the older Florence field showed an actual increase, while the Boulder field, which has never been a large element in the supply, dropped to 15,304 barrels, less than half of its output in 1911. The total output for the State in 1912, therefore, was 206,052 barrels, against 226,926 barrels in 1911. The average prices remained constant in the two fields, but the sharp decline in production of the higher-priced Boulder oil lowered the average price for the State to 97.3 cents per barrel, making the total value $199,661 in 1912 against $228,104 in 1911.

In the following table will be found the production and value of petroleum in the Boulder and Florence fields in Colorado from 1903 to 1912, inclusive:

Production and value of petroleum in Colorado, 1903–1912, by districts, in barrels.

Year.	Boulder.		Florence.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1907	68,353	75,188	263,498	197,625	331,851	272,813
1908	84,174	124,794	295,479	221,609	379,653	346,403
1909	85,709	129,812	225,062	187,900	[a] 310,861	318,162
1910	42,186	63,420	193,482	174,332	[b] 239,794	243,402
1911	37,973	50,393	187,341	175,763	[b] 226,926	228,104
1912	15,304	19,130	190,498	180,281	[c] 206,052	199,661

[a] Includes a small production in Garfield County.
[b] Includes production of Garfield and Rio Blanco counties.
[c] Includes production of Rio Blanco County.

In the following table is given the production of petroleum in Colorado, by fields and months, in 1911 and 1912.

Production of petroleum in Colorado in 1911 and 1912, by fields and months, in barrels.

Month.	1911				1912			
	Boulder.	Florence.	Other.[a]	Total.	Boulder.	Florence.	Other.[a]	Total.
January	3,390	15,483	134	19,007	1,430	13,398	20	14,848
February	2,553	13,612	134	16,299	865	14,425	20	15,310
March	3,337	16,066	134	19,537	1,740	15,410	21	17,171
April	3,343	15,989	134	19,466	967	16,723	21	17,711
May	2,749	14,375	135	17,259	1,586	16,401	21	18,008
June	1,902	14,280	135	16,317	1,126	15,151	21	16,298
July	3,331	16,042	135	19,508	1,509	17,638	21	19,168
August	2,625	16,810	135	19,570	1,267	16,215	21	17,503
September	2,701	17,047	134	19,882	1,109	16,423	21	17,553
October	4,922	17,736	134	22,792	1,306	16,266	21	17.593
November	3,804	15,986	134	19,924	1,154	15,944	21	17,119
December	3,316	13,915	134	17,365	1,245	16,504	21	17,770
Total	37,973	187,341	1,612	226,926	15,304	190,498	250	206,052

[a] Averaged.

FIELD REPORT.

Field report for Colorado in 1911 and 1912, by counties.

County.	Wells.									Acreage.					
	1911					1912				1911			1912		
	Productive Jan. 1.	Completed. Oil.	Completed. Dry.	Abandoned.	Productive Dec. 31.	Completed. Oil.	Completed. Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.	Fee.	Lease.	Total.
Boulder	24	6	8	4	26	....	....	7	19	3,943	900	4,843	2,978	745	3,723
Fremont	56	4	9	6	54	11	13	15	50	5,187	10,440	15,627	2,326	1,780	4,106
Rio Blanco	35	4	1	....	39	4	....	1	42	4,000	8,800	12,800	4,000	8,800	12,800
Other	1	....	....	....	1	....	....	....	1	100	......	100	100	40	140
Total	116	14	18	10	120	15	13	23	112	13,230	20,140	33,370	9,404	11,365	20,769

WYOMING OIL FIELD.

DEVELOPMENT.

The year 1912 marks the entrance of Wyoming as a serious element in the oil industry.

In April a gusher which flowed 1,200 barrels a day was drilled in 45 miles north from Casper, Wyo., in the Salt Creek field. This development started a general boom in the development of Wyoming oil fields, especially in Natrona County. The Mid-west and the Franco-Wyoming refineries were both put into operation after they had been connected with the Salt Creek field by 6-inch pipe lines 43 and 47 miles long, respectively. The gasoline and the kerosene were marketed chiefly in Montana, and the residuum was used as fuel by the Chicago & North Western Railway. Fifty-nine producing oil wells and 30 dry holes were drilled in the State, only nine productive wells being outside of Natrona County. The total acreage of oil lands owned and leased in the State was largely increased; in 1911 the total oil land aggregated 39,550 acres, and in 1912 it increased to 64,810 acres. The acreage in Natrona County increased almost fourfold, from 5,280 acres in 1911 to 20,360 acres in 1912.

PRODUCTION.

The following table gives the production in Wyoming from 1903 to 1912, inclusive:

Production of petroleum in Wyoming, 1903–1912, in barrels.

Year.	Quantity.	Year.	Quantity.
1903	8,960	1908	[b] 17,775
1904	11,542	1909	[b] 20,056
1905	8,454	1910	[b] 115,430
1906	[a] 7,000	1911	[b] 186,695
1907	[b] 9,339	1912	1,572,306

[a] Estimated. [b] Includes the production of Utah.

FIELD REPORT.

The field report for Wyoming in 1911 and 1912 is shown in the following table:

Field report for Wyoming in 1911 and 1912, by counties.

WELLS.

County.	1911					1912			
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Completed.		Abandoned.	Productive Dec. 31.
		Oil.	Dry.			Oil.	Dry.		
Bighorn	22	1	4	7	16	1	6	1	16
Converse	6			1	5	2			7
Crook	9	3		1	11		2	1	10
Fremont	39	2		4	37	4		10	31
Johnson	1				1				1
Natrona	52	25		12	65	50	16	15	100
Uinta	20	6	5	1	25	2		3	24
Total	149	37	9	26	160	59	24	30	189

ACREAGE.

County.	1911			1912		
	Fee.	Lease.	Total.	Fee.	Lease.	Total.
Bighorn	1,960	2,390	4,350	2,360	3,190	5,550
Converse	500		500	468	400	868
Crook	1,880		1,880	1,880	160	2,040
Fremont	100	12,740	12,840	2,776	10,376	13,152
Johnson	160		160	160		160
Natrona	3,520	1,760	5,280	2,020	18,340	20,360
Uinta	4,840	9,700	14,540	10,480	12,200	22,680
Total	12,960	26,590	39,550	20,144	44,666	64,810

UTAH.

DEVELOPMENT.

Considerable prospecting was carried on during 1912, but the developments did not reach the productive stage. Thirteen wells are recorded as ready for production, 9 in San Juan County, 1 in Uinta County, and 3 in Washington County. Some interest was shown in oil prospecting in Summit County, in the northeastern part of the State adjoining the development of Uinta County, Wyo.

An examination of a reported oil field in Grand County, Utah, south and southeast of Green River, has been made by C. T. Lupton, associate geologist of the United States Geological Survey. The area examined lies east of Green River and south of the Denver & Rio Grande Railroad. It extends eastward as far as the middle line of R. 20 E., and south to the center line of T. 24 S.

Prospecting for oil in this general region has been carried on at intervals for over 20 years. About 1891 a well was drilled to a depth of 1,000 feet in the northwestern part of Grand County near the town of Green River. The result was not encouraging and no other development work was done until 1899 and 1900, when three wells were drilled; two were located in Emery County west of Green River and the other in Grand County near Cisco. One of those in Emery County, situated about 10 miles southwest of Green River, yielded a little gas, and the other, 13 miles northwest of the same town, gave a trace of oil. The Cisco well yielded neither gas nor oil. About 1910, owing to the finding at several localities of rocks saturated with oil and asphaltum and also to the constant increase in the price of petroleum and its products, interest was again aroused in this field and during the last three years several wells have been drilled. Six of these wells have been drilled or are being drilled in the area mapped by the Geological Survey and a summary of the results is given below.

The Klondike well, in sec. 26, T. 23 S., R. 19 E., was drilled by the Moab Oil Co. of Utah to a depth of about 700 feet. Gas was encountered at three horizons in this well, but the flows did not last long, as they were cased off. No oil was reported. The Collins well, in sec. 20, T. 21 S., R. 17 E., was drilled to a depth of more than 2,100 feet. Small amounts of gas were encountered at four places in this well. A trace of oil, as indicated by the rainbow color on the water, accompanied each flow of gas. The same company, it is reported, has begun another well about 1½ miles farther east. The Levi No. 1 well, in sec. 25, T. 23 S., R. 18 E., is reported to have struck a little gas and a small quantity of oil. The Levi No. 2 well, in sec. 35, T. 22 S., R. 17 E., was drilled to a depth of about 1,500 feet without encountering oil or gas. A 400-foot hole has been drilled near the Levi No. 2, but no evidence of oil or gas was found. The Queen well, in sec. 18, T. 23 S., R. 19 E., was drilled to a depth of 920 feet. No gas was encountered, but a "showing" of oil was obtained at 910 feet. About 45 or 50 miles southwest of the town of Green River two wells are being drilled at the present time.

In the recent examination it was found that the strata in the area southwest of the town of Green River dip gently to the north and northeast. There are no anticlines or domes in which large quantities of oil or gas might be expected to collect, but a prominent fault zone, with a throw of a few hundred feet, extends in a northwest-southeast direction across the field, and about 4 miles north of this fault there is another which extends but a few miles on each side of Green River. One oil seep (known locally as "goin's seep") is on this fault near the south boundary of T. 21 S., R. 16 E., and the rocks in the immediate vicinity are fairly well saturated with petroleum. Other faults of greater or less throw were also observed.

FIELD REPORT.

The field report for Utah in 1911 and 1912 is shown in the following table:

Field report for Utah in 1911 and 1912, by counties.

WELLS.

County.	1911					1912			
	Productive Jan. 1.	Completed. Oil.	Completed. Dry.	Abandoned.	Productive Dec. 31.	Completed. Oil.	Completed. Dry.	Abandoned.	Productive Dec. 31.
San Juan	9		7		9		1		9
Uinta	2				2			1	1
Washington	6				6			3	3
Total	17		7		17		1	4	13

ACREAGE.

County.	1911			1912		
	Fee.	Lease.	Total.	Fee.	Lease.	Total.
San Juan	11,700	360	12,060	12,917	160	13,077
Uinta	200		200	200	1,000	1,200
Washington	700		700	600		600
Total	12,600	360	12,960	13,717	1,160	14,877

MISSOURI.

No production of petroleum was reported from Missouri in 1912.

Production of petroleum in Missouri, 1903–1912, in barrels.

Year.	Quantity.	Year.	Quantity.
1903	a 3,000	1908	a 15,246
1904	a 2,572	1909	a 5,750
1905	a 3,100	1910	a 3,615
1906	a 3,500	1911	a 7,995
1907	a 4,000	1912	(b)

a Includes the production of Michigan.
b No production in Missouri; production of Michigan included in Lima, Ohio.

NEW MEXICO.

In the spring of 1912 an effort was made to increase the yield of oil from the small wells, originally drilled for water, about 2½ miles northeast of Dayton, Eddy County. John R. Collins, of the Pecos Valley Oil Co., set a packer in the original oil well below the level of the water horizon and succeeded in demonstrating that the yield of oil could be increased beyond the three barrels a day that the well is producing. The packer was afterwards pulled. Later in the year interest was again aroused in the project. At the end of the year two other companies, one representing prominent California oil interests, were preparing actively for drilling.

IMPORTS.

The value of the imports for consumption of petroleum is reported by the Bureau of Foreign and Domestic Commerce as follows for the last five years: 1908, $607,658; 1909, $197,023; 1910, $1,398,861; 1911, $2,410,884; 1912, $6,082,881. The value of the imports for consumption of ozokerite and paraffin wax and paraffin oil for the same period was: 1908, $507,363; 1909, $778,681; 1910, $1,025,829; 1911, $792,818; 1912, $1,018,524.

EXPORTS.

TERRITORIAL SHIPMENTS.

Alaska.—In the following table are given the shipments of petroleum products to Alaska from 1906 to 1912, inclusive:

Shipments of petroleum products to Alaska from other parts of the United States, 1906–1912, in gallons.

Year.	Crude.		Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1906	2,688,100	$38,409	580,978	$100,694	568,033	$109,964	83,992	$32,854
1907	9,104,300	143,506	636,881	119,345	510,145	99,342	100,145	37,929
1908	11,891,375	176,483	939,424	147,104	566,598	102,567	94,542	36,423
1909	14,034,900	334,258	746,930	118,810	531,727	98,786	85,687	35,882
1910	18,835,670	477,673	788,154	136,569	626,972	95,483	104,512	38,625
1911	18,142,364	406,400	1,238,865	167,915	423,750	57,896	100,141	34,048
1912	3,324,062	64,866	2,736,739	344,739	672,176	100,722	154,565	60,949

Hawaiian Islands, Philippine Islands, and Porto Rico.—In the following table are given the shipments of petroleum products to the Hawaiian Islands, Philippine Islands, and Porto Rico from 1907 to 1912, inclusive:

Shipments of petroleum products to Hawaii, the Philippines, and Porto Rico, 1907–1912, in gallons.

Year.	Crude.		Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
HAWAII.								
1907	38,916,400	$581,905	484,435	$73,405	1,441,637	$230,968	355,451	$104,930
1908	47,719,900	802,325	648,310	91,851	1,143,591	179,507	358,262	140,157
1909	43,461,493	845,805	804,169	127,076	1,401,381	232,340	367,831	121,282
1910	54,117,100	1,061,060	974,268	160,700	1,359,671	226,481	359,528	133,968
1911	46,791,550	917,763	1,329,589	203,052	1,587,873	220,505	466,826	138,927
1912	38,524,000	861,080	2,501,938	343,062	1,817,718	190,939	477,012	165,993
PHILIPPINES.								
1907			79,560	12,930	8,218,400	842,111	181,504	32,598
1908	4,594	322	140,550	21,775	9,234,263	957,284	257,800	61,571
1909	15,489	1,014	184,390	23,428	5,995,090	558,642	362,068	81,278
1910	13,453	1,098	318,070	42,058	10,643,804	862,496	432,867	95,213
1911	5,502	376	1,074,615	158,592	11,653,570	913,760	470,832	107,499
1912	23,815	476	1,326,040	216,810	12,634,519	1,094,596	487,607	121,999
PORTO RICO.								
1907			219,691	38,003	1,700,838	176,808	223,389	53,599
1908	24,937	2,100	285,188	45,479	1,623,477	189,021	264,012	65,776
1909	5,089	340	495,367	93,649	1,931,676	216,316	218,829	78,963
1910	8,739	499	874,814	135,290	1,973,369	222,108	283,935	91,356
1911	51,656	2,899	1,106,327	133,470	2,323,401	207,804	479,579	117,034
1912	2,532	278	1,470,105	223,325	2,168,105	212,043	471,596	134,882

FOREIGN EXPORTS.

The following tables, compiled by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, show 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, 1911 and 1912:

Exports of mineral oils from the United States in the calendar years 1911 and 1912, by kind and port, in gallons.

Kind and port.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
CRUDE.				
New York	49,696,542	$2,558,133	40,778,888	$2,399,698
Philadelphia	2,791,450	153,739	1,532	138
Galveston	726	44	16,000	480
Other districts	149,354,637	3,453,487	147,915,000	4,370,168
Total	201,843,355	6,165,403	188,711,420	6,770,484
NAPHTHA.				
Baltimore	24,562	2,258	40,274	5,843
Boston and Charlestown	32,471	3,935	80,648	11,721
New York	80,101,637	7,149,702	105,423,206	11,933,874
Philadelphia	25,879,405	1,678,741	16,999,114	1,853,716
Galveston	39,241	5,137	30,485	3,273
Other districts	31,217,290	2,642,988	63,426,367	6,650,951
Total	137,294,606	11,482,761	186,000,094	20,459,378

Exports of mineral oils from the United States in the calendar years 1911 and 1912, by kind and port, in gallons—Continued.

Kind and port.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
ILLUMINATING.				
Baltimore	4,070,201	$216,785	64,762	$5,489
Boston and Charlestown	201,169	17,085	162,801	15,994
New York	650,810,744	38,913,023	566,796,456	37,834,220
Philadelphia	286,945,777	14,127,603	257,075,383	14,099,765
Galveston	735,400	40,484		
Other districts	169,531,715	7,740,115	202,038,837	10,128,554
Total	1,112,295,006	61,055,095	1,026,138,239	62,084,022
LUBRICATING AND PARAFFIN.				
Baltimore	7,334,394	925,839	11,753,631	1,445,574
Boston and Charlestown	132,350	29,103	105,537	19,776
New York	115,003,462	15,942,060	144,934,778	19,657,690
Philadelphia	53,319,637	5,124,507	47,255,283	5,348,763
Galveston	784,215	152,488	679,010	137,002
Other districts	6,745,587	1,163,129	11,664,967	1,688,662
Total	183,319,645	23,337,126	216,393,206	28,297,467
RESIDUUM.				
Baltimore			21,801	1,740
Boston and Charlestown	150,000	4,667	159,557	9,988
New York	40,036,883	1,209,180	51,578,976	1,621,150
Philadelphia	24,781,953	647,124	32,425,934	671,617
Galveston	29,640	1,593	270	41
Other districts	68,980,611	2,019,889	182,050,400	4,294,495
Total	133,979,087	3,882,463	266,236,938	6,599,031
Grand total	1,768,731,699	105,922,848	1,883,479,897	124,210,382

RECAPITULATION BY KINDS, IN GALLONS.

Crude	201,843,355	$6,165,403	188,711,420	$6,770,484
Naphtha	137,294,606	11,482,761	186,000,094	20,459,378
Illuminating	1,112,295,006	61,055,095	1,026,138,239	62,084,022
Lubricating and paraffin	183,319,645	23,337,126	216,393,206	28,297,467
Residuum	133,979,087	3,882,463	266,236,938	6,599,031
Total	1,768,731,699	105,922,848	1,883,479,897	124,210,382

RECAPITULATION BY PORTS, IN GALLONS.

Baltimore	11,429,157	$1,144,882	11,880,468	$1,458,646
Boston and Charlestown	515,990	54,800	508,543	57,479
New York	935,649,268	65,772,098	909,512,304	73,446,632
Philadelphia	393,718,222	21,731,714	353,757,246	21,973,999
Galveston	1,589,222	199,746	725,765	140,796
Other districts	425,829,840	17,019,608	607,095,571	27,132,830
Total	1,768,731,699	105,922,848	1,883,479,897	124,210,382

Exports of mineral oils from the United States in 1911 and 1912, by months, in gallons.

Month.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
January	109,437,912	$6,419,647	132,160,209	$7,901,326
February	121,980,429	7,408,493	110,618,086	6,864,817
March	153,405,159	9,212,258	122,254,481	8,037,325
April	154,214,494	9,010,533	163,206,438	10,619,283
May	150,629,691	9,249,122	195,734,654	13,171,878
June	157,232,119	9,318,717	147,859,275	10,573,393
July	170,863,408	9,594,307	186,196,374	11,913,785
August	161,404,093	9,778,537	166.618,226	11,677,602
September	169,055,076	9,980,626	182,896,451	12,235,747
October	154,715,980	9,440,291	148,863,918	9,538,976
November	127,260,425	8,007,664	181,012,206	11,882,373
December	138,532,913	8,502,653	146,059,579	9,793,877
Total	1,768,731,699	105,922,848	1,883,479,897	124,210,382

The following table exhibits the total production of petroleum from 1903 to 1912, in barrels and in gallons, also the separate derivatives exported and their value, together with their sum and value:

Quantity of petroleum produced in, and quantities and values of petroleum products exported from, the United States during each of the calendar years from 1903 to 1912, 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.	
			Quantity.	*Value.*	*Quantity.*	*Value.*
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
1907	166,095,335	6,976.004,070	126,306,549	6,333,715	34,625,525	3,676,206
1908	178,527,355	7,498,148,910	149,190,017	6,519,849	43,887,044	4,542,551
1909	183,170,874	7,693,176,708	170,337,773	6,027,588	68,758,675	5,799,994
1910	209,559,248	8,801,404,416	180,111,166	5,404,253	100,695,382	8,407,102
1911	220,449,391	9,258,874,422	201,843,355	6,165,403	137,294,606	11,482,761
1912	222,113,218	9,328,755,156	188,711,420	6,770,484	186,000,094	20,459,378

Year.	Exports.				Exports.			
	Mineral, refined or manufactured.				Residuum (tar, pitch, and all other, from which the light bodies have been distilled).		Total exports.	
	Illuminating.		Lubricating (heavy paraffin, etc.).					
	Quantity.	*Value.*	*Quantity.*	*Value.*	*Quantity.*	*Value.*	*Quantity.*	*Value.*
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
1907	905,924,296	59,635,208	152,028,855	19,210,353	75,774,754	2,527,582	1,294,659,979	91,383,064
1908	1,129,004,833	75,988,256	147,769,024	18,971,436	77,551,683	2,793,363	1,547,402,601	108,815,455
1909	1,046,401,072	67,814,406	161,639,609	20,016,107	121,966,249	4,180,495	1,569,103,378	103,838,590
1910	940,247,039	55,642,368	163,832,544	20,921,103	117,605,802	3,732,196	1,502,491,933	94,107,022
1911	1,112,295,006	61,055,095	183,319,645	23,337,126	133,979,087	3,882,463	1,768,731,699	105,922,848
1912	1,026,138,239	62,084,022	216,393,206	28,297,467	266,236,938	6,599,031	1,883,479,897	124,210,382

Exports of domestic petroleum from Pacific ports during the calendar years 1910, 1911, and 1912, were as follows:

Exports of petroleum from Pacific ports in 1910, 1911, and 1912, in gallons.

Customs district.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
From—						
Alaska			660	$66		
Los Angeles	7,833,000	$141,260	4,284,000	86,850	8,337,000	$172,600
Puget Sound	6,113,526	147,652	15,280,832	374,318	41,380,250	1,043,653
San Diego	333,609	7,335	590,372	11,451	456,724	8,424
San Francisco	127,470,032	2,310,516	121,073,965	2,110,692	50,987,495	996,789
Total	141,750,167	2,606,763	141,229,829	2,583,377	101,161,469	2,221,466
To—						
Alaska	18,835,670	477,673	18,142,364	406,400	3,324,062	64,866
Canada	5,841,856	140,679	15,411,205	373,114	40,873,128	1,030,508
Chile	20,630,499	295,072	19,454,000	292,200	6,048,110	86,405
Guatemala	4,872,000	69,600	1,092,000	15,600	1,890,000	27,000
Hawaii	54,117,100	1,061,060	46,791,550	917,763	38,524,000	861,080
Mexico	333,609	7,335	590,592	11,467	456,724	8,424
Panama	32,592,000	465,600	36,734,880	524,784	10,038,000	142,800
Peru	4,524,133	89,645	3,000,329	41,367		
Salvador	1,100	33	4,655	240	1,756	49
Other	2,200	66	8,254	442	5,689	334
Total	141,750,167	2,606,763	141,229,829	2,583,377	101,161,469	2,221,466

FOREIGN MARKETS.

In the following table is given a statement showing the foreign markets for oil in the four fiscal years ending June 30, 1912:

Exports of petroleum in its various forms from the United States for the fiscal years 1909 to 1912, by countries and kinds, in gallons.

Country and kind.	Year ending June 30—			
	1909	1910	1911	1912
CRUDE.				
Europe:				
Belgium	201,107	104		2,250
France	33,168,985	13,087,508	21,843,880	36,993,950
Germany			17,500	11,536
Spain	10,038,730	9,691,256	11,616,697	9,431,580
United Kingdom	24,590,204		220	4,068,291
Other Europe	511			1,000,000
	67,999,537	22,778,868	33,478,297	51,507,607
North America:				
Mexico	27,554,581	41,202,786	24,398,337	22,752,588
Cuba	5,493,314	4,713,586	5,228,400	4,593,286
Dominion of Canada	35,366,004	39,222,019	52,260,863	76,324,771
Panama	13,250,620	26,597,900	38,958,000	28,084,880
Other North America	1,899,204	4,004,453	3,052,586	1,946,128
	83,563,723	115,740,744	123,898,186	133,701,653
South America	10,182,832	30,353,669	27,794,095	22,839,341
Japan	8,102,423			
All other countries	6,794	30,704	20,183	61,764
Total crude	169,855,309	168,903,985	185,190,761	208,110,365

Exports of petroleum in its various forms from the United States for the fiscal years 1909 to 1912, by countries and kinds, in gallons—Continued.

Country and kind.	Year ending June 30—			
	1909	1910	1911	1912
REFINED.				
Naphtha.				
Europe:				
France	23,553,067	6,583,437	8,570,396	25,626,916
Germany	750,000	11,394,253	7,668,059	15,317,517
Sweden	378,558	522,680	702,010	1,283,881
United Kingdom	16,148,285	16,924,159	28,332,440	26,820,738
Other Europe	4,623,663	12,419,372	20,487,537	30,877,612
	45,453,573	47,843,901	65,760,442	99,926,664
North America	8,704,588	17,320,657	24,173,133	35,213,601
West Indies	310,241	320,160	539,065	856,510
South America	3,690,656	5,785,161	11,047,387	18,933,132
Asia and Oceania	4,602,975	5,210,862	8,339,291	13,707,125
Africa	1,069,234	1,170,182	2,138,942	2,403,118
	18,377,694	29,807,022	46,237,818	71,113,486
Total naphtha	63,831,267	77,650,923	111,998,260	171,040,150
Illuminating.				
Europe:				
Belgium	54,429,995	41,287,412	51,194,876	47,032,277
Denmark	20,985,608	20,238,497	23,494,756	29,966,403
France	64,534,115	46,924,343	45,322,937	37,702,251
Germany	131,299,633	151,890,625	106,405,766	92,289,677
Italy	23,355,053	26,057,918	23,915,541	30,469,655
Netherlands	134,656,827	121,808,987	102,904,032	112,747,606
Sweden and Norway	43,186,026	37,187,417	43,055,097	39,681,488
United Kingdom	223,313,293	194,226,610	164,599,861	166,215,650
Portugal	5,999,563	5,751,226	3,958,728	6,710,191
Other Europe	3,182,583	4,191,054	3,952,915	7,180,070
	704,942,696	649,564,089	568,804,509	569,995,268
North America:				
British North America	13,824,783	10,201,902	11,257,460	15,605,516
Central America	2,317,303	2,590,238	3,413,245	2,494,184
Mexico	511,276	740,615	200,252	165,396
West Indies—				
British	2,859,903	3,002,377	3,164,058	3,538,767
Other	2,143,867	3,447,741	4,031,921	2,960,860
Other North America	683,574	669,073	836,597	911,203
	22,340,706	20,651,946	22,903,533	25,675,926
South America:				
Argentina	16,384,837	18,490,512	15,723,182	28,449,374
Brazil	27,999,696	29,874,870	30,846,695	37,491,101
Chile	8,264,431	8,059,982	7,123,137	7,361,898
Uruguay	5,154,920	7,009,158	6,140,675	6,675,489
Venezuela	1,372,075	1,444,847	1,449,897	1,511,255
Other South America	3,503,333	3,546,848	3,270,171	2,961,441
	62,679,292	68,426,217	64,553,757	84,450,558
Asia:				
Chinese Empire	87,006,468	65,817,980	107,167,449	68,164,997
Hongkong	10,370,460	12,692,037	12,074,776	14,794,710
East Indies—				
British	42,949,022	37,545,823	51,735,360	57,390,564
Dutch	16,140,190	12,572,121	19,235,260	14,370,190
Other East Indies	8,757,552	4,707,640	6,185,050	7,246,805
Japan	67,707,658	58,067,925	57,750,354	109,215,587
Other Asia	5,610,450	11,596,113	19,887,195	15,101,190
	238,541,800	202,999,639	274,035,444	286,284,043

Exports of petroleum in its various forms from the United States for the fiscal years 1909 to 1912, by countries and kinds, in gallons—Continued.

Country and kind.	Year ending June 30—			
	1909	1910	1911	1912
REFINED—continued.				
Illuminating—Continued.				
Oceania:				
British	26,776,574	26,452,025	29,478,944	32,077,747
Philippine Islands	8,997,610	6,265,167	9,887,437	14,054,707
Other Oceania	930	10,880	17,084	18,417
	35,775,114	32,728,072	39,383,465	46,150,871
British Africa	8,484,285	18,135,570	16,604,729	14,961,057
Other Africa	7,778,563	12,522,003	36,025,605	16,532,125
	16,262,848	30,657,573	52,630,334	31,493,182
Total illuminating	1,080,542,456	1,005,027,536	1,022,311,042	1,044,049,848
Lubricating.				
Europe:				
Belgium	9,853,648	10,671,107	10,229,815	11,806,155
France	18,581,934	20,653,620	19,449,734	25,575,537
Germany	19,708,146	20,533,022	20,450,031	24,308,176
Italy	7,656,884	7,606,839	8,323,598	9,283,969
Netherlands	8,372,364	9,571,203	10,488,285	11,396,618
United Kingdom	42,000,598	54,748,608	53,573,129	62,886,561
Other Europe	6,868,299	7,986,759	9,026,568	11,189,030
	113,041,873	131,771,158	131,541,160	156,446,046
North America	4,537,812	6,095,575	7,064,255	7,587,478
West Indies	1,278,500	1,380,979	1,505,270	1,717,456
South America	6,742,209	7,494,903	7,843,115	10,162,069
Asia and Oceania	15,583,310	17,047,643	18,752,639	20,859,871
Africa	3,070,567	6,640,019	6,936,056	5,352,277
	31,212,398	38,659,119	42,101,335	45,679,151
Total lubricating	144,254,271	170,430,277	173,642,495	202,125,197
Residuum (barrels).				
Europe	92,070,389	112,792,362	102,430,883	111,321,764
North America	10,962,529	10,742,492	15,708,381	30,443,892
All other countries	155,115	520,409	5,258,924	26,573,822
Total residuum	103,188,033	124,055,263	123,398,188	168,339,478

PRICES.

Accompanying the increase in price of crude oils, there was an almost continuous rise in price of refined oil during the year 1912. Between January and May there was a gain of 25 per cent in the wholesale price at tide water, from 4 to 5 cents a gallon for bulk oil; then came a slight decline to 4.65 cents in October, and then a rise to 4.85 cents by the end of the year. Oil in barrels rose from 7.5 cents a gallon in January to 8.6 cents in May and closed at 8.5 cents at the end of the year. Oil in cases varied from 9 cents to 10.55 cents during the year. These quotations are for oil with a flash of 70° C., by the Abel closed cup.

Weekly prices of refined petroleum in the United States in 1912, at New York, in cents per gallon.

Week ending—	Refined oil.			Week ending—	Refined oil.		
	Bulk.	Cases.	Barrels.		Bulk.	Cases.	Barrels.
Jan. 6	4.00	9.00	7.50	July 6	5.00	10.50	8.60
13	4.10	9.10	7.60	13	5.00	10.50	8.60
20	4.10	9.10	7.60	20	5.00	10.50	8.60
27	4.35	9.35	7.85	27	4.85	10.35	8.45
Feb. 3	4.60	9.90	8.10	Aug. 3	4.75	10.25	8.35
10	4.60	9.90	8.10	10	4.75	10.25	8.35
17	4.60	9.90	8.10	17	4.75	10.25	8.35
24	4.60	9.90	8.10	24	4.75	10.25	8.35
Mar. 2	4.60	9.90	8.10	31	4.75	10.25	8.35
9	4.60	10.10	8.20	Sept. 7	4.75	10.25	8.35
16	4.60	10.10	8.20	14	4.75	10.25	8.35
23	4.60	10.10	8.20	21	4.75	10.25	8.35
30	4.60	10.10	8.20	28	4.75	10.25	8.35
Apr. 6	4.60	10.10	8.20	Oct. 5	4.75	10.25	8.35
13	4.60	10.10	8.20	12	4.75	10.25	8.35
20	4.85	10.35	8.45	19	4.65	10.25	8.35
27	4.85	10.35	8.45	26	4.65	10.25	8.35
May 4	5.00	10.50	8.60	Nov. 2	4.65	10.25	8.35
11	5.00	10.50	8.60	9	4.65	10.25	8.35
18	5.00	10.50	8.60	16	4.65	10.25	8.35
25	5.00	10.50	8.60	23	4.80	10.40	8.50
June 1	5.00	10.50	8.60	30	4.80	10.40	8.50
8	5.00	10.50	8.60	Dec. 7	4.80	10.40	8.50
15	5.00	10.50	8.60	14	4.80	10.40	8.50
22	5.00	10.50	8.60	21	4.80	10.55	8.50
29	5.00	10.50	8.60	28	4.80	10.55	8.50

Wholesale prices of refined petroleum at New York at the first of each month, 1908–1912.

Month.	1908			1909			1910			1911			1912		
	Date.	Cents per gallon.		Date.	Cents per gallon.		Date.	Cents per gallon.		Date.	Cents per gallon.		Date.	Cents per gallon.	
		In barrels.	In cases.		In barrels.	In cases.		In barrels.	In cases.		In barrels.	In cases.		In barrels.	In cases.
January	4	8.75	10.90	2	8.50	10.90	1	8.05	10.45	7	7.40	8.90	6	7.50	9.00
February	1	8.75	10.90	6	8.50	10.90	5	7.90	10.30	4	7.40	8.90	3	8.10	9.90
March	7	8.75	10.90	6	8.50	10.90	5	7.90	10.30	4	7.40	8.90	2	8.10	9.90
April	4	8.75	10.90	3	8.50	10.90	2	7.90	10.30	1	7.40	8.90	6	8.20	10.10
May	2	8.75	10.90	1	8.50	10.90	7	7.75	10.15	6	7.25	8.75	4	8.60	10.50
June	6	8.75	10.90	5	8.50	10.90	4	7.75	10.15	3	7.25	8.75	1	8.60	10.50
July	4	8.75	10.90	3	8.40	10.80	2	7.65	10.05	1	7.25	8.75	6	8.60	10.50
August	1	8.75	10.90	7	8.25	10.65	6	7.65	10.05	5	7.25	8.75	3	8.35	10.25
September	5	8.75	10.90	4	8.25	10.65	3	7.50	9.90	2	7.25	8.75	7	8.35	10.25
October	3	8.50	10.90	2	8.25	10.65	1	7.50	9.90	7	7.35	8.85	5	8.35	10.25
November	7	8.50	10.90	6	8.15	10.55	5	7.40	8.90	4	7.35	8.85	2	8.35	10.25
December	5	8.50	10.90	4	8.05	10.45	3	7.40	8.90	2	7.35	8.85	7	8.50	10.40

Monthly average prices, in cents per gallon, of petroleum exported from the United States in bulk, 1909–1912.

Month.	1909		1910		1911		1912	
	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.
January	3.4	6.5	2.9	6.5	3.1	5.3	3.3	5.6
February	4.6	6.7	2.7	6.0	3.5	5.3	2.5	5.6
March	3.9	6.5	2.7	5.9	2.4	5.6	3.2	5.9
April	3.7	6.8	3.4	6.1	2.8	5.5	3.7	5.9
May	4.9	7.1	3.0	6.1	2.8	5.6	4.0	6.4
June	3.4	6.3	3.6	6.0	3.1	5.4	3.6	6.4
July	2.6	6.5	2.5	6.3	2.8	5.4	3.3	6.2
August	3.9	6.1	2.3	6.1	3.2	5.6	3.4	6.2
September	3.5	6.4	3.4	5.9	2.4	5.4	3.9	6.3
October	2.9	6.2	3.0	5.7	3.6	5.5	3.7	5.9
November	2.9	6.3	3.2	5.0	3.9	5.7	4.1	5.8
December	3.1	6.5	2.9	5.5	3.2	5.4	4.0	6.0

FOREIGN OIL FIELDS.

CANADA.

PRODUCTION.

Production has been declining since 1907. During 1912 the rate of decline, as shown by the Geological Survey of Canada, was greater than in the previous year.

Persistent effort is being made to develop petroleum, natural gas, and oil shales in the neighborhood of the old Albert mines in New Brunswick. Natural gas has already arrived at the commercial stage.

In the following table is given the total production of petroleum in Canada from 1903 to 1912, inclusive, as reported by the Geological Survey of Canada:

Production of petroleum in Canada, 1903–1912.

Year.	Quantity.	Value.	Average price per barrel.
	Barrels.[a]		
1903	486,637	$1,048,974	$2.155
1904	552,575	984,310	1.780
1905	634,095	856,028	1.350
1906	569,753	761,760	1.337
1907	788,872	1,057,088	1.340
1908	527,987	747,102	1.415
1909	420,755	559,604	1.330
1910	315,895	388,550	1.230
1911	291,096	357,073	1.227
1912	243,614	345,930	1.420

[a] Barrels of 25 imperial gallons.

Production of petroleum in Ontario and New Brunswick, 1909–1912, by districts, in barrels.

District.	1909	1910	1911	1912
Bothwell	38,092	36,998	35,244	34,486
Dutton	9,513	7,752	6,732	4,335
Lambton	243,123	205,456	184,450	150,272
Leamington	5,929	141	13,501 (Leamington and Onondaga)	7,115 (Leamington and Onondaga)
Onondaga (Brant County)	....	1,005		
Tilbury and Romney	124,003	63,058	48,708	44,727
Total Ontario	420,660	314,410	288,635	240,935
New Brunswick	95	1,485	2,461	2,679
Total Canada	420,755	315,895	291,096	243,614

Production of petroleum in Ontario, Canada, 1903–1912, by districts, in barrels of 35 imperial gallons.

District.	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
Bothwell	48,880	47,654	47,959	43,836	40,556	39,820	38,707	36,615	35,094	33,257
Coatsworth (Romney)	......	......	......	......	49,784	11,165	1,082	......	......	......
Dutton	21,483	14,217	20,976	18,597	14,698	12,268	10,052	7,860	3,598	2,455
Leamington	1,190	25,241	113,806	35,958 (Leamington, Blytheswood, Comber, Staples)	16,210	18,117	9,367	248	......	......
Blytheswood	......	669	......							
Comber	......	97	......							
Staples	......	......	......							
East Tilbury	......	......	......							
Raleigh, including Pardos Siding and Sandison	1,161	3,274	......	115,400 (East Tilbury and Raleigh)	344,358	170,589	115,862	60,416	49,027	43,376
Moore Township	......	36,971	93,815	53,030	32,720	25,667	18,033	14,614	......	......
Onondaga	......	......	......	......	......	......	......	1,070	12,602	......
Oil Springs	56,405	75,530	78,125	68,100	55,813	61,252	60,868	55,508	56,248	41,532
Pelee Island	......	1,023	......	......	......	......	......	......	......	......
Richardson Station (Chatham), including Blakely	......	......	1,249	1,376	940	2,883	2,923	1,689	1,776	711
Thamesville	......	5,027	2,463	1,585	1,139	853	710	141	......	......
Wheatley	1,995	4,490	1,750	......	......	......	......	......	......	......
Petrolia and all other districts	350,390	278,299	250,701	247,446	206,285	171,019	156,581	129,372	126,089	95,968
Total	481,504	492,492	610,844	585,328	762,503	513,633	414,185	307,533	284,434	217,299

PRICES.

The average monthly prices per barrel from 1908 to 1912, inclusive, are given in the following table:

Average monthly prices per barrel for crude oil at Petrolia, 1908–1912.

Month.	1908	1909	1910	1911	1912	Month.	1908	1909	1910	1911	1912
January	$1.34	$1.44	$1.24	$1.22	$1.26	August	$1.44	$1.26	$1.22	$1.22	$1.44
February	1.34	1.44	1.24	1.22	1.35	September	1.44	1.26	1.22	1.24	1.44
March	1.34	1.44	1.24	1.22	1.38	October	1.44	1.25	1.22	1.24	1.44
April	1.44	1.44	1.24	1.22	1.38	November	1.44	1.24	1.22	1.24	1.48
May	1.44	1.36	1.24	1.22	1.40	December	1.44	1.24	1.22	1.24	1.59
June	1.44	1.33	1.23	1.22	1.42						
July	1.44	1.27	1.22	1.22	1.42	The year	1.41½	1.33	1.23	1.22⅔	1.42

MEXICO.

PRODUCTION.

The production from the Ebano, the Juan Casiano, and the Potrero del Llano fields was slightly augmented by the development of the Panuco and the Topila fields. Altogether the output increased from

14,051,643 barrels in 1911 to 16,558,215 in 1912. The quantity given for 1911 is slightly greater than that reported by other statisticians, the difference being due chiefly to what is considered as marketed oil and what merely as unmarketed storage. Eventually this difference disappears. Fifty cents a barrel (United States currency) may be taken as a fair valuation of the oil at point of sale.

The best available estimate of the production of petroleum in Mexico from 1907 to 1912 is as follows:

Production of petroleum in Mexico, 1907–1912.

1907	barrels	1,000,000
1908	do	3,481,410
1909	do	2,488,742
1910	do	3,332,807
1911	do	14,051,643
1912	do	16,558,215

IMPORTS.

The following table shows the quantity of crude petroleum, naphtha, and illuminating oil imported from the United States into Mexico in 1910, 1911, and 1912:

Imports of petroleum and specified products into Mexico from the United States, years ending June 30, 1910, 1911, and 1912.

Kind of oil.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
Crude	41,202,786	$1,428,632	24,398,337	$814,298	22,752,588	$884,320
Naphtha	61,550	8,246	363,101	41,890	314,667	37,373
Illuminating	740,615	76,952	200,252	26,734	165,396	20,607
Lubricating	1,376,321	263,599	1,308,964	253,608	1,060,745	194,270
Residuum	155,072	8,461	1,023,559	27,555	118,758	6,984
Total	43,536,344	1,785,890	27,294,213	1,164,085	24,412,154	1,143,554

Quantity and value of mineral oils imported into Mexico from the United States 1903–1912.

Year ending June 30—	Mineral.					
	Crude.		Refined, including residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
1903	9,859,154	$559,332	1,153,015	$218,272	11,012,169	$777,604
1904	10,938,448	663,575	1,179,894	222,005	12,118,342	885,580
1905	14,036,517	786,613	1,216,421	224,061	15,252,938	1,010,674
1906	14,366,495	766,353	3,295,325	616,479	17,661,820	1,382,832
1907	19,992,434	1,037,226	3,906,472	511,990	23,898,906	1,549,216
1908	17,523,440	901,115	1,839,803	320,235	19,363,243	1,221,350
1909	27,554,581	1,184,398	1,979,093	306,579	29,533,674	1,490,977
1910	41,202,786	1,428,632	2,333,558	357,258	43,536,344	1,785,890
1911	24,398,337	814,298	2,895,876	349,787	27,294,213	1,164,085
1912	22,752,588	884,320	1,659,566	259,234	24,412,154	1,143,554

PRODUCTION OF PETROLEUM IN MEXICO IN 1912.

By E. De Golyer.

DEVELOPMENT AND PRODUCTION.

The increase in the production of crude petroleum in the Republic of Mexico during the year 1912 over the production during the preceding year was the result of increased facilities for the transportation of oil. As during the preceding year, the discovered fields were capable of a production greatly exceeding the capacity of the transportation systems.

Several important wells were "brought in" during the year, proving the extensions of fields already discovered and at Chila-Salinas proving a new field. No appreciable amount of this new production reached the market, however, and at the close of the year the amount of oil being produced in Mexico was still controlled by transportation facilities or rather curtailed by a lack of them. As during the preceding year, 95 per cent of the Mexican output was both produced and marketed by two sets of interests: (1) The Pearson interests, controlling the Compañía Mexicana de Petróleo "El Águila," S. A., a producing, refining, and selling company; the Mexican Eagle Transportation Co., with its fleet of oil tankers (built or building) of 200,000 tons cargo capacity; and the Anglo-Mexican Petroleum Products Co., an export sales company; and (2) the Doheney interests, controlling the Mexican Petroleum Co. of Delaware (Ltd.), owner of the Mexican, Huasteca, Tuxpam, and Tamiahua Petroleum Cos., producers and marketers, and the Petroleum Transport Co. of Maine, with a fleet of oil tankers of 37,000 tons capacity under construction. The Pearson group covers every phase of the industry from exploration and exploitation of oil through transportation and refining to sale of refined products to the ultimate consumer. The Doheney group covers all phases of the industry except refining and sale to the ultimate consumer. Some refining is carried on by this group, but only to separate the lighter oil and manufacture asphalt.

Most of the oil produced by the Pearson group is pumped through an 8-inch line from Potrero del Llano to Tuxpam Bar, a distance of 33 miles, and most of the export shipments are made from this port. Regular shipments are also made to distributing depots at Vera Cruz and Coatzacoalcos, from which points railroads are supplied with fuel and shipments of fuel oil are made to the interior. Shipments are made to the refinery at Minatitlan from Coatzacoalcos.

The development of the loading arrangement at Tuxpam has been very successful and has been watched closely by persons interested in the transportation of oil. The ships lie in the open roadstead at a distance of 1 to 2 kilometers from the shore. The oil is pumped through submarine lines and received into the ships through flexible hose which is attached to the end of the lines. Ships of any draft can load in this manner. A great many difficulties were encountered in laying the first submarine lines, but a scheme was developed whereby the lines were laid on the shore and pulled into position in the sea by powerful tugs. By the end of 1912 this station was loading more oil than was being loaded in the port of Tampico for marine shipment.

The oil produced at Furbero by the Oil Fields of Mexico (Ltd.), an affiliated company, is also received at the Tuxpam Bar station by the "Águila" Co. It is pumped through a 6-inch line from Furbero, a distance of 90 kilometers. Oil is also handled by a 6-inch pipe line from Potrero del Llano, Tierra Amarilla, and Tanhuijo to Tancochin on the Tamiahua lagoon, from which point it is barged across the lagoon to Bustos and from there pumped to Tampico. An 8-inch line from Tanhuijo to Tampico is under construction and a large refinery is being built at the latter point by the same interests.

The Pearson interests are the sole producers of oil in the Isthmus of Tehuantepec. The oil is sent by pipe line and water transportation to the Minatitlan refinery.

Oil is produced by the Doheney interests at the Juan Casiano field of the Huasteca Petroleum Co. and at the Ebano-Chijol field of the Mexican Petroleum Co. Casiano oil is pumped to Tampico through a double 8-inch line. At that port foreign shipments of oil are made and deliveries to the refinery of the Waters-Pierce Oil Co. and to the railways are also made. Domestic shipments of crude oil are made from the same port. Some of the oil produced at the Ebano-Chijol field is partly distilled, asphalt being manufactured and the tops sold to the Waters-Pierce refinery. The remainder of the Ebano oil is delivered to the railways for use as fuel.

Aside from the fields controlled by these two interests, there are three commercially important fields in Mexico which have been developed to the present time, the Topila, the Panuco, and the Chila-Salinas fields.

The condition of the Topila field is not very promising at present. During the latter part of 1912 it suffered from an invasion of salt water, and as the year closed the field was not capable of a production of more than 500 barrels a day. The producing companies in the Topila field are the East Coast Oil Co. (Southern Pacific), Mexican Fuel Co. (Waters-Pierce), Topila Petroleum Co. (Spellacy), and J. R. Sharp (Producers Oil Co.). Approximately 1,500,000 barrels of oil have been produced in this field, most of it being purchased by the Tampico Co. (Texas Co.). The oil is barged to Tampico via Panuco River. Part of the oil produced has been purchased by the Waters-Pierce Oil Co. An 8-inch pipe line is being built by the East Coast Co. from Tampico to Panuco via Topila. With the exception of a small amount of oil locally used, the Topila oil has been exported.

The first important well in the Chila-Salinas field was "brought in" during the early part of the year by the Tampico Oil (Ltd.), and more successful wells have been drilled and an 8-inch line laid to Panuco River, although no deliveries had been made up to the end of the year. This field is controlled in part by the Mexican Fuel Oil Co. (Producers Oil Co.), but mostly by the Tampico Oil (Ltd.).

More developemnt is taking place at Panuco than in any other Mexican field, though only small deliveries have thus far been made. The oil which has reached the market is from the wells owned by the Vera Cruz-Mexican Oil Syndicate (Ltd.) (Hammond-Mestres). It is transported by barges on Panuco River to Tampico. The producing companies at Panuco are the East Coast, the Vera Cruz-Mexican, the Freeport-Mexican, the National, and the Tampico-Panuco Oil Fields. The East Coast 8-inch line, above referred to, should be completed and afford an outlet for the oil from this field during 1913.

Of the crude oil produced during 1912, 6,675,768 barrels were exported, all of it going to the United States, with the exception of 50,000 barrels to Porto Rico. Exportations of refined products were made from the Águila Refinery at Minatitlan throughout the year. The bulk of foreign shipments has been made in tank steamers flying a foreign flag, only the *San Antonio*, *San Bernardo*, *San Cristobal* of the Mexican Eagle line and the barge *Spindle-Top* of the Mexican Fuel Co. (Waters-Pierce) being under the Mexican colors. The shipments for the most part have been in vessels owned or chartered to such foreign interests as were receiving oil, though this will change during the coming year, with the completion and delivery of their fleets to the Mexican Eagle and the Petroleum Transport Cos.

FIELD EXPLORATION.

Exploratory drilling has been carried on in the Tampico region at various points within an area extending from a point 95 miles north of Tampico to a point 105 miles south of the same port and in its widest part from the coast to a point 65 miles west of Tampico. During the year exploratory drilling in the unproved territory was carried on as follows:

The Texas-Mexican Asphalt & Petroleum Co. continued drilling at Chapopote on the Hacienda San José de las Rusias, about 65 miles north of Tampico.

The American International Fuel & Petroleum Co. finished its seventh well on the Los Esteros lease, and drilling was suspended on account of unfavorable results.

The Mexican Petroleum Co. drilled a well near Auza on the Tampico-San Luis branch of the National Railways. The results were unfavorable.

Sawyer & Sill commenced a well just east of the Chila station on the same line. This well was drilling at the end of the year.

The Dos Banderas Oil Co. continued drilling on the west shore of the Pueblo Viejo Lagoon, near Tampico.

The Mexican Associated Oil Co. continued drilling at El Barco, near Panuco River.

The Mexican Fuel Oil Co. (Producers Oil Co.) drilled several wells at Caracol, one in the Chila-Salinas field being successful.

The Scottish-Mexican Oil Co. completed wells at Topila, Mirador, and Ganahl on Panuco River; all failures.

The Tampico Petroleum Co. drilled several unsuccessful wells at Limon, near the Ebano field.

The Gulf Coast Corporation continued drilling at Tampalache, near Panuco, but was unsuccessful.

The Compañía Mexicana de Petróleo "El Águila," S. A., commenced several new wells in the San Pedro field.

The Compañía Mexicana Perforadora drilled wells at El Hijo and La Mora on Tempoal River, but was unsuccessful.

The Compañía Mexicana de Petróleo "El Águila," S. A., drilled two wells near Tempoal, but was unsuccessful.

The Huasteca Petroleum Co. drilled two wells at San Miguel near San Geronimo, but was unsuccessful.

The Zaleta Mar and the Mexican Eastern Cos. began wells near Juan Casiano.

The Electra Petroleum Syndicate drilled an unsuccessful well near Rancho Abajo.

The Vera Cruz-Mexican Oil Syndicate drilled wells at Tinaja and San Marcos, but was unsuccessful.

The Compañía Mexicana de Petróleo "El Águila," S. A., continued drilling at San Marcos, Tierra Amarillo, and Alazan, and brought in small wells at San Marcos, Tanhuijo, and Tierra Amarillo, and a 15,000-barrel well at Alazan. The last well proved the extension of the Potrero field a mile to the north. Operations were commenced by the same company at Tlacolula and Tierra Blanca, but no wells had been finished at the end of the year.

The Huasteca Petroleum Co. continued operations at Cerro Azul.

The Standard Oil Co. of Mexico completed a well at El Gallo. Results unfavorable.

Operations continued on a small scale at Furbero by the Oil Fields of Mexico Co., but only partly favorable results were obtained. At the end of the year preparations were being made to resume operations on a large scale.

Although the production of the fields of the Tampico region has been great enough to cause Mexico to be third in importance among nations in the production of crude petroleum, a very small number of wells had been drilled up to December 31, 1912, when 252 wells had been drilled in the region since the beginning of the industry. Of these wells, 64 were actually producing, and 90 per cent of the production of the year had come from less than 5 of these producing wells. On the same date 42 wells were drilling, 12 rigs were building, and 16 locations had been laid out.

The most promising feature of the year in the Tampico region was the new capital which entered the field. A great amount of land was leased, and preparations for drilling were made by several new companies.

At the end of the year there were approximately 89 companies organized for operation in the Mexican fields. Fifty-five of these companies are American, 21 Mexican, and 13 British. The various companies represent an approximate investment of $175,000,000 (United States currency), distributed by nationalities with regard to capital investment as follows: American, $97,500,000; British, $75,000,000; and Mexican, $2,500,000.

The greater part of this capital is invested in leaseholds of oil property.

Geologically, the oil of the Tampico region occurs in the Oligocene, Eocene, and Cretaceous formations, the oil-bearing rock being for the most part a porous limestone.

On the Isthmus of Tehuantepec, the Águila Co. continued operations at Ixhuatlan, Tecuanapa, and Soledad, fields being developed at each of these places. The old San Cristobal field continued producing. Exploration was carried on by the same company at La Reforma, in the State of Chiapas. No further work was done by the Anglo-Mexican Oil Fields (Ltd.), at its camp near Pichucalco, Chiapas.

Geologically, the oil-bearing rocks of the Isthmus region are of Pliocene and Pleistocene age. The formation in which the oil occurs is usually a true quartz sand.

Exploratory operations were also carried on in the northern part of the State of Sonora and near the city of Vera Cruz, but no favorable results were obtained.

On July 1, the Government put into operation a tax of 20 cents (Mexican currency) per ton on all petroleum produced in the Republic.

As there is a very high import duty on crude petroleum, the Government occupies the unique position of both protecting and taxing heavily its youngest important industry.

TRINIDAD.

In addition to descriptions of the oil fields of Trinidad given in the reports of this series for 1910 and 1911, it may be noted that there are now 90 wells, 46 of which were drilled in the fiscal year 1911–12. In that period 250,000 barrels were exported.

Recent information furnished by the courtesy of Mr. A. Beeby Thompson states that developments on a large scale have been undertaken by only two companies, the Trinidad Oilfields (Ltd.) and the New Trinidad Lake Asphalt Co. Both companies have operated in the southern part of the island where several anticlinal folds follow a general east-west direction. Many wells sunk to depths of 900 to 1,500 feet have given initial flows of several thousand barrels daily, and several wells have yielded in the course of a few months 10,000 to 15,000 tons of oil, one having an estimated yield of 50,000 tons.

In the Oropuche region several wells have struck oil in commercial quantities, and at Icacos and Cedros on the southern anticline some high-grade oil resembling that of Guayaguayare was struck. At Tabaquite regular supplies of a high-grade oil containing 30 per cent of benzine have been obtained from a number of wells averaging 350 feet deep. Gasoline extracted on the spot finds a ready sale in the island and is well spoken of by local motorists.

Operations on an extended scale are projected by the Shell-Burma interests, which are negotiating extensive grants of concessions from the Trinidad Government.

VENEZUELA.

The concession in Venezuela owned by the Bermudez Co., subsidiary of the General Asphalt Co. (American), for petroleum rights on Pedernales Islands in the district Benitez, and on the Peninsula of Paria, dated July 14, 1910, gave a 3-year period to the concessionaire in which to select areas on which to operate, and an additional period of 47 years for operation. Since the acquisition of the concession geologists have carefully examined all of the territory. Twenty-eight areas of about 1,250 acres each have been selected as worthy of development. Surveying, staking, and mapping of the areas is nearly finished, and the necessary documents for completing titles are being filed with the Government at Caracas. Eighteen of the areas are in and near Bermudez Asphalt Lake, four on Pedernales Islands, three at Mari-Mari, and three at Yaguaropara, aggregating 35,000 acres. The terms of this concession provide for the payment of a land tax at the rate of 8 cents per acre per annum and of a royalty at the rate of 5 per cent on all oil produced and shipped. It is also provided that development work shall be begun on each area selected on or before July 14, 1913, for which arrangements have been made by the company.

PERU.

The fields of Peru, which were described in the report for 1911, continue to yield increasing quantities of oil, except the small field near Lake Titicaca. The total output in 1912 was 1,751,143 barrels, an increase from 1,368,274 barrels in 1911.

The production of petroleum in Peru in recent years is shown in the following tables:

Production of petroleum in Peru, 1903–1912, in tons and barrels.

Year.	Production.	
	Metric tons.	Barrels.
1903	37,079	278,092
1904	38,683	290,123
1905	59,720	447,880
1906	71,506	536,294
1907	100,830	756,226
1908	134,824	1,011,180
1909	175,482	1,316,118
1910	177,347	1,330,105
1911	182,436	1,368,274
1912	233,486	1,751,143

One metric ton=7.5 barrels.

Production of petroleum in Peru, 1905–1912, by districts, in barrels.

Year.	Lobitos.	Negritos.	Zorritos.	Lake Titicaca (Huancane).	Total.
1905	[a] 75,000	335,160	37,720	.....	447,880
1906	162,000	330,510	42,419	1,365	536,294
1907	279,000	396,750	65,476	15,000	756,226
1908	319,898	543,750	71,429	[a] 76,103	1,011,180
1909	429,195	740,070	70,750	[a] 76,103	1,316,118
1910	400,080	773,025	107,000	[a] 50,000	1,330,105
1911	391,290	882,698	64,286	[a] 30,000	1,368,274
1912	587,048	1,071,000	78,095	[a] 15,000	1,751,143

[a] Estimated.

In the following table are given, so far as can now be ascertained, the production, shipments, and stocks of petroleum and the number of producing wells in the Lobitos oil field of Peru in the years 1905 to 1912, inclusive:

Production, shipments, and stocks of petroleum and number of producing wells in Lobitos oil field, 1905–1912.

Year.	Production.		Shipments.	Stock Dec. 31.	Producing wells Jan. 1.
	Metric tons.	*Barrels.*	*Metric tons.*	*Metric tons.*	
1905	[a] 10,000	75,000	.....	.....	.....
1906	[a] 21,600	162,000	17,576	.....	.....
1907	[a] 37,200	279,000	25,821	4,816	.....
1908	42,653	319,898	36,131	8,860	26
1909	57,226	429,195	54,289	11,797	62
1910	53,344	400,080	.....	.....	.....
1911	52,172	391,290	.....	.....	92
1912	78,273	587,048	.....	.....	100

[a] Estimated.

The following table gives the production of petroleum in the Negritos oil field of Peru from 1904 to 1912, in tons and barrels:

Production of petroleum in Negritos oil field, Peru, 1904–1912.

Year.	Production.	
	Metric tons.	Barrels.
1904	39,508	296,310
1905	44,688	335,160
1906	44,068	330,510
1907	52,900	396,750
1908	72,500	543,750
1909	98,676	740,070
1910	103,070	773,025
1911	117,693	882,698
1912	142,800	1,071,000

Production of petroleum in Zorritos oil field of Peru, 1903–1912, in gallons.

Year.	Crude petroleum.	Refined.[a]	Gasoline.	Benzine.
1903	2,060,000	276,100	61,745	
1904	2,080,000	365,000	46,200	
1905	1,584,242	300,000	29,570	
1906	1,781,600	350,000	54,000	10,000
1907	2,750,000	420,000	101,000	20,000
1908	3,000,000	500,000	150,000	30,000
1909	2,971,510	469,610	96,520	....
1910	4,494,000	....	....	....
1911	[b] 2,700,000	650,000	....	200,000
1912	3,280,000	476,620	226,440	....

[a] Kerosene. [b] 64,286 barrels.

BOLIVIA.

The Bolivian oil prospects have additional interest on account of the proximity of the Argentine localities. Prof. M. A. Rakusin [1] has examined the three well-known Bolivian deposits, which he regards as secondary, and finds they belong to the so-called "petroliferous formation" (Sistema de Salta) which extends from northern Argentina into the center of Bolivia. They are Cretaceous, with the exception of a locality known as Kachenta Mendoza, which is Upper Triassic. In the Peima region oil is found in two horizons separated by clay slates; anticlinal conditions were evident. The Kuarezuti locality is on a continuation of the same folds, a few miles from Peima. The third locality, Lomas de Ipaguaciu, is in the lowland of Kahko, a few miles east of Sierra de Aquaragui, on the eastern slope of which the other two fields are located. The oil is light brown, and has a specific gravity of 0.898. It contains no light distillates. The percentage of kerosene is 31; the rest is heavy residuals: sulphur is only 0.07 per cent.

ARGENTINA.

The Argentine Government, in drilling for water in 1908 near the town of Comodoro Rivadavia, Chubut Province, about 850 miles southwest of Buenos Aires, obtained a considerable amount of gas at 480 feet, according to J. P. Cappeau.[2] When Mr. Cappeau visited this

[1] Rakusin, M. A., Petroleum in South Bolivia: Petroleum Rev., March 22, 1913.
[2] Oil in Argentine Republic: Fuel Oil Jour., April, 1913.

field in 1910 seven wells had been drilled. The first did not go deep enough for the oil sand. A second one furnished a large gas well at 1,845 feet, and a third found gas at 565 feet—and is on fire. A fourth on the shore of the Gulf of St. George near the town showed oil, but was never tested. Two more wells about 1¼ miles back from the shore had produced more than 30,000 barrels of oil by flowing and pumping. The oil was stored in earthen tanks, but small iron tanks are now being constructed. Since then four additional wells have been completed which showed more or less oil at about 1,840 feet; another well flowed oil at 2,360 feet, but the casing collapsed and shut off the flow, which had been estimated at 6,000 barrels a day. In January, 1913, a well known as No. 4, which had been completed in 1909, was cleaned out and produced as much as 2,100 barrels a day. The Government is drilling a deep test well, hoping to reach 3,500 feet; the present depth of the well is about 2,400 feet; seven oil sands have been passed through. Three other companies are drilling within a radius of 16 miles. Mr. Cappeau estimated the capacity of the wells already completed at 25 to 300 barrels each day, and the field has developed about 4 miles in length by 1½ miles in width. Oil is from 19° to 20° B., and contains asphalt, with about 3 per cent gasoline and 5 per cent kerosene. The climate is similar to that of Pennsylvania. The mineral rights are owned by the Government. Location is made under laws which are somewhat similar to the placer laws of the United States. Showings of paraffin base oil have been found in the extreme north of Argentina near the Bolivian line.

On the eastern flank of the Andes Mountains numerous seepages of oil and sometimes of gas are found at intervals along the entire length of the Argentine frontier, from Tierra del Fuego to the Bolivian border, and for many miles into Bolivia. Drilling operations are reported in Tierra del Fuego. The oil is usually heavy and asphaltic, except in northern Argentina and in Bolivia, where seepages of paraffin oil have been found.

According to an oral communication from C. W. Washburne, of the United States Geological Survey, who has recently returned from geological work in Argentina, the conditions of the occurrence of petroleum in Patagonia may be roughly estimated as follows:

The greater part of Argentina, including Patagonia, is a broad low platform made up of a complex of metamorphosed rocks with intrusions of granite and quartz porphyry, the western border of which is the Andes Mountains. This platform has been covered with land sediments, which are very flat and consist of Cretaceous and older red beds, overlain by tuffaceous sandstones and sandy shales, but with no considerable layers of very dense shales. Near the Patagonian coast there are marine layers of early Tertiary age in the tuffaceous strata. The sediments are thin in most places along the east coast, usually only a few hundred feet thick. More commonly the metamorphic and old igneous rocks reach the surface. Along the eastern flank of the Andes Mountains seepages of oil are abundant, especially in the northern part of the republic. Wells drilled near Comodoro Rivadavia on the coast of Patagonia have developed very thick oil at about 1,800 feet, and a lighter oil, accompanied by enough gas to produce gushers is encountered at greater depth. This oil is in the "Red Beds," a continental Cretaceous formation, which rests on granite and metamorphic rocks.

The following information has been kindly furnished for this report by H. Keidel, chief of the geological department of the Dirección General de Minas, Geología é Hidrología, of Argentina:

There can be distinguished to-day in Argentina four different oil-bearing regions, namely: (1) The eastern border of the Andes in the Provinces of Salta, Jujuy, and Tucuman; (2) the limited deposit of Cacheuta near Mendoza; (3) a long zone of seepages on the eastern border of the Andes in the Province of Mendoza and in the Territory of Neuquen; and (4) the oil field of Comodoro Rivadavia on the Atlantic coast. Almost always the oil or its derivatives, often in the form of asphalt (albertite), occurs in Mesozoic formations. At the few places where one finds it in Tertiary rocks, the deposits are secondary.

The oil has been found in shales of Rhetic age; on the eastern border of the Andes, in the Province of Mendoza and in Neuquen, it occurs in shales and sandstones from the Upper Jurassic to the Lower Cretaceous. In the Provinces of Salta, Jujuy, and Tucuman it occurs in a series of red-colored shales and sandstones, known as "formación petrolífera." We do not know exactly the age of these formations, but very probably they belong to the Lower and Upper Cretaceous. The oil in the wells of Comodoro Rivadavia has been found in rocks of the Lower or Upper Cretaceous, known as "areniscas abigarradas" or "formación de dinosaurios." These deposits are overlain by marine formations of Tertiary age. The underlying formations are not known. Perhaps the metamorphic rocks of pre-Cambrian and Paleozoic age, which compose the greater part of the plain region of Argentina, do not lie very deep. But it is more probable that there exists, between those rocks and the petroliferous strata, marine deposits of the Lower Cretaceous or the Jurassic. Such deposits are found at several places in the interior of Patagonia. On the Atlantic coast it is impossible to make any statement by observation, because the strata, dipping slightly to the southeast, disappear below the sea. At any rate it can be said that there is much resemblance between the succession of the Mesozoic deposits and the mode of occurrence of the oil on the eastern flank of the Andes, in Neuquen, and on the Atlantic coast, in Comodoro Rivadavia.

RUSSIA.

GENERAL CONDITIONS.

The net result of the operations in the various oil fields of Russia was a gain of 2.77 per cent, or an increase from 66,183,691 barrels in 1911 to 68,019,208 barrels in 1912. This result was made possible by the fact that the old wells of the Baku field did not decline in 1912 proportionately to their decline in 1911, owing doubtless to the vigorous cleaning out which they received in 1911 when the heavy decline had become alarming. Further, the inevitable slight decline in Baku was more than offset in Surakhany, which doubled its product. Sviatoi, Tcheleken, Ferghana, and Maikop also showed gratifying increases, whereas Grosny, though only partly developed, declined from 9,026,361 barrels to 7,851,140 barrels. If the extended review of the undeveloped oil resources of Russia given in the preceding report of this series be recalled, it is evident that great possibilities exist to the north and east of present developments, which possibilities are largely dependent on the attitude that the government may consider best suited to the ultimate good of the industry.

It is to be noted from the detailed tables of field work that in the old Baku fields the number of active wells increased not only by completion but by being cleaned and drilled deeper. The total stocks of crude oil and of oil products increased in 1912.

The new oil area in the Baku region known as Surakhany has only been partly developed, and is still a region of much interest on account of the light character of the oil and the variation in quality with the depth. The original hand-dug oil wells obtained near Surakhany Lake are 35 to 70 feet deep. They yield so-called "white oil," which is also obtained from those drilled wells which are only 700 feet, and yield oil by drip traps from natural gas or by baling without gas. The oil is slightly yellow and has a specific gravity of 0.776 to 0.785. The baled oil is somewhat darker than that which condenses from the natural gas. Similar oil is obtained as a condensation product from deeper wells—875 to 1,100 feet—and in some cases is perfectly white and has a gravity of only 0.765. Distillation shows 70 per cent below 150° C., with a specific gravity of 0.76, and 26 per cent of kerosene below 200° C., with specific gravity of 0.800 and flash of 86° F.

The northern areas of the field yield oil with a red color and a specific gravity of 0.795 to 0.800 at 1,281 feet, and at 1,540 feet to 1,610 feet in the southern areas. This oil has 20 per cent more kerosene and correspondingly less gasoline.

Dark-red petroleum is obtained in the northern areas at 1,365 feet and in the south at 1,225 to 1,330 feet. It yields only 10 per cent of gasoline. Still darker oil is obtained at 1,759 feet and at 2,100 feet in the northern area and at 2,200 to 2,500 feet in the central area. It contains 1.5 to 2.25 per cent of paraffin wax, shows no gasoline, and contains sulphur compounds. These deposits are only slightly developed, except the oil at a depth of 1,225 to 1,281 feet in the northern area. Wells frequently yield only gas at first and yield oil subsequently.

The Djengi oil field referred to in the last report received additional development in 1912. According to the Petroleum Review [1] petroleum has been known in this district for a very long time, and was brought to Baku in leather bags on the backs of mules. This district is approximately 30 miles from the town of Baku in the direction of Shemacha. There is a good road between these two points. In 1910 a dispute as to the ownership of this field was settled in favor of the government and its management was given into the hands of the minister of agriculture. Many areas of land have been obtained there since by the prominent Russian producers. Exploitation has been begun by Nobel Bros., and it is claimed that good supplies of oil have been obtained at comparatively shallow depths. This company is about to construct a pipe line to Baku.

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[1] Issue of May 17, 1913.

PRODUCTION.

The usual tables of production, refining, and shipment follow:

Production of petroleum in Russia, 1903–1912, by fields.

Year.	Baku.		Grosny.		Maikop.	
	Poods.[a]	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		
1904	614,115,445	73,723,290	40,095,331	4,813,365		
1905	414,762,000	49,791,356	43,057,052	5,168,914		
1906	447,520,000	53,723,889	38,373,603	4,606,675		
1907	476,002,000	57,143,097	39,214,612	4,707,637		
1908	465,343,000	55,863,504	52,058,895	6,249,567		
1909	492,500,000	59,123,650	57,033,015	6,846,700		
1910	497,842,212	59,764,971	74,048,358	8,889,359	1,304,800	156,640
1911	434,310,329	52,138,095	75,189,591	9,026,361	7,933,936	952,453
1912	429,300,000	51,536,615	65,400,000	7,851,140	9,200,000	1,104,442

Year.	Other.		Total.	
	Poods.	Barrels of 42 gallons.	Poods.	Barrels of 42 gallons.
1903			629,675,155	75,591,256
1904			654,210,776	78,536,655
1905			457,819,052	54,960,270
1906	[b] 4,721,000	566,747	490,614,603	58,897,311
1907			515,216,612	61,850,734
1908	[c] 611,221	73,376	518,013,116	62,186,447
1909			549,533,015	65,970,350
1910	[d] 12,708,290	1,525,604	585,903,660	70,336,574
1911	[e] 33,876,295	4,066,782	551,310,151	66,183,691
1912	[f] 62,700,000	7,527,011	566,600,000	68,019,208

[a] 61.05 poods=1 metric ton crude; 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 kopeck=0.515 cents.

[b] Produced in Bereki and Tchimion oil fields.

[c] Produced in Surakhany.

[d] Includes 10,613,909 poods produced in Surakhany, 1,392,306 poods produced in Sviatoi, 610,500 poods produced in Ferghana, and 91,575 poods produced in Taman.

[e] Includes 19,896,524 poods produced in Surakhany, 2,515,363 poods produced in Sviatoi, 10,205,740 poods produced in Tcheleken, and 610,500 poods produced in Ferghana.

[f] Includes 43,900,000 poods produced in Surakhany, 3,300,000 poods produced in Sviatoi, 13,300,000 poods produced in Tcheleken, and 2,200,000 poods produced in Ferghana.

Baku field.—The total production of crude petroleum on the Apsheron Peninsula or Baku field and the shipments of the chief petroleum products from Baku to all points from 1903 to 1912 are shown in table following.

Total production of crude petroleum on the Apsheron Peninsula and shipments of petroleum products from Baku, 1903–1912, in barrels.

Year.	Production.	Shipments from Baku.					
		Illuminating.	Lubricating.	Other products.	Residuum.	Crude oil.	Total.
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	159,045	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
1907	57,143,097	11,450,019	1,724,664	565,689	27,833,892	4,290,500	45,864,764
1908	55,863,504	10,682,750	1,754,034	105,163	23,989,778	5,398,200	41,929,925
1909	59,123,650	8,261,368	1,728,833	1,087,115	23,404,954	6,182,973	40,665,243
1910	59,764,971	9,978,406	1,892,046	1,381,921	24,414,210	6,207,278	43,873,861
1911	52,138,095	10,406,454	1,999,503	1,388,776	26,091,096	5,713,538	45,599,367
1912	51,536,615	10,639,886	2,372,605	1,875,209	21,961,469	6,054,524	42,903,693

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, 1903–1912, in barrels.

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
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
1907	8,594,118	22,036,734	10,750,901	15,761,344	....	57,143,097
1908	8,363,860	23,727,367	9,392,557	14,379,720	....	55,863,504
1909	8,763,505	24,873,950	10,492,198	14,753,901	[a] 240,096	59,123,650
1910	8,228,392	23,379,366	11,532,820	14,265,551	[b] 2,358,842	59,764,971
1911	7,661,934	21,121,650	9,977,837	12,304,431	[c] 1,072,243	52,138,095
1912	7,839,136	20,480,192	9,459,784	12,533,013	1,224,490	51,536,615

[a] Other. [b] Includes 1,286,599 barrels in other districts. [c] 1910.

Production of petroleum from pumping and flowing wells in the Baku field, 1903–1912, by districts, in barrels.

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
PUMPING.						
1903	10,642,274	27,302,022	12,822,336	14,396,376	31,008	65,194,016
1904	9,848,380	25,384,514	15,043,217	19,061,944	36,495	69,374,550
1905	6,866,747	16,265,306	9,927,971	14,861,945	24,009	47,945,978
1906	8,142,017	18,513,445	10,436,615	15,282,113	35,414	52,409,604
1907	8,594,118	21,676,950	10,353,782	15,137,215	....	55,762,065
1908	8,363,860	23,585,230	9,250,060	13,529,900	....	54,729,050
1909	8,763,505	24,849,940	9,843,938	12,953,181	[a] 192,077	56,602,641
1910	8,228,392	23,267,266	10,456,391	13,612,313	[b] 1,323,713	56,888,075
1911	7,661,934	21,086,257	9,774,918	11,306,740	[c] 1,072,243	50,902,092
1912	7,839,136	20,456,182	9,183,674	11,236,494	60,024	48,775,510
FLOWING.						
1903	....	361,837	1,576,615	4,485,918	....	6,424,370
1904	....	644,778	1,020,288	2,683,674	....	4,348,740
1905	....	229,004	1,302,761	313,613	....	1,845,378
1906	....	225,570	1,053,181	35,534	....	1,314,285
1907	....	359,784	397,119	624,129	....	1,381,032
1908	....	142,137	142,497	849,820	....	1,134,454
1909	....	24,010	648,260	1,800,720	[a] 48,019	2,521,009
1910	....	112,100	1,076,429	653,238	[a] 1,035,129	2,876,896
1911	....	35,393	202,919	997,691	....	1,236,003
1912	....	24,010	276,110	1,296,519	1,164,466	2,761,105

[a] Other. [b] Includes 251,470 barrels in other districts. [c] 1910.

Number and condition of wells in the Baku fields in years ending Dec. 31, 1911 and 1912.

Condition of wells.	Balakhani.		Sabunchi.		Romani.		Bibi-Eibat.		Total.	
	1911	1912	1911	1912	1911	1912	1911	1912	1911	1912
Completed	27	60	62	111	27	39	19	17	135	227
Producing, Dec. 31	778	888	966	1,118	254	282	282	300	2,280	2,588
Trial pumping, Dec. 31	19	9	34	29	5	1	8	13	66	52
Drilling, Dec. 31	24	41	68	72	31	33	34	37	157	183
Drilling deeper, Dec. 31	......	16	....	25	....	12	....	19	....	72
Cleaning out and repairing	10	6	24	26	9	15	9	11	52	58
Standing idle	365	335	666	608	228	220	162	158	1,421	1,321
Rigs up, ready for drilling	16	24	47	60	4	6	13	20	80	52
New wells sunk	45	79	91	119	37	33	13	21	186	110
Length of wells drilled, in feet	65,751	92,743	132,475	172,739	60,039	64,134	54,019	45,255	312,284	374,871

The stocks of petroleum and petroleum products in the Baku field at the close of the year from 1908 to 1912 were as follows:

Stocks of petroleum in Baku, Dec. 31, 1908–1912, in barrels.

	1908	1909	1910	1911	1912
At oil wells: Crude	1,032,413	1,080,432	938,391	906,625	952,676
At refineries:					
Crude	1,239,736	2,495,087	3,073,853	1,887,270	2,551,577
Illuminating	675,375	938,971	947,024	1,028,885	1,268,626
Lubricating	195,600	247,358	272,017	272,170	260,397
Residuals	4,804,333	4,703,372	5,647,526	3,195,771	3,396,775
Other products	119,370	234,048	224,240	306,825	443,643
Total	8,066,827	9,699,268	11,103,051	7,597,546	8,873,694

Grosny field.—The following tables show the production in the Grosny field from 1908 to 1912:

Production of petroleum in the Grosny oil field, 1908–1912, in poods and barrels.

Year.	Pumping.		Flowing.		Total.	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*
1908	37,741,980	4,530,850	14,316,915	1,718,717	52,058,895	6,249,567
1909	50,997,451	6,122,143	6,035,564	724,557	57,033,015	6,846,700
1910	58,097,733	6,974,518	15,950,625	1,914,841	74,048,358	8,889,359
1911	71,481,505	8,581,213	3,708,086	445,148	75,189,591	9,026,361
1912	65,319,687	7,841,499	109,920	13,196	65,429,607	7,854,695

Well record in the Grosny field in 1908–1912.

Year.	Number of plots.		Total wells.	Producing, Dec. 31.	Boring and deepening, Dec. 31.	Average depth of wells.	Total sum of depth of producing wells.	Total length of wells drilled in the year.
	Producing.	Being exploited.						
						Feet.	*Feet.*	*Feet.*
1908	....	....	287	172	51	1,348.2	203,574	....
1909	....	....	320	182	58	1,458.1	250,831	82,537
1910	44	71	343	234	67	1,557	....	87,836
1911	80	195	358	195	61	1,670	....	72,933
1912	....	....	402	....	71	1,752	....	18,986

Crude petroleum on hand in Grosny field Jan. 1, 1910, 285,829 barrels; Dec. 31, 1910, 787,949 barrels; Dec. 31, 1911, 141,649 barrels; Dec. 31, 1912, 245,583 barrels.

Novorossisk.—The following tables show the shipments of petroleum and its products from Novorossisk from 1907 to 1912, and stocks on December 31, 1911 and 1912:

Shipments of petroleum from Novorossisk, 1907–1912, in metric tons.

Year.	Crude oil.	Illuminating.[a]	Benzine.	Residuals.	Total.
1907	....	34,414	31,543	24,922	90,879
1908	....	15,824	38,690	18,112	72,626
1909	....	23,248	54,800	49,920	127,968
1910	6,025	32,187	63,232	67,973	169,417
1911	18,690	62,044	65,520	76,092	222,346
1912	....	90,444	123,098	24,817	238,359

[a] Refined.

Stocks of petroleum at Novorossisk, Dec. 31, 1911 and 1912.

	1911		1912	
	Poods.	Barrels.	Poods.	Barrels.
Crude	179,800	21,585	72,000	8,643
Illuminating oils	317,600	39,700	443,400	55,425
Astatki	282,000	31,333	230,000	25,555
Other products	1,361,000	162,459	1,073,900	127,845
Total	2,140,400	255,077	1,819,300	217,468

Batum.—The following table shows the shipments of petroleum products from Batum from 1908 to 1912:

Shipments of petroleum from Batum, 1908–1912.

Year.	Refined petroleum.	Lubricating.	Residuals.	Total.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
1908	460,580	141,986	70,820	673,386
1909	405,857	164,840	78,839	649,536
1910	423,993	157,608	45,811	627,412
1911	353,518	171,725	57,282	582,525
1912	327,338	188,894	53,300	569,532

The following were the stocks of petroleum products held at Batum at the close of the year from 1908 to 1912, in poods and barrels:

Stocks of petroleum at Batum, Dec. 31, 1908–1912.

	1908		1909		1910		1911		1912	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*
Illuminating	3,484,000	435,500	2,700,000	350,000	2,590,778	323,847	2,216,007	278,251	3,384,654	423,082
Lubricating	1,124,000	137,410	972,000	118,826	1,092,431	133,670	888,605	108,631	2,009,475	245,657
Solar oil	97,000	11,758	24,000	3,000						
Vaseline	23,000	2,644	158,000	18,860	} 522,032	60,000	300,585	35,880	963,794	107,088
Residuals	714,000	79,333	577,000	64,111						
Total	5,442,000	666,645	4,431,000	554,797	4,205,241	517,517	3,405,197	422,762	6,357,923	775,827

AUSTRIA-HUNGARY.

GALICIA.

Production.—The decline in production in Galicia which began in 1910 continued unabated in 1912, owing to conditions reviewed in the preceding report and caused by foreign competition and the entrance of salt water. In spite of a reduction of stocks from 871,330 metric tons in 1911 to 512,540 metric tons in 1912, the amount supplied to the trade was less by about 200,000 tons than in 1911.

An encouraging feature of new exploration for oil in Galicia which developed in 1913 was the discovery of oil in a well known as Henryk No. 1 in the Tustanowice field at the great depth of 5,740 feet. The drilling is being continued.

The details of production are given below.

Production of petroleum in Galicia, 1903–1912.

Year.	Metric centners.[a]	Barrels of 42 gallons.	Year.	Metric centners.[a]	Barrels of 42 gallons.
1903	7,279,710	5,234,475	1908	17,540,220	12,612,295
1904	8,271,167	5,947,383	1909	20,767,400	14,932,799
1905	8,017,964	5,765,317	1910	17,625,600	12,673,688
1906	7,604,432	5,467,967	1911	14,629,400	10,519,270
1907	11,759,740	8,455,841	1912	11,870,070	8,535,174

[a] 1 metric centner or quintal=100 kilograms (220.462 pounds); 1 metric centner or quintal of crude petroleum=0.71905 barrel of 42 gallons.

In the following table is given the production of petroleum in Galicia in 1908 to 1912, inclusive, by fields, in tons:

Production of petroleum in Galicia, 1908–1912, by fields, in metric tons.[a]

Field.	1908	1909	1910	1911	1912
East Galicia:					
Tustanowice	1,318,710	1,706,435	1,404,320	1,105,420	856,440
Boryslaw	266,910	231,195	209,300	197,320	170,500
Schodnica	36,480	34,860	32,860		
Urycz					
Mraznica	30,022	28,110	38,170		
Other fields					
West Galicia:					
Potok		11,370	13,010	160,200	160,067
Rogi	50,640	9,540	8,200		
Rowne					
Krosno		20,690	25,200		
Tarnawa-Wielopole-Zagorz	18,200	6,770	2,700		
Kobylanka, Kryg, Zalawie, Lipinki, Libusza, etc	33,060	27,770	28,800		
Total	1,754,022	2,076,740	1,762,560	1,462,940	1,187,007

[a] 1 metric ton=7.1905 barrels of crude petroleum of 42 gallons=2,204.62 pounds.

Deliveries of Galician petroleum to refineries, 1908–1912, in metric tons.

	1908	1909	1910	1911	1912
Delivered to refineries:					
In Galicia and Bucovina	457,020	451,290	362,160	392,020	533,500
In the rest of Austria	540,820	672,970	547,950	488,770	535,160
In Hungary	338,720	384,090	319,380	347,550	313,930
To the State refinery in Drohobycz	....	....	208,760	337,340	372,270
Total	1,336,560	1,508,350	1,438,250	1,565,680	1,754,860
Exported	....	41,920	3,280	840	1,010
Used as fuel	....	120,000	97,430	90,120	33,910
Stocks in the Government reservoirs	....	406,470	819,700	a 871,330	b 512,540
Total	....	2,076,740	2,358,660	2,527,970	2,302,320

a Does not include producers' storage, which decreased from 858,490 tons to 605,280 tons.
b Does not include producers' storage, which decreased to 280,510 tons.

Imports and exports.—In the following table are given the imports and exports of petroleum products into and from Austria-Hungary in 1909–1912:

Imports and exports of petroleum into and from Austria-Hungary in 1909–1912, in metric tons.

Kind.	1909		1910		1911		1912	
	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.
Illuminating oils	1,761	290,915	1,460	266,739	1,517	265,378	1,413	383,178
Lubricating and other oils	19,614	130,862	15,358	139,071	18,213	91,065	19,617	155,532
Benzine	10	32,528	40	39,320	10	41,904	89	68,686
Paraffin	507	38,042	455	44,432	631	37,940	540	51,648
Crude petroleum	....	51,558	18,967	5,472	19,020	610	17,871	1,645
Total	21,892	543,905	36,280	495,034	39,391	436,467	39,530	660,689

ROUMANIA.

General conditions.—As in 1911, so in 1912 Roumania continued to increase in production of petroleum, the quantity reaching 1,806,942 metric tons, or 12,991,913 barrels, an increase of 17 per cent, which was approximately the percentage of gain shown in 1911. The great Bustenari field declined and was greatly exceeded in output by Moreni, in which was the chief increase. There was also an evident tendency to develop the Bambovitza, Buzeu, and Bacau fields, all of which showed gains.

Roumania attained its maximum annual output of crude petroleum in 1912, and in addition the yield of every petroleum product increased as did also exports, home consumption, and stocks. The number of drilled wells increased, but the number of hand-dug wells declined.

Production.—The following tables give the statistics of the production of petroleum in Roumania in 1912:

Roumanian petroleum industry, 1908–1912, in metric tons.

	1908	1909	1910	1911	1912
Crude-oil production	1,147,727	1,297,257	1,352,407	1,544,847	1,806,942
Crude oil treated at refineries	1,012,616	1,107,825	1,215,299	1,404,403	1,667,389
Output of refineries:					
Benzine	180,190	201,253	230,703	260,653	352,492
Illuminating oil	248,274	263,998	272,222	312,711	345,802
Lubricating oil	89,753	43,446	25,064	24,703	43,438
Residuals	473,770	576,600	667,260	783,136	898,011
Home consumption:					
Benzine	9,055	14,041	20,314	24,450	30,656
Illuminating oil	38,422	39,451	41,849	43,941	49,941
Lubricating oil	11,955	15,698	17,544	22,401	28,997
Residuals	347,323	366,703	360,551	434,094	540,383
Fuel at the refineries	113,753	109,077	108,314	123,029	140,590
Exports:					
Benzine	122,860	108,218	125,751	124,384	173,817
Illuminating oil and distillate	263,633	261,637	339,282	318,441	353,563
Crude, residuals, etc	78,765	49,715	116,223	233,895	318,443
Paraffin	187	545	285	476	600
Stocks on Dec. 31:					
Benzine	44,783	40,071	29,006	51,862	60,647
Illuminating oil	41,541	79,613	56,557	73,908	126,009
Lubricating oil and residuals	73,761	157,204	270,493	248,375	227,140

Production of petroleum in Roumania in 1912, by districts and months, in metric tons.[a]

Month.	District Prahova.					Dambovitza.	Buzeu.	Bacau.	Total.
	Bustenari-Calinet-Bordeni.	Campina Poiana.	Moreni.	Other.	Total.				
January	22,380	28,563	50,444	11,940	113,327	9,104	4,260	2,317	129,008
February	21,702	33,582	60,010	10,255	125,549	11,965	5,616	2,937	146,067
March	23,935	27,984	60,286	10,498	122,703	10,385	5,537	1,379	140,004
April	26,959	24,254	66,749	9,924	127,886	6,680	6,693	2,222	143,481
May	28,784	24,089	63,371	11,568	127,812	5,523	8,124	3,355	144,814
June	27,815	22,978	81,357	12,187	144,337	5,232	8,807	3,213	161,589
July	25,535	23,242	93,566	11,900	154,243	5,175	7,014	2,911	169,343
August	26,476	22,599	75,167	10,624	134,866	4,914	6,450	2,369	148,599
September	24,767	20,880	90,471	15,183	151,301	3,726	7,614	1,645	164,286
October	24,854	21,415	87,375	13,209	146,853	4,124	8,999	1,925	161,901
November	22,769	21,507	71,798	12,574	128,648	3,806	7,954	1,831	142,239
December	25,655	24,312	77,507	12,398	139,872	3,684	10,203	1,852	155,611
Total	301,631	295,405	878,101	142,260	1,617,397	74,318	87,271	27,956	1,806,942

[a] 1 metric ton=7.19 barrels of 42 gallons.

The percentages of the total production furnished by each of the departments of Roumania is given in the following table:

Percentage of production of petroleum in Roumania, 1908–1912, by departments.

Department.	1908	1909	1910	1911	1912
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Prahova	95.49	94.23	92.10	89.67	89.51
Dambovitza	2.29	2.33	3.20	4.47	4.11
Buzeu	.93	1.96	2.94	4.08	4.83
Bacau	1.29	1.48	1.76	1.78	1.55
Total	100.00	100.00	100.00	100.00	100.00

Percentage of refined products from Roumanian crude petroleum, 1908–1912.

Product.	1908	1909	1910	1911	1912
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Crude benzine	17.8	18.1	19.0	18.6	21.2
Illuminating oil	24.7	23.8	22.4	22.3	20.7
Lubricating oil	8.8	3.9	2.0	1.8	2.6
Residue	46.7	52.0	54.9	55.8	53.8
Loss	2.0	2.2	1.7	1.5	1.7

The production of petroleum in Roumania in the last 10 years has been as follows:

Production of petroleum in Roumania, 1903–1912, in barrels.

Year.	Quantity.	Year.	Quantity.
1903	2,763,117	1908	8,252,157
1904	3,599,026	1909	9,327,278
1905	4,420,987	1910	9,723,806
1906	6,378,184	1911	11,107,450
1907	8,118,207	1912	12,991,913

Well record.—The well record in Roumania in 1912 is shown in the following table:

Well record in Roumania in 1912, by districts.

District.	Jan. 1, 1912.						Dec. 31, 1912.					
	Bore holes.			Hand wells.			Bore holes.			Hand wells.		
	Producing.	Drilling.	Abandoned.	Producing.	Drilling.	Abandoned.	Producing.	Drilling.	Abandoned.	Producing.	Drilling.	Abandoned.
Prahova	709	220	441	125	104	420	745	255	459	101	74	308
Dambovitza	17	14	30	71	12	129	18	21	19	61	11	138
Buzeu	39	21	16	44	2	63	48	41	22	44	2	59
Bacau	75	5	27	304	31	472	57	17	40	283	86	435
Total	840	260	514	544	149	1,084	868	334	540	489	173	940

Exports.—In the following table are given the exports of petroleum products from Roumania in the years 1908–1912, in tons:

Exports of petroleum products from Roumania in 1908–1912, in metric tons.

Kind.	1908	1909	1910	1911	1912
Crude oil, gas oil, lubricating oil, and residuals	76,196	49,715	116,223	124,384	173,817
Illuminating oil	262,176	261,637	339,282	318,441	353,563
Benzine	122,332	108,218	125,751	233,895	318,443
Paraffin scale	....	545	285	476	600
Total	460,704	420,115	581,541	677,196	846,423

GERMANY.

In the following table are shown the quantity and value of petroleum produced in the German Empire, by States, from 1903 to 1912, inclusive:

Production of petroleum in the German Empire, 1903–1912, 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.*
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	[a] 22,154	59,196	81,350	578,610	5,036,000	1,198,568
1907	[a] 26,124	80,255	106,379	756,631	7,056,000	1,679,328
1908	[a] 28,898	113,002	141,900	1,009,278	9,942,000	2,366,196
1909	[a] 29,726	113,518	143,244	1,018,837	10,118,000	2,408,084
1910			145,168	1,032,522	10,146,000	2,414,748
1911			142,992	1,017,045	10,045,000	2,390,710
1912			[b] 140,000	995,764	9,790,285	2,330,088

1 metric ton, crude=7.1126 barrels.

[a] Includes Bavaria. [b] Estimated.

GREAT BRITAIN.

Oil shale.—In the following table is shown the production of oil shale in Great Britain in 1902 to 1911, taken from the Mineral Statistics of the United Kingdom:

Quantity and value of oil shale produced in Great Britain, 1902–1911, in long tons.

Year.	England.		Scotland.		Wales.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902			2,105,953	$2,434,277	1,581	$2,886	2,107,534	$2,437,163
1903	193	$282	2,009,265	2,222,294	144	263	2,009,602	2,322,839
1904			2,331,885	2,695,578	1,177	2,146	2,333,062	2,697,725
1905	2,000	2,920	2,493,081	2,881,343	1,704	2,890	2,496,785	2,887,153
1906			2,545,724	3,200,449	798	1,358	2,546,522	3,201,807
1907			2,690,028	3,923,971			2,690,028	3,923,971
1908			2,892,039	3,870,118			2,892,039	3,870,118
1909	40	34	2,967,017	3,970,723			2,967,057	3,970,757
1910			3,130,280	4,189,114			3,130,280	4,189,114
1911			3,116,803	4,171,174			3,116,803	4,171,174

AUSTRALIA.

In No. 87 of the Daily Consular and Trade Reports of the Department of Commerce for 1913 a valuable description is given of the mineral oil in the British Empire. From this the following information is extracted supplementary to that given in the 1911 report of this series.

Oil shale is obtained in New South Wales. The quantity mined in 1911 was 75,104 long tons, valued at $179,965. Trade in various classes of oil is said to be extending and a corresponding increase in the output of shale may be expected. In 1911 bounties to the amount of $7,255 were paid by the Government on 178,920 gallons of kerosene, and $3,805 on 625,600 pounds of refined paraffin wax. The Tasmanite shale fields of Tasmania in the Mersey district, near the northern shore of the island, yield an oil that can be separated into products suitable for heat, illumination, and lubrication. It is estimated that the 7-foot bed extends over an area of 2,000 acres and represents 12,000,000 tons of shale. It is a brownish-gray rock containing small yellowish-brown resinous looking bodies. It can be ignited with a match. Newspaper reports state that an oil concession has been applied for in the Northern Territory of Australia by Americans for the right to search over a prescribed area and for a lease if oil is found.

NEW SOUTH WALES.

Quantity and value of oil shale produced in New South Wales, 1902–1912, in long tons.

Year.	Quantity.	Value.
1902	62,880	$290,613
1903	34,776	139,265
1904	37,871	130,276
1905	38,226	103,399
1906	32,446	138,549
1907	47,331	154,996
1908	46,303	126,855
1909	48,718	114,932
1910	68,293	164,955
1911	75,104	179,965
1912	[a] 75,000	180,000

[a] Estimated.

ITALY.

Production.—In the following table will be found the production of petroleum in Italy from 1903 to 1912. This table is taken from the volumes of the Rivista del Servizio Minerario:

Production of petroleum in Italy, 1903–1912.

Year.	Number of wells in operation.	Quantity.		Value.	
		Metric tions.	United States barrels.	Lire.[a]	Dollars.
1903	10	2,486	17,876	737,293	142,298
1904	10	3,543	25,476	1,053,294	203,286
1905	9	6,123	44,027	1,826,802	352,573
1906	12	7,451	53,577	2,226,559	429,726
1907	13	8,327	59,875	1,663,300	321,017
1908	14	7,088	50,966	1,415,640	273,219
1909	12	5,895	42,388	1,178,660	227,481
1910	9	7,069	50,830	1,413,800	272,863
1911	9	10,390	74,709	1,454,600	280,737
1912 [b]	9	12,000	86,286	1,680,000	324,240

[a] Lira=$0.193. 1 metric ton, crude=7.1905 barrels. [b] Estimated.

BRITISH INDIA.

Production.—The following table gives the production of petroleum in India from 1903 to 1912 in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1903–1912.

Year.	Quantity.		Value.	
	Imperial gallons.	Barrels (42 United States gallons).	Rupees.[a]	Dollars.
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
1907	152,045,677	4,344,162	9,150,225	2,968,637
1908	176,646,320	5,047,038	10,530,135	3,416,327
1909	233,678,087	6,676,517	13,652,580	4,429,352
1910	214,829,647	6,137,990	12,538,905	4,068,039
1911	225,792,094	6,451,203	13,265,970	4,303,923
1912	249,083,518	7,116,672	14,629,170	4,746,190

[a] The value of the rupee is taken as 32.44⅓ cents; 15 rupees=£1.

Production of petroleum in India, 1908–1912, by provinces, in imperial gallons.

Province.	1908	1909	1910	1911	1912
Burma	173,402,790	230,396,617	211,507,903	222,225,531	245,335,209
Eastern Bengal and Assam	3,243,110	3,280,750	3,320,680	3,565,163	3,747,359
Punjab	420	720	1,064	1,400	950
Total	176,646,320	233,678,087	214,829,647	225,792,094	249,083,518

DUTCH EAST INDIES.

In the following table is given the production of petroleum in the Dutch East Indies during the years 1903 to 1912, inclusive:

Production of petroleum in Dutch East Indies, 1903–1912.

Year.	Borneo.		Java.		Sumatra.		Total.		
	Metric tons.	Liters.	Metric tons.	Liters.	Metric tons.	Liters.	Metric tons.	Liters.	Barrels.
1903	105,102	116,446,337	91,568	106,244,811	563,988	694,661,269	760,658	917,352,417	5,770,056
1904	215,109	238,327,180	110,053	127,692,388	542,936	668,731,900	868,098	1,034,751,468	6,508,485
1905	439,487	486,924,000	110,711	128,456,000	513,630	632,635,700	1,063,828	1,248,015,700	7,849,896
1906	387,455	429,275,398	111,378	129,229,083	602,501	742,097,300	1,101,334	1,300,601,781	8,180,657
1907	489,151	541,948,068	142,983	165,900,000	713,841	879,235,063	1,345,975	1,587,083,131	9,982,597
1908	511,049	566,209,890	137,013	158,974,000	738,588	909,715,827	1,386,650	1,634,899,717	10,283,357
1909	411,506	455,922,397	140,351	162,846,428	922,894	1,136,720,015	1,474,751	1,755,488,840	11,041,852
1910	633,472	701,853,114	142,503	165,344,877	719,740	886,505,130	1,495,715	1,753,703,121	11,030,620
1911	814,707	902,654,621	172,438	190,766,435	683,523	841,895,279	1,670,668	1,935,316,335	12,172,949
1912	671,662	744,167,950	184,989	214,641,699	621,481	765,481,929	1,478,132	1,724,291,578	10,845,624

1 gallon Borneo crude=7.5322 pounds.
1 gallon Java crude=7.1924 pounds.
1 gallon Sumatra crude=6.7754 pounds.
1 United States barrel=158.985 liters; 1 liter=1.0567 quarts.

CHINA.

A report prepared some years ago by the French engineer Paul de Hees, of Hankow, has just become available through the Bureau of Foreign and Domestic Commerce, Department of Commerce, in which a detailed description is given of the salt and petroleum industry as it existed when the report was published in the Province of Szechwan, China. Oil and natural gas have been known for many years in the southern part of this Province, northwest of the village of Lon Tcheon, in a tract about 8 miles north and south by 15 miles east and west. The oil and gas are produced incidentally to the salt industry, in which they are chiefly used as fuel. There are about 800 salt wells in operation. Many of the wells abandoned for salt are still sources of natural gas. Salt water is sometimes found at 800 feet and the oil and gas much deeper. The oil sells for 3 cents a pound or half the price of imported oil. The gas sells for 5 taels a month for each three burners supplied. The axis of the oil field seems to run southwest and northeast. The center of interest seems to be a short distance northeast of the salt field. The oil is found at depths of 1,000 to 2,000 feet. The oil is obtained in the same way as the salt.

The crude oil, after settling, burns well, with a clear flame and seems to have good illuminating power for domestic lighting, but its use is prohibited. At the time of the report there were 15 producing wells. During the first months after opening they yield about 25 barrels a day. The wells soon settle down to a tenth of this or less, and then are long lived.

JAPAN.

The successful introduction, by the Nippon Oil Co. of the rotary drilling system from California, has resulted in an increased production in Nishiyama. The tables of production follow.

In the following table is given the production of petroleum in Japan from 1903 to 1912, inclusive:

Production of petroleum in Japan, 1903–1912.[a]

[Barrels of 42 gallons.]

Year.	Crude.	
	Koku.	*Barrels.*
1903	1,065,116	1,209,971
1904	1,249,536	1,419,473
1905	1,296,482	1,472,804
1906	1,501,563	1,705,776
1907	1,755,464	1,994,207
1908	1,815,001	2,061,841
1909	1,657,036	1,882,393
1910	1,695,950	1,926,599
1911	1,458,860	1,657,265
1912	1,471,307	1,671,405

1 koku=39.7 English gallons=47.46 United States gallons=1.136 United States barrels.

[a] Exclusive of the island of Formosa.

In the following table is given a statement of the production of petroleum in Japan, 1905–1912, by fields, as reported by the mining bureau of the department of agriculture and commerce, Tokyo:

Production of petroleum in Japan, 1905–1912, by fields.

Field.	1905	1906	1907	1908
NIIGATA PREFECTURE.				
Echigo:	*Koku.*	*Koku.*	*Koku.*	*Koku.*
Higashiyama	273,844	304,847	342,042	263,667
Nishiyama	271,495	294,277	360,115	492,393
Niitsu	634,704	808,655	970,556	807,002
Kubiki	97,075	76,578	63,572	62,938
Amaze	5,220	7,262	12,447	....
Ojiya	14,180	9,964	6,732	7,097
Others (except Formosa)	....	....	....	6,450
Total quantity	1,296,482	1,501,563	1,755,464	1,639,547
Total value	....	....	....	$3,225,153

Field.	1909	1910	1911	1912
	Koku.	*Koku.*	*Koku.*	*Koku.*
Akita	3,194	12,924	23,193	33,903
Hokkaido	2,169	1,892	1,359	6,476
Nagano	64	61	....	....
Niigata	1,648,678	1,678,301	1,431,908	1,425,920
Shizuoka	2,931	2,637		
Yamagata	....	135	....	....
Enshyu	....	....	2,400	1,968
Total	1,657,036	1,695,950	1,458,860	1,468,267
Formosa	5,664	3,208	1,442	3,040
Total	1,662,700	1,699,158	1,460,302	1,471,307

Production of petroleum in Japan and Formosa, 1906–1912.

Year.	Japan.		Formosa.		Total.	
	Koku.	*Barrels.*	*Koku.*	*Barrels.*	*Koku.*	*Barrels.*
1906	1,501,563	1,705,776	4,394	4,992	1,505,957	1,710,768
1907	1,755,464	1,994,207	*a* 6,717	7,631	1,762,181	2,001,838
1908	1,815,001	2,061,841	7,310	8,304	1,822,311	2,070,145
1909	1,657,036	1,882,393	5,664	7,170	1,662,700	1,889,563
1910	1,695,950	1,926,599	3,208	4,062	1,699,158	1,930,661
1911	1,458,860	1,657,265	1,442	1,638	1,460,302	1,658,903
1912	1,468,267	1,667,951	3,040	3,454	1,471,307	1,671,405

a Estimated.

NEW ZEALAND.

A large amount of capital has been expended in attempts to prove the value of oil deposits in various parts of the Taranaki district of New Zealand. At Moturoa wells close to the beach yield oil rich in paraffin wax. Encouragement is given by the New Zealand Government to the incipient petroleum industry by means of a rebate of duty on rigs and machinery for oil drilling, and the New Zealand Geological Survey is giving special attention to petroleum areas. Oil concessions have been granted over an area near Gisborne, Hawkes Bay district, on the east coast of North Island, to the New Zealand Oilfields, Ltd., an English company formed in 1910. Two wells are being drilled by American rotary machinery.

AFRICA.

Beds of shale rich in oil are reported in Natal. Mineral oil is believed to exist near Harrismith in Orange Free State. There are indications of oil near Ceres in Cape Province. Bituminous sands on the Gold Coast and in Nigeria have led to considerable exploration for petroleum, and some has been found. Several samples of crude petroleum obtained at Bonyere, in the Axim district of the Gold Coast, have been examined at the Imperial Institute. The Société Française du Pétrole, Ltd., controls an area of 150 square miles in the Gold Coast Colony and 19 square miles in the French Ivory Coast Colony; drilling is in progress. In southern Nigeria the Southern Nigeria Bitumen Corporation is engaged in boring operations.

In Egypt prospecting continued steadily on the borders of the Red Sea, with no sensational developments.

Samples of oil from Ulad Aissa, Sherarda, and Ain Feriba, in Morocco, transmitted by the British consul at Fez, have been analyzed in the Imperial Institute and show specific gravities of 0.853 to 0.950 with much water. One sample showed 1.70 per cent of sulphur and considerable asphalt.

WORLD'S PRODUCTION.

PRODUCTION AND RANK OF COUNTRIES.

The following table shows the world's production for 1912 in barrels and metric tons and for the years 1908 to 1911, inclusive, in barrels:

World's production of crude petroleum, 1908–1912, by countries, in barrels and metric tons.

Country.	1908	1909	1910	1911	1912			
					Rank.	Barrels.	Metric tons.	Percentage of total production.
United States	178,527,355	183,170,874	209,557,248	220,449,391	1	222,113,218	29,615,096	63.25
Russia	62,186,447	65,970,350	70,336,574	66,183,691	2	68,019,208	9,317,700	19.37
Mexico	3,481,410	2,488,742	3,332,807	14,051,643	3	16,558,215	2,207,762	4.71
Dutch East Indies	10,283,357	11,041,852	11,030,620	12,172,949	5	10,845,624	1,478,132	3.09
Roumania	8,252,157	9,327,278	9,723,806	11,107,450	4	12,991,913	1,806,942	3.70
Galicia	12,612,295	14,932,799	12,673,688	10,519,270	6	8,535,174	1,187,007	2.43
India	5,047,038	6,676,517	6,137,990	6,451,203	7	7,116,672	989,801	2.03
Japan	2,070,145	1,889,563	1,930,661	1,658,903	9	1,671,405	222,854	.48
Peru	1,011,180	1,316,118	1,330,105	1,368,274	8	1,751,143	233,486	.50
Germany	1,009,278	1,018,837	1,032,522	1,017,045	10	995,764	a 140,000	.28
Canada	527,987	420,755	315,895	291,096	11	243,614	32,612	.07
Italy	50,966	42,388	42,388	74,709	12	a 86,286	a 12,000	.02
Other	a 30,000	a 30,000	a 30,000	a 200,000	......	250,000	33,333	.07
Total	285,089,615	298,326,073	327,474,304	345,512,185	......	351,178,236	47,276,725	100.00

a Estimated.

UNITED STATES GEOLOGICAL SURVEY PUBLICATIONS, 1901-1912, ON THE OIL FIELDS OF THE UNITED STATES.

The following publications of the United States Geological Survey refer to the oil fields of the United States; the later papers supplement the general description of the oil and gas fields given in these reports for 1907 and 1908:

ANNUAL REPORTS.

[a] Eighth Annual Report of the United States Geological Survey, 1886–87, J. W. Powell, Director, 1889.

Pt. II, pp. 475–1063, pls. liv–lxii.

The Trenton limestone as a source of petroleum and inflammable gas in Ohio and Indiana, by Edward Orton, pp. 475–662, pls. liv–lx. $1.50.

Eleventh Annual Report of the United States Geological Survey, 1889–90, J. W. Powell, Director, 1891.

Pt. I. Geology, 757 pp., 66 pls.

The Natural Gas Field of Indiana, by Arthur John Phinney, pp. 587–742, pls. lxii–lxvi.

[a] Twenty-second Annual Report of the United States Geological Survey, 1900–1901, Charles D. Walcott, Director, 1901.

Pt. III. Coal, oil, cement, 763 pp., 53 pls.

The Gaines oil field of northern Pennsylvania, by M. L. Fuller, pp. 573–627, pls. xxxvi–xliii. $2.00.

PROFESSIONAL PAPERS.

[a] 56. Geography and geology of a portion of southwestern Wyoming, with special reference to coal and oil, by A. C. Veatch. 1907. 178 pp., 26 pls. 60c.

65. Geology and water resources of the northern portion of the Black Hills and adjoining regions in South Dakota and Wyoming, by N. H. Darton. 1909. 105 pp., 24 pls.

BULLETINS.

[a] 184. Oil and gas fields of the western interior and northern Texas coal measures and of the Upper Cretaceous and Tertiary of the western Gulf coast, by George I. Adams. 1901. 64 pp., 10 pls. 30c.

[a] 198. The Berea grit oil sand in the Cadiz quadrangle, Ohio, by W. T. Griswold. 1902. 43 pp., 1 pl. 10c.

[a] 212. Oil fields of the Texas-Louisiana Gulf Coastal Plain, by C. W. Hayes and William Kennedy. 1903. 174 pp., 11 pls. 20c.

[a] 213. Contributions to economic geology. 1902; S. F. Emmons and C. W. Hayes, geologists in charge. 1903. 449 pp. 25c.

The petroleum fields of California, by George H. Eldridge, p. 306.

The Boulder, Colo., oil field, by N. M. Fenneman, p. 322.

Asphalt, oil, and gas in southwestern Indiana, by Myron L. Fuller, p. 333.

Structural work during 1901 and 1902 in the eastern Ohio oil fields, by W. T. Griswold, p. 336.

Oil fields of the Texas-Louisiana Gulf Coastal Plain, by C. W. Hayes, p. 345.

[a] 225. Contributions to economic geology, 1903; S. F. Emmons and C. W. Hayes, geologists in charge. 1904. 527 pp., 1 pl. 35c.

Petroleum fields of Alaska and the Bering River coal fields, by G. C. Martin, p. 365.

Structure of the Boulder oil field, Colorado, with records for the year 1903, by N. M. Fenneman, p. 383.

The Hyner gas pool, Pennsylvania, by M. L. Fuller, p. 392.

Oil and gas fields of eastern Greene County, Pa., by Ralph W. Stone, p. 396.

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[a] Geological Survey's stock of the paper is exhausted, but many of the papers marked in this way may be purchased from the Superintendent of Documents, Washington, D. C., at the prices indicated.

[a] 238. Economic geology of the Iola quadrangle, Kansas, by G. I. Adams, Erasmus Haworth, and W. R. Crane. 1904. 83 pp., 11 pls. 25c.

250. The petroleum fields of the Pacific coast of Alaska, with an account of the Bering River coal deposits, by G. C. Martin. 1905. 64 pp., 7 pls.

256. Mineral resources of the Elders Ridge quadrangle, Pennsylvania, by R. W. Stone. 1905. 86 pp., 12 pls.

[a] 259. Report on progress of investigations of mineral resources of Alaska in 1904, by A. H. Brooks and others. 1905. 196 pp., 3 pls. 15c.

[a] 260. Contributions to economic geology, 1904; by S. F. Emmons and C. W. Hayes, geologists in charge. 1905. 620 pp., 4 pls. Out of print.

The Florence, Colo., oil field, by N. M. Fenneman, p. 436.

Notes on the geology of the Muskogee oil field, Oklahoma, by J. A. Taff and M. K. Shaler, p. 441.

Oil and gas in the Independence quadrangle, Kansas, by F. C. Schrader and Erasmus Haworth, p. 446.

Oil fields of the Texas-Louisiana Gulf coast, by N. M. Fenneman, p. 459.

Oil and asphalt prospects in Salt Lake Basin, Utah, by J. M. Boutwell, p. 468.

[a] 264. Record of deep-well drilling for 1904, by M. L. Fuller, E. F. Lines, and A. C. Veatch. 1905. 106 pp. 10c.

265. Geology of the Boulder district, Colorado, by N. M. Fenneman. 1905. 101 pp., 5 pls.

279. Mineral resources of the Kittanning and Rural Valley quadrangles, Pennsylvania, by Charles Butts. 1906. 198 pp., 11 pls.

[a] 282. Oil fields of the Texas-Louisiana Gulf Coastal Plain, by N. M. Fenneman. 1906. 146 pp., 11 pls. 20c.

[a] 285. Contributions to economic geology, 1905; S. F. Emmons and E. C. Eckel, geologists in charge. 1906. 506 pp., 13 pls. Out of print.

The Salt Lake oil field near Los Angeles, Cal., by Ralph Arnold, p. 357.

The Nineveh and Gordon oil sands in western Greene County, Pa., by F. G. Clapp, p. 362.

286. Economic geology of the Beaver quadrangle, Pennsylvania, by L. H. Woolsey. 1906. 132 pp., 8 pls.

296. Economic geology of the Independence quadrangle, Kansas, by F. C. Schrader and Erasmus Haworth. 1906. 74 pp., 6 pls.

[a] 298. Record of deep-well drilling for 1905, by Myron L. Fuller and Samuel Sanford. 1906. 299 pp. 25c.

300. Economic geology of the Amity quadrangle in eastern Washington County, Pa., by F. G. Clapp. 1907. 145 pp., 8 pls.

[a] 304. Oil and gas fields of Greene County, Pa., by R. W. Stone and F. G. Clapp. 1907. 110 pp., 3 pls. 45c.

[a] 309. The Santa Clara Valley, Puente Hills, and Los Angeles oil districts, southern California, by G. H. Eldridge and Ralph Arnold. 1907. 266 pp., 41 pls. 80c.

[a] 314. Report on progress of investigations of mineral resources of Alaska in 1906, by A. H. Brooks and others. 1907. 235 pp., 4 pls. 30c.

[a] 317. Preliminary report on the Santa Maria oil district, Santa Barbara County, Cal., by Ralph Arnold and Robert Anderson. 1907. 69 pp., 2 pls. 15c.

[a] 318. Geology of oil and gas fields in Steubenville, Burgettstown, and Claysville quadrangles, Ohio, West Virginia, and Pennsylvania, by W. T. Griswold and M. J. Munn. 1907. 196 pp., 13 pls. 75c.

[a] 321. Geology and oil resources of the Summerland district, Santa Barbara County, Cal., by Ralph Arnold. 1907. 91 pp., 20 pls. 25c.

[a] 322. Geology and oil resources of the Santa Maria oil district, Santa Barbara County, Cal., by Ralph Arnold and Robert Anderson. 1907. 161 pp., 26 pls. 50c.

[a] 335. Geology and mineral resources of the Controller Bay region, Alaska, by G. C. Martin. 1908. 141 pp., 10 pls. 70c.

[a] 340. Contributions to economic geology, 1907, Part I: Metals and nonmetals except fuels. C. W. Hayes, Waldemar Lindgren, geologists in charge. 1908. 482 pp., 6 pls. 30c.

Petroleum and natural gas—California: Contra Costa County, Miner ranch field, by Ralph Arnold. Utah: Southern Utah oil field, by G. B. Richardson. Wyoming: Bighorn basin gas fields, by C. W. Washburne; Uinta County, Labarge oil field, by A. R. Schultz, pp. 339–374.

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[a] Geological Survey's stock of the paper is exhausted, but many of the papers marked in this way may be purchased from the Superintendent of Documents, Washington, D. C., at the prices indicated.

346. Structure of the Berea oil sand in the Flushing quadrangle, Ohio, by W. T. Griswold. 1908. 30 pp., 2 pls.

[a] 350. Geology of the Rangely oil district, Rio Blanco County, Colo., with a section on the water supply, by H. S Gale. 1908. 60 pp., 4 pls. 20c.

[a] 357. Preliminary report on the Coalinga oil district in Fresno and Kings counties, Cal., by Ralph Arnold and Robert Anderson. 1908. 142 pp., 2 pls. 20c.

364. Geology and mineral resources of the Laramie basin, Wyoming, by N. H. Darton and C. E. Siebenthal. 1909. 81 pp., 8 pls.

365. The fractionation of crude petroleum by capillary diffusion, by J. E. Gilpin and M. P. Cram. 1908. 33 pp.

381. Contributions to economic geology, 1908, Part II: Mineral fuels. M. R. Campbell, geologist in charge. 1910. 599 pp., 24 pls.

Geology and oil prospects of the Reno region, Nevada, by R. Anderson. Two areas of oil prospecting in Lyon County, western Nevada, by R. Anderson. Analyses of crude petroleum from Oklahoma and Kansas, by D. T. Day. The Madill oil pool, Oklahoma, by J. A. Taff and W. J. Reed. Development in the Boulder and Florence oil fields, Colorado, by C. W. Washburne, pp. 475–544.

394. Papers on the conservation of mineral resources. 1909. 214 pp., 12 pls.

[a]398. Geology and oil resources of the Coalinga district, California, by Ralph Arnold and Robert Anderson, with a report on the chemical and physical properties of the oils, by I. C. Allen. 1910. 354 pp., 52 pls. 85 cents.

401. Relations between local magnetic disturbances and the genesis of petroleum, by George F. Becker. 1909. 24 pp.

406. Preliminary report on the McKittrick-Sunset oil region, Kern and San Luis Obispo counties, California, by Ralph Arnold and Harry R. Johnson. 225 pp., 5 pls.

415. Coal fields of northwestern Colorado and northeastern Utah, by Hoyt S. Gale. 1910. 265 pp., 22 pls.

429. Oil and gas in Louisiana, with a brief summary of their occurrence in adjacent States, by G. D. Harris. 1910. 192 pp., 22 pls.

431. Contributions to economic geology, 1909, Part II: Mineral fuels. M. R. Campbell, geologist in charge.

Natural gas in North Dakota, by A. G. Leonard. The San Juan oil field, Utah, by H. E. Gregory. Gas and oil prospects near Vale, Oreg., and Payette, Idaho, by C. W. Washburne. Gas prospects in the Harney Valley, Oregon, by C. W. Washburne. Preliminary report on the geology and oil prospects of the Cantua-Panoche region, California, by Robert Anderson.

450. Mineral resources of the Llano-Burnet region, Texas, with an account of the pre-Cambrian geology, by Sidney Paige. 1911. 103 pp., 5 pls.

[a]452. The Lander and Salt Creek oil fields, Wyoming. The Lander oil field, Fremont County, by E. G. Woodruff; The Salt Creek oil field, Natrona County, by C. H. Wegemann. 1911. 87 pp., 12 pls. 30 cents.

454. Coal, oil, and gas of the Foxburg quadrangle, Pennsylvania, by E. W. Shaw and M. J. Munn. 1911. 85 pp., 10 pls.

456. Geology of the oil and gas fields of the Carnegie quadrangle, Pennsylvania, by M. J. Munn. 1911. 99 pp., 5 pls.

467. Geology and mineral resources of parts of Alaska Peninsula, by W. W. Atwood. 1911. 137 pp., 14 pls.

471. Contributions to economic geology (short papers and preliminary reports), 1910. Part II: Mineral fuels. M. R. Campbell, geologist in charge.

[a]475. Diffusion of petroleum through fuller's earth, by J. Elliott Gilpin and O. E. Bransky. 5 cents.

[a]491. The data of geochemistry (second edition), by F. W. Clarke. 1911. 782 pp. 70 cents.

531. Contributions to economic geology (short papers and preliminary reports), 1911. Part II: Mineral fuels. M. R. Campbell, geologist in charge.

Four advance chapters issued as indicated below; others to follow:

(a) The Menifee gas field and Ragland oil field, Kentucky, by M. J. Munn; (b) Oil and gas development in north-central Oklahoma, by R. H. Wood; (c) Geology and petroleum resources of the De Beque oil field, Colorado, by E. G. Woodruff; (d) Geologic structure of the Punxsutawney, Curwensville, Houtzdale, Barnesboro, and Patton quadrangles, central Pennsylvania, by G. H. Ashley and M. R. Campbell.

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IN PREPARATION.

543. Geology and geography of a portion of Lincoln County, Wyo., by A. R. Schultz.
—. A reconnaissance of the geology and oil prospects of northwestern Oregon, by C. W. Washburne.
——. Reconnaissance report on oil and gas fields in Wayne County, Ky., by M. J. Munn.

WATER-SUPPLY PAPER.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 1905. 52 pp., 4 pls.

FOLIOS OF THE GEOLOGIC ATLAS OF THE UNITED STATES CONCERNING PETROLEUM AND NATURAL-GAS FIELDS, 1897–1911.[a]

40. Wartburg, Tenn., by A. Keith. 1897.
53. Standingstone, Tenn., by M. R. Campbell. 1899.
72. Charleston, W. Va., by M. R. Campbell. 1901. Out of print.
76. Austin, Tex., by R. T. Hill and T. W. Vaughan. 1902.
82. Masontown-Uniontown, Pa., by M. R. Campbell. 1902. Out of print.
92. Gaines, Pa.-N. Y., by M. L. Fuller and W. C. Alden. 1903.
94. Brownsville-Connellsville, Pa., by M. R. Campbell. 1903.
102. Indiana, Pa., by G. B. Richardson. 1904.
105. Patoka, Ind.-Ill., by M. L. Fuller and F. G. Clapp. 1904.
107. Newcastle, Wyo.-S. Dak., by N. H. Darton. 1904.
115. Kittanning, Pa., by C. Butts and F. Leverett. 1904.
121. Waynesburg, Pa., by R. W. Stone. 1905.
123. Elders Ridge, Pa., by R. W. Stone. 1905.
125. Rural Valley, Pa., by C. Butts. 1905.
132. Muskogee, Okla., by J. A. Taff. 1906.
134. Beaver, Pa., by L. H. Woolsey. 1906.
135. Nepesta, Colo., by C. A. Fisher. 1906.
144. Amity, Pa., by F. G. Clapp. 1907.
146. Rogersville, Pa., by F. G. Clapp. 1907.
148. Joplin district, Mo.-Kans., by W. S. T. Smith and C. E. Siebenthal. 1907. Out of print.
159. Independence, Kans., by F. C. Schrader. 1908.
163. Santa Cruz, Cal., by J. C. Branner, J. F. Newsome, and R. Arnold. 1909.
[b]165. Aberdeen-Redfield, S. Dak., by J. E. Todd. 1909.
[b]172. Warren, Pa.-N. Y., by C. Butts. 1910.
[b]176. Sewickley, Pa., by M. J. Munn. 1911.
[b]177. Burgettstown-Carnegie, Pa., by E. W. Shaw and M. J. Munn. 1911.
[b]178. Foxburg-Clarion, Pa., by E. W. Shaw, E. F. Lines, and M. J. Munn. 1911.
[b]180. Claysville, Pa., by M. J. Munn. 1911.
[b]184. Kenova, Ky.-W. Va.-Ohio, by W. C. Phalen. 1912.

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[a] The price of folios named in this list is 5 cents each.
[b] Issued in two editions—library (18 by 22 inches) and field (6 by 9 inches). Specify edition desired. Price same for either edition.

PEAT.

By Charles A. Davis.

INTRODUCTION.

The widespread occurrence of peat deposits of excellent quality in the northern part of the United States has attracted attention to their potential economic value as sources of heat, power, and light. Three factors have intensified the interest in peat during the last decade—(1) the higher cost of other fuels, especially coal, in districts remote from mines; (2) the frequent and well-substantiated reports of the rapid increase in the use of peat as fuel in Europe, particularly in large manufacturing and power plants; (3) the fact that peat deposits are most numerous outside of the fields of workable coal, in regions where the winter is severe and where manufacturing is already well established.

Numerous attempts have been made in many parts of this country to produce peat fuel on a commercial scale, but work on nearly all these enterprises has been discontinued apparently, so far as could be learned, before they had reached the producing stage. Inquiry has shown that the chief cause of the failure of most, if not all, such attempts has been too great optimism, arising from ignorance of the real difficulties to be met in producing peat fuel in marketable form. Insufficient capital, the attempt to use new and hitherto untried machinery, lack of experience in handling the raw material, and poor transportation facilities have also contributed to cause failure. So far as is known, very few of the peat fuel plants established in this country have gone beyond the experimental stage, and many of them were never equipped with essential machinery. The failure of such plants to establish themselves should not be charged to the intended product, which never was made, but to the real causes, for there seems no reason why properly located and equipped peat-fuel plants in charge of skilled superintendents should not be successful sources of local supply of cheap fuel of good quality.

PRODUCTION.

PEAT FUEL.

Reports from all known peat-fuel plants in the United States show that, with one exception, they were idle during the summer of 1912. The only plant reporting production made air-dried, cylindrical peat blocks, which, when thoroughly dry, were about 6 inches long and 2 inches in diameter, dense and hard, and stood handling well. Some of these blocks were perforated lengthwise to facilitate drying. The principal objection that could be made to this product was its high content of ash, which was caused principally by sand that had been mixed with the peat in digging, handling, and drying, and that could easily be seen in and on the dry blocks.

This fuel was treated in the way described below to make it ready for use. The wet peat was run through a simple pug mill, forced through a series of tubular openings to give it shape, and cut into the required lengths as it issued from the machine. The blocks or tubes thus formed fell upon wooden pallets, which were removed to a sandy drying ground as fast as filled and spread out to permit the peat to dry. During the drying much sand became attached to the blocks.

The output of peat fuel was reported as about 1,300 tons, valued at $4,550. All this peat was sold.

PEAT COKE.

The experimental peat coke plant in Connecticut mentioned in the report for 1911 began operations in 1912, but early in the spring was badly damaged by fire, and the remainder of the year was spent in rebuilding with fireproof materials.

FERTILIZER AND FERTILIZER FILLERS.

The peat made in the United States in 1912, as in previous years, was used chiefly in agriculture.

The peat best adapted for use as a fertilizer contains a rather large percentage of combined nitrogen—2 per cent or more—and should also be so well decomposed that it contains little or no woody or fibrous material. The method of preparing suitable material for fertilizer filler is simple, but requires a somewhat costly plant. The field bearing the peat deposit, unless it is already under cultivation, is generally thoroughly drained and plowed and planted for one or two seasons with some cultivated crop which destroys or disintegrates the coarse material and aerates and improves the physical condition of the upper layers of peat.

When the fields thus formed are in proper condition they are plowed again and lightly harrowed. The peat thus exposed to the wind and sun quickly loses a large part of its moisture. After a time, the length of which must depend on the size of the field and the weather, the partly dry material is scraped into long windrows by horse or other power and loaded on cars, by which it is hauled to the factory for futher drying or for storage.

The drying is completed by passing the air-dried material through long, rotary cylindrical driers through which the heated air and gases from furnaces directly connected with the cylinders are forced by fan blowers. The dry peat, containing 10 per cent of water, falls from the lower end of the drying cylinder and is removed by conveyors to screens, thence to storage bins or directly to cars.

The low selling price of the finished product and the relatively high cost of production leaves but a small margin of profit even if advantage is taken of every method of reducing the cost of drying the raw material. Experience covering several years in a number of widely separated localities shows conclusively that the practice of drying the peat on the fields, so that it contains the lowest practicable content of moisture before it is gathered, is indispensable to commercial success in making peat fertilizer filler unless some more certain and very cheap mechanical method of dewatering the raw peat can be devised, and none has yet been announced. Production is not only greatly decreased in cloudy and wet weather, but the cost per ton of the product is enhanced, for the tonnage of raw material to be handled for a given output is considerably larger and the cost per ton of drying by the use of fuel is greatly increased. This fact can easily be perceived when it is remembered that a ton of peat containing 50 per cent of water consists of 1,000 pounds of water and 1,000 pounds of dry matter, whereas a ton containing 80 per cent water consists of 1,600 pounds of water and 400 pounds of dry matter. It is therefore necessary to dig and handle nearly 5 tons of raw peat and drive off almost 4 tons of water to get a ton of salable material if the raw peat contained 80 per cent of water, instead of less than 2 tons, if its content of water were as low as 50 per cent when it was removed from the field.

Consideration of these facts shows that the producers of peat fertilizer filler had a very unfavorable season in 1912 to fill their contracts, because of long periods of heavy rainfall and cool weather during the spring and summer of that year. It is remarkable, therefore, that the production does not show a greater decrease.

Production was further decreased by the fact that before the field season was over, fire destroyed three plants that were active producers in 1911.

In 1912 the total production of peat for fertilizer, so far as reported, was 41,080 short tons, of which about 8,000 tons was reported as sold air-dried—that is, not dried by artificial heat. The value of this material at the selling prices reported was $186,522, or about $4.50 a ton. The highest price reported was $9 a ton for small quantities sold in bags. The lowest price was $2.50 a ton f. o. b. at the plant for carload lots of sun-dried material.

PEAT FOR OTHER COMMERCIAL PURPOSES.

In 1912, as in past years, a small production of peat was reported for miscellaneous commercial uses.

Stock food.—The amount sold for mixing with prepared stock foods was reported to be 3,000 short tons, at an average price of about $6 a ton. The effects of this material in the mixtures in which they are sold are reported to be very beneficial to all kinds of live stock.

Paper stock.—An increased production of paper stock from peat fiber over that of 1911 was reported by the only company producing this material. The production of dry peat fiber for 1912 was reported to be about 2,000 short tons, which probably represents the handling of at least twice this quantity of peat. No value was given for this product, as none was sold, but the quoted prices of other paper stock of the same grade sold in open market show that it would have a value of at least $10 a ton, or $20,000.

Peat stable litter.—The production of peat-moss stable litter in the United States, so far as could be learned, was suspended entirely in 1912. As in past years, however, peat moss was imported from Holland into the large seaports of the country, especially New York, Baltimore, and Philadelphia. The quantity of both peat-moss litter and its by-product, peat dust or peat mull, made and used in all European countries where the proper types of peat are found, has greatly increased within the last few years, and many new plants for preparing these products were erected in 1912.

The imports of peat stable litter into the United States in 1912 were almost exactly the same as in 1911, 9,053 short tons (8,083 long tons), valued at $39,867, as compared with 9,022 short tons, valued at $39,372 in 1911. This material is used almost exclusively as bedding for horses in stables in the thickly populated parts of large cities. It is especially adapted to this purpose on account of its absorbent and deodorizing properties and should be more extensively used.

CONSUMPTION.

The total production and consumption of peat for all purposes in the United States for 1912, so far as reports could be obtained, are shown in the following table:

Production and consumption of peat in the United States in 1912, in short tons.

Use.	Production.		Imports.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fuel (machine-peat)	1,300	$4,550			1,300	$4,550
Fertilizer	41,080	186,022			41,080	186,022
Stock food	3,000	18,000			3,000	18,000
Paper	2,000	20,000			2,000	20,000
Stable litter			9,053	$39,867	9,053	39,867
Total	47,380	228,572	9,053	39,867	56,433	268,439

PREPARATION AND USE OF PEAT FUEL IN EUROPE.

Preparation.—No marked change in the methods of making peat fuel was made during 1912, although experiments in pressing water from the raw peat again attracted the attention of practical peat producers. A number of machines and processes for reducing the water content of peat quickly and at low cost were patented in several peat-producing countries, but no thoroughly practical demonstration of their efficiency has yet been reported. The need for such machinery was emphasized by a cold, wet summer in northern Europe which made peat-fuel getting by existing methods of air drying on the surface of the deposit very unsatisfactory, and which left some large users of peat with a short supply of poorly dried material at the end of the drying season.

Peat-fuel making for large consumers.—The large manufacturing and power plants which employ peat as fuel get their supply by two methods—(1) they prepare their own peat, though they are sometimes obliged to supplement their production by buying from local small producers; (2) they contract with some company or individual for the year's supply at a fixed price per ton, delivered at the plant.

The second plan is reported to be most liked and most economical, as the production of the dried fuel is then kept entirely distinct from other operations of the plant.

Peat machinery.—No marked modifications of the machinery essential for preparing machine peat were announced, but some well-known types of machinery for digging, macerating, and spreading were improved and strengthened by their makers, thus increasing their daily capacity.

New plant using peat fuel.—A second large Mond gas-producer plant, equipped for recovering ammonia from the gas generated from peat, was erected near Codigoro, Ferrara, Italy, as a result of the successful operation of the plant first installed by the same company near Pontedera, close to Milan. The new plant is designed for recovering ammonia only.

Artificial drying plant.—The plant near Pontedera, Italy, has been equipped with a tunnel-drying system to insure a steady supply of dry fuel, as the local climatic conditions are unfavorable for complete drying in the open air.

Increased use of peat fuel in Russia.—Authentic reports from Russia and eastern Germany show that as the prices of fuel oil and of coal have risen in those regions the use of peat fuel has increased to a marked extent, both in manufacturing and in central electric stations.

Peat fuel in Canada.—The Canadian Government's demonstration that, under the conditions prevailing in Canada, air-dried machine peat can be made and sold at a profit by the use of the best types of the simple machinery used in Europe was so impressive that at the end of the Government tests in 1911 the plant was taken over by a commercial company. In 1912 the plant was rebuilt and equipped with new and more powerful machinery, which, however, was installed so late in the season that no more than test runs were made.

CEMENT.

By Ernest F. Burchard.

INTRODUCTION.

On January 23, 1913, the preliminary estimate of Portland cement production for the calendar year 1912 was released to the press by the United States Geological Survey. So early a compilation of these figures was rendered possible only through the hearty cooperation of the majority of the manufacturers. It was stated at that time that there was apparently an increase of about 3,500,000 barrels over the production of Portland cement in 1911. Complete returns show that the increase was between 3,500,000 and 4,000,000 barrels, and that the preliminary estimate was only 0.6 per cent below the exact total quantity produced. Early preliminary estimates have now been made for the Portland cement production of 1911 and 1912, and occasion is taken here to express thanks to those cement manufacturers whose prompt and complete replies rendered it possible to prepare these estimates. It is also earnestly requested that all producers make their complete reports to the Survey in the future not later than the middle of January, in order that the preliminary estimate may continue to be of practical value to the industry. The preliminary estimate could not give consideration to the comparatively small production of natural and puzzolan cements, but these are treated in full in the present chapter.

In the chapter on the cement industry for 1910[1] a summary was given of the resources of the United States in limestone, marl, shale, and clay suitable for making Portland cement. A map showing the distribution of the principal limestone formations available for making cement accompanied that chapter, a large edition of which was printed, and copies may still be obtained free of charge. In April, 1913, the Survey issued Bulletin 522, on the Portland cement materials and industry of the United States. This bulletin contains the data relating to Portland cement materials formerly published in Bulletin 243, essentially revised, together with revised maps printed, for the most part, on a uniform scale, showing the limestone formations in 23 States, besides several smaller areas. Bulletin 522 is also distributed free of charge. Mineral Resources for 1911 contained, in connection with the chapter on the cement industry, a small map showing the location of the Portland cement plants in the United States. No great change in the roll of active plants took place in 1912. The chapters on the cement industry in 1910 and 1911 and Bulletin 522 contain comprehensive bibliographies of Government and private publications on cement and concrete. In

[1] Burchard, E. F., Cement: Mineral Resources U. S. for 1910, pt. 2, U. S. Geol. Survey, 1911, pp. 488–532.

view of the Survey literature now available neither the supplies of raw materials for the manufacture of cement nor the bibliography of cement literature need be reviewed in this chapter.

Attention is called here to the fact that a slight change has been made in this chapter in the basis on which certain statistics are reported. In addition to obtaining the statistics of production of Portland cement the quantities shipped during the calendar year are given, and the stocks on hand at the close of the year. The value is not requested in connection with the production of Portland cement, but rather in connection with the shipments of cement, with which it logically belongs. By thus giving the annual shipments and their corresponding value the volume of the Portland cement business may be much more truly gaged, and at the same time no cement is overlooked, for both the production and the stock are recorded.

For natural and puzzolan cements, the manufacture of which is not extensive, only shipments and value are given, and as the production and shipments of these kinds of cement are nearly the same the shipments may for all practical purposes be considered as representing the production. On account of this change the tables of statistics of natural and puzzolan cements for 1911 and 1912 will not be exactly comparable, but in future reports, after the 1911 table has dropped out, this slight inconsistency will disappear.

PRODUCTION OF ALL CEMENTS.

The total quantity of Portland, natural, and puzzolan cement produced in the United States in 1912 was 83,351,191 barrels, valued at $67,461,513, as compared with 79,547,958 barrels, valued at $66,705,136, in 1911. This represents an increase in quantity of 3,803,233 barrels, or 4.78 per cent, and in value of $756,377, or 1.13 per cent. It should be noted here that any table in which the production of these three kinds of cement is combined to form a total of barrels is necessarily inconsistent, for the weights per barrel of each kind of cement are different. Portland cement is sold in barrels weighing 380 pounds, natural cement in 265-pound barrels, and puzzolan cement in 330-pound barrels. The percentage of increase in quantity compares favorably with that of 1911 over 1910, which was 2.27 per cent, but the value relatively decreased, although the total value increased slightly.

The distribution of the total production among the three main classes of cement is shown in the following table for the years 1910, 1911, and 1912:

Total production of cement in the United States in 1910, 1911, and 1912, by classes.

Class.	1910		1911		1912	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.	Quantity (barrels).	Value.
Portland	76,549,951	$68,205,800	78,528,637	$66,248,817	82,438,096	$67,016,928
Natural	1,139,239	483,006	926,091	378,533	[a]821,231	367,222
Puzzolan	95,951	63,286	93,230	77,786	[a]91,864	77,363
Total	77,785,141	68,752,092	79,547,958	66,705,136	83,351,191	67,461,513

[a] Shipments.

PORTLAND CEMENT.

PRODUCTION AND SHIPMENTS.

The total production of Portland cement in the United States in 1912, as reported to the United States Geological Survey, was 82,438,096 barrels, valued at $67,016,928; the production for 1911 was 78,528,637 barrels, valued at $66,248,817. The output for 1912 represents an increase in quantity of 3,909,459 barrels, or nearly 4.98 per cent, and an increase in value of $768,111, or 1.13 per cent. The value assigned to the production is proportional to the value of the Portland cement shipped in 1912.

The shipments of Portland cement from the mills in the United States in 1912 were, according to reports received by the Survey, 85,012,556 barrels, valued at $69,109,800, compared with 75,547,829 barrels, valued at $63,762,638, shipped in 1911. The shipments, therefore, represent an increase in quantity of 9,464,727 barrels, or 12.52 per cent, and in value of $5,347,162, or 8.38 per cent. The average price per barrel in 1912, according to these figures, was a trifle less than 81.3 cents, compared with 84.4 cents in 1911. This represents the value of cement in bulk at the mills, including the labor cost of packing, but not the value of the sacks or barrels. The average price per barrel for the country is about 13.9 cents higher than the average price received for Portland cement in the Lehigh district, where it was sold at the cheapest rate, and is near the average price received in the Iowa-Missouri district but falls 54.5 cents below the average price received on the Pacific coast, where Portland cement brought the highest figure during the year.

The quantity of Portland cement produced, 82,438,096 barrels of 380 pounds, is equivalent to 13,985,034 long tons, and the value per long ton is $4.79. Compared with the production of pig iron for 1912, which was 29,726,937 long tons,[1] having a value of $414,096,232, or $13.93 per ton at the furnace, the Portland cement production approximates 47.04 per cent of the quantity of pig iron and 16.18 per cent of its value.

The average price of Portland cement in the United States has been increased slightly over the average for ordinary gray cement by the inclusion in the totals of 163,803 barrels of white Portland cement, valued at $2.29 a barrel. The greater part of this white cement—157,777 barrels—was produced in the Lehigh district, so that the value for that district has been increased in greater proportion than that of the other districts. Mills that produced white Portland cement as part of their product in 1912 were distributed as follows: Two in California, one in Colorado, one in Indiana, and two in Pennsylvania, besides one mill in Pennsylvania which produced white cement exclusively.

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[1] Quantity, which includes ferroalloys, according to figures of the American Iron and Steel Institute; value according to the United States Geological Survey.

PRODUCTION BY STATES.

In the following table the Portland cement production for 1911 and 1912 is given by States, or by groups of States where there are less than three producers in a single State. By the term "producer" is meant a Portland cement manufacturing company, whether the company operates one or more plants. In the table the term "producing plant" is applied to a mill or group of mills located at one place and operated by one company, but each establishment at a different place is counted as a plant. The value of the marketed production or shipments for 1912 will be found on the following page.

Production of Portland cement in the United States in 1911 and 1912, by States.

1911				1912		
State.	Producing plants.	Quantity (barrels).	Value.	State.	Producing plants.	Quantity (barrels).
Pennsylvania	25	26,864,679	$19,258,253	Pennsylvania	23	26,441,338
Indiana	5	7,407,830	5,937,241	Indiana	5	9,924,124
California	8	6,317,701	8,737,150	California	8	5,974,299
Kansas	12	4,871,903	3,725,108	New York	7	4,492,806
Illinois	5	4,582,341	3,583,301	Missouri	5	4,355,741
New Jersey	3	4,411,890	3,259,528	Illinois	5	4,299,357
Missouri	4	4,114,859	3,349,312	New Jersey	3	4,246,803
Michigan	11	3,686,716	3,024,676	Michigan	10	3,494,621
New York	7	3,314,217	2,669,194	Iowa	3	3,228,192
Iowa	3	1,952,590	1,881,253	Kansas	10	3,225,040
Ohio	5	1,451,852	1,228,680	Ohio	5	1,433,344
Washington	3	960,573	1,496,807	Washington	3	1,362,416
Utah	3	662,849	827,523	Utah	3	868,312
Texas	4	2,438,493	2,541,449	Texas	4	2,977,179
Oklahoma	2			Oklahoma	2	
Tennessee	2	1,981,341	1,590,438	Tennessee	2	2,348,886
West Virginia	1			West Virginia	1	
Kentucky	1			Kentucky	1	
Virginia	2	1,487,753	1,084,315	Virginia	1	1,737,739
Maryland	2			Maryland	2	
Colorado	2	1,162,081	1,272,317	Colorado	2	1,035,764
Montana	1			Montana	1	
Alabama	2	858,969	782,272	Alabama	2	992,135
Georgia	2			Georgia	1	
Total	115	78,528,637	66,248,817	Total	109	82,438,096

SHIPMENTS BY STATES.

It is possible to present here for the first time, from reports of the producers, the shipments of Portland cement for the year 1912, by States, and in connection therewith the total selling value in bulk at the mills and the average price per barrel. These data are given in the following table. It is not practicable to give corresponding data for 1911, but the estimated shipments, with values, are given by commercial districts for 1911 in the table on the following page.

Shipments of Portland cement in the United States in 1912, by States.

State.	Shipping plants.	Quantity (barrels).	Value.	Average price per barrel.
Pennsylvania	26	27,539,076	$18,918,165	$0.687
Indiana	5	9,634,582	7,237,591	.751
California	8	6,093,790	8,215,894	1.348
Missouri	5	4,614,547	3,700,776	.802
Illinois	5	4,602,617	3,444,085	.748
New York	7	4,543,060	3,448,735	.759
New Jersey	3	4,490,645	3,052,098	.680
Michigan	10	3,651,094	3,145,001	.861
Kansas	12	3,592,148	2,815,113	.784
Iowa	3	3,190,354	2,790,396	.875
Washington	3	1,438,137	2,012,785	1.399
Ohio	5	1,382,923	1,166,589	.844
Utah	3	760,668	937,119	1.232
Texas	4	2,952,592	3,088,058	1.045
Oklahoma	2			
Tennessee	2	2,471,233	1,729,419	.6998
West Virginia	1			
Kentucky	1			
Virginia	2	1,916,218	1,420,639	.741
Maryland	2			
Colorado	2	1,103,279	1,109,889	1.006
Montana	1			
Alabama	2	1,035,593	877,448	.847
Georgia	2			
Total	116	85,012,556	69,109,800	.813

PRODUCTION AND SHIPMENTS, BY COMMERCIAL DISTRICTS.

In addition to considering the Portland cement industry by States it is also of interest, and perhaps of more practical importance, to regard the commercial district as the geographic unit. Accordingly, beginning in 1911, the plants producing Portland cement were grouped together into 11 districts, the grouping being based to some extent on the relations of the plants to their trade territory. These relations are, of course, governed largely by transportation facilities and rates, and it has been found advisable to divide Pennsylvania, Indiana, and Texas in order to accomplish a logical grouping. The same grouping has been followed for both 1911 and 1912, but it is probable that certain of the present groups, particularly the Southeastern States, should be still further subdivided, and this may be done in the report for 1913.

In the following table an attempt has been made to summarize such of the essential features of the cement industry in the commercial districts as are available for both the years 1911 and 1912:

Production and shipments of Portland cement in 1911 and 1912, by commercial districts.

[Figures opposite P relate to production; those opposite S relate to shipments.]

District.		Active plants.		Production and shipments (barrels).		Percentage of change, 1912.	Average factory price per barrel.		Percentage of change, 1912.
		1911	1912	1911	1912		1911	1912	
Lehigh district (New Jersey and eastern Pennsylvania)	P..	24	22	25,972,108	24,762,083	− 4.65	....	....	....
	S..	25	25	25,192,464	26,013,891	+ 3.26	$0.715	$0.674	−5.73
New York	P..	7	7	3,314,217	4,492,806	+35.56	....	....	....
	S..	8	7	3,058,463	4,543,060	+48.54	.805	.759	−5.71
Ohio and western Pennsylvania	P..	9	9	6,756,313	7,359,402	+ 8.92	....	....	....
	S..	9	9	6,654,269	7,398,753	+11.19	.766	.757	−1.17
Michigan and northeastern Indiana	P..	13	12	4,519,726	4,308,645	− 4.67	....	....	....
	S..	14	12	4,550,896	4,417,808	− 2.92	.827	.851	+2.92
Kentucky and southern Indiana	P..	3	3	2,818,820	3,091,603	+ 9.67	....	....	....
	S..	3	3	2,800,526	3,134,841	+11.94	.793	.764	−3.65
Illinois and northwestern Indiana	P..	6	6	8,617,341	10,659,357	+23.69	....	....	....
	S..	6	6	8,537,442	10,677,479	+25.07	.791	.744	−5.94
Southeastern States (Maryland, Virginia, West Virginia, Tennessee, Georgia, and Alabama)	P..	11	9	4,049,063	4,737,257	+16.99	....	....	....
	S..	10	11	3,723,183	5,081,209	+36.47	.793	.737	−7.06
Iowa and Missouri	P..	7	8	6,067,449	7,583,933	+24.99	....	....	....
	S..	7	8	5,932,856	7,804,901	+31.55	.862	.832	−3.48
Great Plains States (Kansas, Oklahoma, and central Texas)	P..	17	15	7,010,396	5,807,043	−17.16	....	....	....
	S..	16	17	6,332,698	6,174,085	− 2.5	.834	.866	+3.83
Rocky Mountain States (Colorado, Utah, Montana, and western Texas)	P..	7	7	2,124,930	2,299,252	+ 8.20	....	....	....
	S..	7	7	1,994,790	2,234,602	+12.02	1.186	1.165	−1.77
Pacific coast States (California and Washington)	P..	11	11	7,278,274	7,336,715	+ .80	....	....	....
	S..	11	11	6,770,242	7,531,927	+11.25	1.406	1.358	−3.41
Total	P..	115	109	78,528,637	82,438,096	+ 4.97	....	....	....
	S..	116	116	75,547,829	85,012,556	+12.53	.844	.813	−3.67

According to this table there was in 1912, compared with 1911, a decrease in production in only three districts—the Lehigh, the Michigan-northeastern Indiana, and the Great Plains—and a decrease in shipments in only the last two of these districts. The mills in the State of New York made the greatest increase in both production and shipments, the percentages being, respectively, 35.56 and 48.54. The Iowa-Missouri district came next, with an increase in production and shipments, respectively, of 24.99 and 31.55 per cent. The Southeastern States showed an increase in production of 16.99 per cent and in shipments of 36.47 per cent. The two districts made up of Kentucky and southern Indiana and of the Rocky Mountain States showed almost the same rate of progress, the increase in the first district being 9.67 per cent for production and 11.94 per cent for shipments, and in the second 8.20 per cent for production and 12.02 per cent for shipments. The Pacific coast States showed only 0.8 per cent increase in production, but 11.25 per cent increase in shipments. The decrease in production was about parallel in the Lehigh and the Michigan and northeastern Indiana districts, being 4.65 per cent in the former and 4.67 per cent in the latter. The largest percentage of decrease was shown in the production of Portland cement in the Great Plains States, which fell off 17.16 per cent. The net change for the country at large was an increase in both production and shipments, amounting to 3,909,459 barrels, or nearly 4.98 per cent for the former, and to 9,464,727 barrels, or 12.53 per cent, for the latter.

In 1911 the production exceeded the shipments of Portland cement by 2,980,808 barrels, or 3.8 per cent of the production, but in 1912 the relation between production and shipments was reversed and the shipments exceeded production by 2,574,460 barrels, or 3.1 per cent of the production.

LEHIGH DISTRICT.

The Lehigh district of eastern Pennsylvania-New Jersey has, except in four years, shown a steady increase in production of Portland cement from 1890 to the present time. The years in which slight decreases were recorded are 1893, 1908, 1911, and 1912. The first two decreases were coincident with years of general business depression, but the decrease in 1911 and 1912 may perhaps be attributed in large part to an overproduction in 1910 and to the building of many mills in other parts of the United States which have restricted the trade territory of the Lehigh district. The production for 1912 was 24,762,083 barrels and the shipments were 26,013,891 barrels, valued at $17,538,989, or 67.4 cents a barrel. This production represented a decrease in quantity of 1,210,025 barrels compared with the production for 1911, and an average decrease in price of 4.1 cents a barrel. The production of white Portland cement from three plants, amounting to 157,777 barrels, valued at an average price of $2.29 a barrel, is included in the figures for 1912. There was no net gain or loss in the number of shipping plants in the Lehigh district, but two less plants produced cement than in 1911.

The following table shows the annual production of Portland cement in the Lehigh district since 1890, the total production for the country, and the percentage of the Lehigh district output each year compared with the total production:

Portland cement production in the Lehigh district and in the United States, 1890–1912, in barrels.

Year.	Lehigh district output.	Total output, United States.	Percentage of total manufactured in Lehigh district.	Year.	Lehigh district output.	Total output, United States.	Percentage of total manufactured in Lehigh district.
1890	201,000	335,500	60.0	1902	10,829,922	17,230,644	62.8
1891	248,500	454,813	54.7	1903	12,324,922	22,342,973	55.2
1892	280,840	547,440	51.3	1904	14,211,039	26,505,881	53.7
1893	265,317	590,652	44.9	1905	17,368,687	35,246,812	49.3
1894	485,329	798,757	60.8	1906	22,784,613	46,463,424	49.0
1895	634,276	990,324	64.0	1907	24,417,686	48,785,390	50.0
1896	1,048,154	1,543,023	68.1	1908	20,200,387	51,072,612	39.6
1897	2,002,059	2,677,775	74.8	1909	24,246,706	64,991,431	37.3
1898	2,674,304	3,692,284	72.4	1910	26,315,359	76,549,951	34.4
1899	4,110,132	5,652,266	72.7	1911	25,972,108	78,528,637	33.1
1900	6,153,629	8,482,020	72.6	1912	24,762,083	82,438,096	30.0
1901	8,595,340	12,711,225	67.7				

PRODUCTION ACCORDING TO RAW MATERIALS.

In the following table the production of Portland cement in the United States is classified according to the kinds of raw materials from which the cement is manufactured. 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 a few middle and western plants.

Type 2 includes cement made from a mixture of comparatively pure limestone with clay or shale. This mixture is employed at the majority of plants in the United States.

Type 3 includes cement manufactured from a mixture of marl and clay. This type of mixture is used in certain plants in the States of Michigan, Ohio, Indiana, New York, and Utah.

Type 4 includes Portland cement manufactured from a mixture of limestone and blast-furnace slag.

This table shows a continuation in the decrease in the relative production from cement rock (type 1) and from marl (type 3), and the corresponding increase in the production from limestone (type 2) and from slag (type 4).

Production, in barrels, and percentage of total output of Portland cement in the United States according to type of material used, 1898–1912.

Year.	Type 1. Cement rock and pure limestone.		Type 2. Limestone and clay or shale.		Type 3. Marl and clay.		Type 4. Blast-furnace 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
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,693	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9
1909	24,274,047	37.3	32,219,365	49.6	2,711,219	4.2	5,786,800	8.9
1910	26,520,911	34.6	39,720,320	51.9	3,307,220	4.3	7,001,500	9.2
1911	26,812,129	34.1	40,665,332	51.8	3,314,176	4.2	7,737,000	9.9
1912	24,712,780	30.0	44,607,776	54.1	2,467,368	3.0	10,650,172	12.9

STOCKS ON HAND.

Reports were received from nearly all the mills in the United States which shipped any Portland cement in 1912, giving stocks of finished cement on hand December 31, 1912. For the very few mills which did not report this information an estimate, believed to be very close, has been made. The apparent stock on hand at the end of 1912 amounted to 7,811,329 barrels, compared with 10,385,789 barrels on hand at the close of 1911, according to reports and revised estimates, thus indicating a reduction in stock of more than 2,500,000 barrels during 1912. The apparent stock on hand at the close of 1911 as given in Mineral Resources for 1911 was more than 11,000,000 barrels, but this estimate of quantity was based on very incomplete and, in some instances, inaccurate reports from the mills and has accordingly been revised. Although there is still room for greater accuracy in certain of the reports to the Survey on the stocks of Portland cement on hand, the totals for stocks and shipments show plainly that there was a general movement in 1912 to reduce stocks and to regulate production according to the market.

The following table gives the stocks on hand in the various States and districts at the close of 1912:

Stocks of Portland cement Dec. 31, 1912, by States and districts.

States.	Quantity.	Districts.	Quantity.
	Barrels.		*Barrels.*
Alabama and Georgia	84,368	Lehigh district (New Jersey and eastern Pennsylvania)	1,927,495
California	485,182	New York	555,989
Colorado and Montana	51,333	Ohio and western Pennsylvania	640,672
Illinois	321,116	Michigan and northeastern Indiana	515,619
Indiana	1,193,612	Kentucky and southern Indiana	285,422
Iowa	436,877	Illinois and northwestern Indiana	1,106,547
Kansas	442,426	Southeastern States (Maryland, Virginia, West Virginia, Tennessee, Georgia, and Alabama)	348,182
Kentucky, Tennessee, and West Virginia	137,660	Iowa and Missouri	893,720
Maryland and Virginia	148,058	Great Plains States (Kansas, Oklahoma, and Central Texas)	708,657
Michigan	370,956	Rocky Mountain States (Colorado, Utah, Montana, and western Texas)	222,037
Missouri	456,843	Pacific coast States (California and Washington)	606,989
New Jersey	231,398		
New York	555,989		
Ohio	200,800		
Oklahoma and Texas	323,496		
Pennsylvania	2,135,969		
Utah	113,439		
Washington	121,807		
Total	7,811,329	Total	7,811,329

QUANTITY CONSUMED.

An approximate estimate of the total consumption of Portland cement in the United States in 1912 might be made as follows: To the shipments, 85,012,556 barrels, add the imports, 68,503 barrels, and from the sum, 85,081,059 barrels, which represents the total available supply, subtract the exports, 4,215,532 barrels, which leaves 80,865,527 barrels as the total consumption. As compared with the apparent consumption in 1911, which amounted to 72,577,090 barrels, the consumption in 1912 increased 8,288,437 barrels, or 11.4 per cent.

GROWTH OF PORTLAND CEMENT PRODUCTION, 1890-1912.

The growth of Portland cement production for the years 1890 to 1912, inclusive, is illustrated graphically in figure 1. For comparison the decline in natural cement production is plotted on the same diagram.

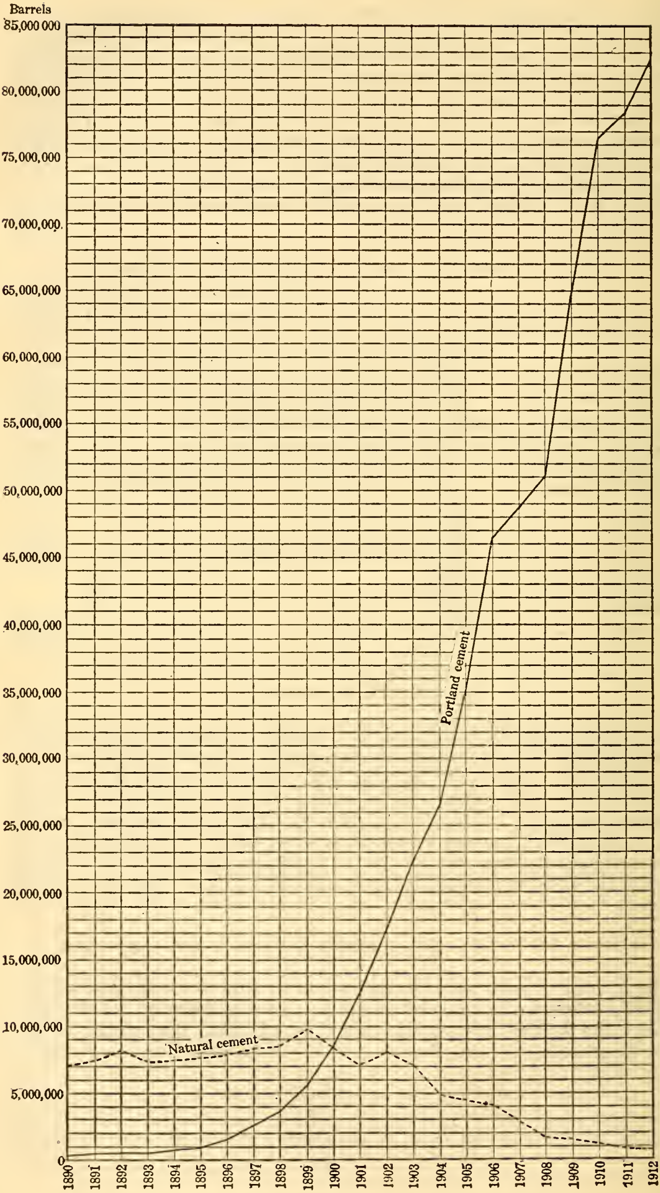

FIGURE 4.—Production of Portland and natural cements 1890–1912.

In the following table statistics are given covering the annual production of Portland cement in the United States from the beginning of the industry in the early seventies to the present day:

Production of Portland cement in the United States, 1870–1912, in barrels.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1870–1879	82,000	$246,000	1899	5,652,266	$8,074,371
1880	42,000	126,000	1900	8,482,020	9,280,525
1881	60,000	150,000	1901	12,711,225	12,532,360
1882	85,000	191,250	1902	17,230,644	20,864,078
1883	90,000	193,500	1903	22,342,973	27,713,319
1884	100,000	210,000	1904	26,505,881	23,355,119
1885	150,000	292,500	1905	35,246,812	33,245,867
1886	150,000	292,500	1906	46,463,424	52,466,186
1887	250,000	487,500	1907	48,785,390	53,992,551
1888	250,000	487,500	1908	51,072,612	43,547,679
1889	300,000	500,000	1909	64,991,431	52,858,354
1890 [a]	335,500	704,050	1910	76,549,951	68,205,800
1891	454,813	967,429	1911	78,528,637	66,248,817
1892	547,440	1,153,600	1912	82,438,096	67,022,172
1893	590,652	1,158,138			
			Total	590,190,930	562,248,143
1894	798,757	1,383,473			
1895	990,324	1,586,830			
1896	1,543,023	2,424,011			
1897	2,677,775	4,315,891			
1898	3,692,284	5,970,773			

[a] The figures for 1890 and previous years were estimates made at the close of each year and are believed to be substantially correct. Since 1890 the official figures are based on complete returns from all producers.

This table and the curve indicate that the Portland industry showed a fair rate of growth from its beginning in the seventies until 1895. At the latter date, however, a rapid development commenced, coincident, it may be noted, with the development of coal burning in the rotary kiln. This rapid rate of growth continued until 1907, when it was checked temporarily by the financial troubles of that year. Still later there was another short era of growth more rapid than ever before, only to be checked in 1911 by a combination of factors, the most important of which were overproduction in 1910 and generally quiet business conditions in 1911.

In 1912 the rate of growth increased slightly compared with 1911, owing in part to a resumption of construction work that had been deferred. This resumption was no doubt encouraged by the low price at which cement might be obtained.

The output of Portland cement has so far shown an increase each year, rising from 42,000 barrels in 1880 to 335,500 barrels in 1890, to 8,482,020 barrels in 1900, and to 82,438,096 barrels in 1912. The output of natural cement, on the other hand, reached its maximum in 1899, with an output of 9,868,179 barrels. Since that year it has shown an almost continuous decrease annually, until now it has become a relatively unimportant factor in the cement market.

PRICES.

According to reports made to the United States Geological Survey by the manufacturers the average price by districts of Portland cement per barrel in 1912 in bulk at the mills ranged between 67.4 cents in the Lehigh district and $1.358 on the Pacific coast, as compared with 71.5 cents and $1.406 for the same districts in 1911. The average price for the whole country was 81.3 cents in 1912, as compared with 84.4 cents in 1911, a decrease of 3.1 cents a barrel. The average price in 1912 reached the same level as in 1909 and is the lowest point recorded for Portland cement. The lowest average price reported to the Survey was 62 cents a barrel, received at several plants in Pennsylvania, and much cement was sold as low as 65 cents, not only in the East but in the Middle West. The highest figure reported was $1.65 a barrel, reported by a California plant.

Certain of the results of the low prices, which have continued below 90 cents for the last five years, are discussed under "Condition of the Portland-cement industry."

The following table gives the average factory price of Portland cement per barrel in bulk from 1870 to 1912:

Average price per barrel of Portland cement, 1870–1912.

1870–1880	$3.00	1893	$1.91	1903	$1.24
1881	2.50	1894	1.73	1904	.88
1882	2.01	1895	1.60	1905	.94
1883	2.15	1896	1.57	1906	1.13
1884	2.10	1897	1.61	1907	1.11
1885–1888	1.95	1898	1.62	1908	.85
1889	1.67	1899	1.43	1909	.813
1890	2.09	1900	1.09	1910	.891
1891	2.13	1901	.99	1911	.844
1892	2.11	1902	1.21	1912	.813

CONDITION OF THE PORTLAND CEMENT INDUSTRY.

Although the year 1911 closed with a large proportion of mills running and prices at their highest level for that year, the activity in the cement trade did not continue far into the early part of 1912. For the majority of plants in the United States the first three to six months of 1912 was a very quiet period. Fully 45 of the active plants were idle during three months or more, the majority having shut down on account of full stock houses and lack of demand for cement. Plants using marl in the northern districts were closed during the winter season according to custom, and about half the plants in Kansas were closed for several months on account of the scarcity of natural gas, but they improved the period of enforced idleness by installing coal-burning systems. Nearly all plants underwent a short period of idleness on account of repairs, and certain plants were handicapped by a scarcity of labor and by a shortage of cars for bringing coal. Besides the condition of the fuel supply, trade conditions were also adverse in Kansas, and in Colorado and other West-Central States the demand for cement was not as active as might have been desired. From various parts of the country—Alabama, Kansas, Pennsylvania, Texas, and Virginia—certain plants are reported to be in the hands of receivers. On the Pacific coast trade appears to have been in a better condition than elsewhere in the United States, but even there not all the plants were operated continuously, and prices decreased slightly. The only new construction work under way was in the Pacific coast States, where, it is reported, two new plants were under construction in Washington, one in Oregon, and one in California, all of which may produce some cement in 1913.

According to the course of the industry throughout the year 1912, it is probable that during the first five months both production and shipments of Portland cement by months fell below the figures reached in corresponding months in 1911, and that the entire gains over 1911 were made in the last seven months of the year. Although the general tone of comment on the cement industry in 1912 was depressing, it must not be understood that the pessimistic note was

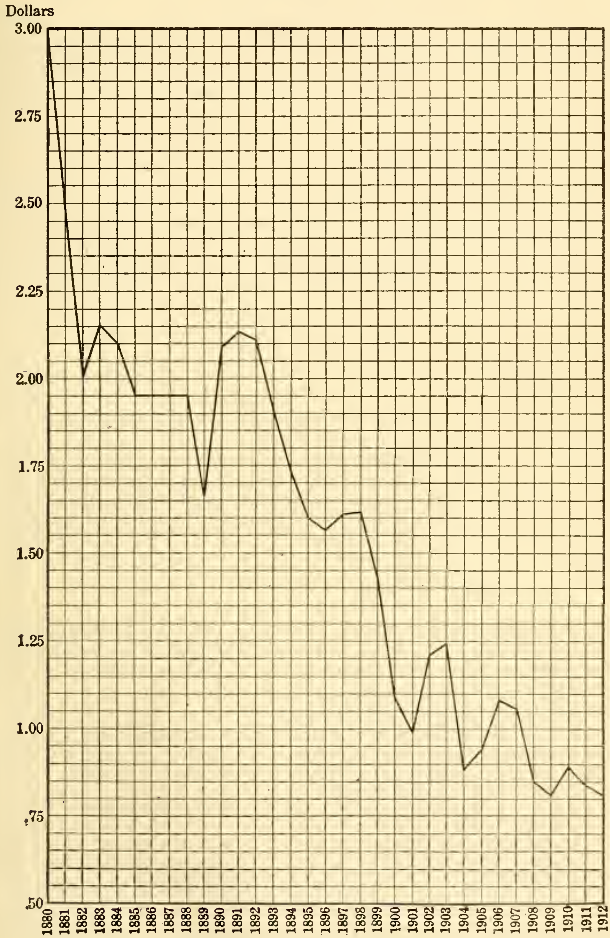

FIGURE 5.—Range in Portland cement prices, 1880–1912.

unanimous. Certain plants, some of them in the Lehigh district, reported an improvement in trade conditions compared with 1911. Taken altogether the year 1912 was one of large production and still larger shipments and of low prices. Low prices undoubtedly were largely the cause of the large volume of sales, and so long as cement continues to sell at a low figure the demand for it is apt to be active, especially as the prices of lumber and many other structural materials have increased steadily for several years.

For the sake of effecting savings on "cross freights" and on administrative and sale expenses, an effort was made early in 1912 to merge 13 Portland cement companies in a company capitalized at $40,000,000; nine of these companies were in Kansas, one in Missouri, one in Texas, and two in Oklahoma. The parties to the negotiations failed, however, to agree on appraisals of certain properties, and the project was abandoned.

The American Association of Portland Cement Manufacturers, comprising most of the manufacturers as far west as Utah, with headquarters in Philadelphia, is doing much to increase the use of cement and to steady the industry, by means of engineering literature, illustrated lectures, and monthly statistical reports of production, shipments, stock, etc. A second organization, the Western Association of Portland Cement Manufacturers, comprising companies on the Pacific coast, with headquarters in Portland, Oreg., has been established recently, and it is expected that it will perform similar services for the manufacturers in its territory.

The Cement Products Exposition Co. held expositions during 1912 in Chicago, Kansas City, and Pittsburgh, continuing the work of former years in educating the general public in the use of cement and concrete.

A new feature in marketing Portland cement has been introduced recently, consisting of shipping the cement in bulk rather than in sacks. It is considered that considerable expense can be saved by this method, especially where the shipments are made directly to large jobs, and also where dealers can store and handle the cement in bulk.[1]

NOTES ON USES OF CEMENT CONCRETE.

The construction of concrete pavements and roads is a phase of concrete work that is receiving increased attention at the present time. A valuable paper on this subject by A. N. Johnson, State engineer, Illinois Highway Commission, summarizes the results of much study and practical experience on this subject.[2]

The use, on a large scale, of concrete by municipalities for heavy masonry such as wharves, tunnels, viaducts, and retaining walls, has become well established. In the chapter in this series on the cement industry in 1909 the writer noted that a most promising but little-developed field for the use of cement in the United States is that of architectural and art work. It is gratifying to note that during the last three years much development has taken place in this field. It is also significant that the greatest appreciation of the possibilities of cement in this field is displayed by cities in the Central States, rather than in the East where the greatest quantity of cement is made. In an illustrated article the Concrete-Cement Age[3] says:

> The Chicago park system, which is recognized as one of the most beautiful chains of intercity breathing spots and recreational grounds in the world, offers a splendid

[1] Concrete-Cement Age, August, 1912, p. 41, and January, 1913, pp. 27-28.

[2] Johnson, A. N., Concrete highway construction: Concrete-Cement Age, December, 1912, pp. 72-75 (paper read at the American Road Congress, Atlantic City, N. J., October, 1912.)

[3] Goodnow, Marc N., Attractive use of concrete in Chicago parks: Concrete-Cement Age, November, 1912, pp. 29-33.

and striking example of what may be accomplished by modern municipalities with crushed stone and cement in designing and executing artistic buildings, ornamental ground pieces, and flower receptacles.

GROWTH OF CEMENT INDUSTRY ON PACIFIC COAST.[1]

In view of the fact that the Pacific coast district is practically the only field of extension of the Portland-cement industry at present, the following notes on the history and growth of the cement industry in that section are of interest here:

The industry on the Pacific coast is a little more than 29 years old. In the late eighties and early nineties two plants in California were making a natural cement from the argillaceous limestones occurring at Jamul, in southern California, and at Santa Cruz, in the central part of the State. A plant at Benicia, northeast of San Francisco, was making a cement from a calcareous conglomerate. At these plants the natural rock was quarried and broken up by hand. This rock, without further treatment, was burned in standing kilns of simple construction. The burnt rock was cooled and then picked over by hand. The pieces that showed the proper degree of burning were crushed and ground to a powder in the old-fashioned burr mill. The equipment of one of these natural-cement plants probably would not cost to exceed $5,000. The whole process was exceedingly crude and the investment very small as compared with the modern cement plant.

Moreover the cement made at these early plants was untrustworthy and exceedingly irregular in quality. The cement made at Benicia was used in the construction of the city hall at San Francisco and the poor quality was well shown in the ruins after the big earthquake of 1906.

The poor quality of the product and competition with imported Portland cement caused these natural cement plants to cease operation.

The first Pacific coast plant, 1884.—The first plant to make a true Portland cement of good quality was operated in Oregon. Several early writers mention this plant and state that it was the first to use successfully a rotary kiln. * * * The plant was located at Oregon City on the spot where the city pumping plant now stands. The factory was designed and managed by a Mr. Middleton. This man must have been a genius in his line, for his plant was built along plans that did not come into general use, even in the older cement plants in the East, until 10 years later. The raw material, a cement rock from southern Oregon, was ground in pebble mills and this raw mix was burned in a gas-fired rotary kiln. The resulting clinker was ground to a cement in a pebble mill. The gas was made for the most part from Australian coal, though local coal was used to some extent. Power was derived from the Falls of the Willamette, just above the plant.

The output of this pioneer plant was 100 barrels per day of true Portland cement. The product was in great demand and was superior in quality to the imported Portland cement. The cement was used in sidewalks and curb work and in making artificial stone.

The plant was operated on this scale for a little over a year and then it was decided to raise the capitalization of $50,000 and increase the capacity of the plant. About this time the directors ordered a survey of the quarry. It was discovered that the rock was practically exhausted. They had been operating on a thin saucer-like body of stone that was standing on edge against the side of the hill. What they had supposed to be an inexhaustible mountain of stone was in reality a thin veneer. * * * Along about 1890 the machinery was broken up and sold.

Later developments.—In 1894 Uriah Cummings, one of the most experienced men in the cement business and owner of a large factory in New York, planned to start a plant near Los Angeles. He knew the game thoroughly, and went into the matter of transportation and freight rates at the very first. * * * He then gave up all plans of operating a plant on the coast and went back East.

The first plant to operate successfully was started in 1898 by the California Portland Cement Co., at Colton, about 50 miles east of Los Angeles. The initial capacity was only 500 barrels per day. This old plant was later remodeled, and four years ago a new mill was built, increasing the capacity to 2,500 barrels per day of "Colton" cement.

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[1] Newhall, C. A., Growth of cement industry on Pacific coast; Concrete-Cement Age, vol. 2, No. 4, April, 1913, pp. 196–198.

With modern machinery and new methods of controlling the raw materials, this plant is now making a high-grade cement.

In 1903 two plants were started, the Standard Portland Cement Co., at Napa Junction, Cal., and the Pacific Portland Cement Co., at Cement, Cal. Both of these plants are near tidewater on San Francisco Bay. Both companies were very successful from the start. The cement compared favorably with any on the market at that time and was in great demand on account of the price being a little lower than that of the imported cement. Both plants were enlarged from time to time, and in 1906 each company built a new mill.

The new mill of the Pacific Portland Cement Co. was located only a short distance from the old mill. Both mills draw raw material from the same quarries, so the product of each mill is essentially the same. The combined capacity of the two mills of the Pacific Portland Cement Co. is about 5,000 barrels per day of "Golden Gate" cement.

The Standard Co. located its new plant, the Santa Cruz Portland Cement Co., at Davenport, Cal., near Santa Cruz and about 150 miles south of San Francisco. The raw materials used at this new plant were vastly different from the materials used at the old plant at Napa Junction, and consequently there was a great difference in the quality of the finished product. * * * The attempt to market the cement from both mills under the same brand was a failure and the company was later reorganized. The Napa Junction plant marketed the "Standard" brand. The factory at Santa Cruz was remodeled and a different kind of raw material used. The product was marketed as the "Blue Cross" brand. The Santa Cruz plant is the largest single unit in the world, with a rated output of 12,000 barrels per day.

In 1907 the Washington Portland Cement Co. started operation at Concrete, Wash., in Skagit County, with a capacity of 800 barrels per day. Three years later the capitalization was raised to $700,000 and the daily capacity was increased to 2,500 barrels of "Washington" cement.

The next year, 1908, the Superior Portland Cement Co. was started, the plant not one-half mile away from the plant of the Washington. The Superior is capitalized at $1,000,000, with a daily output of 1,500 barrels of "Superior" brand per day.

In 1909 two plants were started; that of the Riverside Portland Cement Co., at Riverside, Cal., with a capacity of 3,000 barrels per day of "Riverside" brand; and that owned by the Los Angeles Aqueduct Commission, of the city of Los Angeles.

The history of this experiment in municipal ownership is interesting * * * . It is sufficient to say that when the aqueduct commission called for bids on something like 1,000,000 barrels of cement the manufacturers put in a figure that seemed unduly high. The engineers of the commission figured that they could build and operate their own plant and still save the city a good sum, so the bids were rejected and the municipal plant constructed. Figures given by Mr. Mulholland [1] show that the city has been saved a considerable sum over the original bid of the manufacturers but would break about even at the price for which cement is now offered.

In 1910 the plant of the Golden State Portland Cement Co. was started at Oro Grande—on the Mohave Desert, in southern California. This plant is capitalized at $200,000 and rated at 1,000 barrels per day.

In 1911 the Inland Portland Cement Co., a subsidiary of the Lehigh Portland Cement Co., Allentown, Pa., began operations at Metaline Falls, Wash., north of Spokane.

In 1913, three new plants will be in operation—the International, just out of Spokane; the Olympic, in Bellingham, Wash.; and the San Juan, near Watsonville, on Monterey Bay, Cal. [A mill of the Portland Cement Co. at Oswego, near Portland, Oreg., was also under construction in 1912.—E. F. B.]

Changes in 29 years.—In the 29 years since 1884 the cement industry on the Pacific coast has grown from the single plant at Oregon City, with its 100 barrels per day capacity and $50,000 capitalization, to a total of 13 plants, capitalized at about $24,000,000 and with a combined output of about 38,500 barrels per day.

During these 29 years of physical growth there has been an even more astounding change in the quality of the cement. While it is common knowledge that the industry has grown very rapidly, but few people realize or know of the revolutionary changes that have taken place in the methods of manufacture, with the resulting changes in the quality of the cement produced by these new methods. On the Pacific coast these changes have been felt within the last five years only, though in Europe and the East the transition from old methods to new has been more gradual and has extended over a period of about 15 years.

[1] Chief engineer Los Angeles Aqueduct Commission.

MANUFACTURING CONDITIONS.

In 1912 there were 109 plants reported as having produced Portland cement, as compared with 115 plants in 1911. The total number of rotary kilns in the producing plants was 867 as compared with 916 in 1911. These kilns ranged in length from 40 to 240 feet, and the lengths as reported were distributed as follows:

Lengths of rotary cement kilns in the United States, 1911 and 1912.

Length.	1911 Number of kilns.	1912 Number of kilns.	Length.	1911 Number of kilns.	1912 Number of kilns.
Feet.			*Feet.*		
40 to 60	208	173	125	163	172
60 to 90	149	135	125 to 140	60	63
100	84	103	150 or more	26	29
110	140	106			
120	86	86	Total	916	867

There was a gain in the number of kilns 100 feet and 125 feet or more in length, but a decrease in the number of kilns less than 100 feet in length and also in the number of 110-foot kilns, so that there was a net decrease of 49 kilns, and the total number of kilns more than 100 feet was 559, exactly the same number as in 1911.

The apparent total annual kiln capacity in 1912 of plants, either active or only temporarily closed, according to producers' reports, due allowance being made for the customary loss of time from breakdowns and from necessary shutdowns for repairs, was about 110,000,000 barrels of Portland cement. This is a reduction of 2,500,000 barrels from the total capacity for 1911, which was estimated on the same basis. The total production for 1912, 82,438,096 barrels, was, according to these figures, apparently about 75 per cent of the normal cement-producing capacity of the country. This percentage, however, is probably too high, in view of the large number of idle kilns during the first three or four months of the year. The apparent average output per kiln in 1912 was about 95,000 barrels, as compared with 85,730 barrels in 1911.

The only plants which reported a commercial production of Portland cement in 1912 that were not among the active producers in 1911 were the Lumberman's Portland Cement Co., at Carlyle, Kans., and the Cape Girardeau Portland Cement Co., at Cape Girardeau, Mo. Seven plants that were active in 1911 reported no production in 1912, among them 1 plant in Georgia, 1 in Virginia, 2 in Pennsylvania, and 3 in Kansas. Several plants made shipments of cement in 1912 although they produced none.

A summary of kiln fuels in 1912 shows that 84 plants, employing a total of 695 kilns, operated with powdered coal as a kiln fuel; 20 plants, with 126 kilns, burned oil; and 5 plants, with 46 kilns, burned natural gas. As compared with 1911 this shows a decrease of 3 coal-burning plants, of 4 gas-burning plants, and an increase of 1 oil-burning plant, although in 1912 the number of active kilns which burned oil was less than in 1911.

The following table summarizes these data for 1911 and 1912, together with the quantities and percentages of Portland cement produced with coal, oil, and gas:

Summary of Portland cement kiln fuels in 1911 and 1912.

Fuel.	1911				1912			
	Number of plants.	Number of kilns.	Barrels.	Percentage of total.	Number of plants.	Number of kilns.	Barrels.	Percentage of total.
Coal	87	714	64,125,198	81.7	84	695	69,546,889	84.4
Oil	19	143	10,960,563	13.9	20	126	9,674,276	11.7
Natural gas	9	59	3,442,876	4.4	5	46	3,216,931	3.9
Total	115	916	78,528,637	100.0	109	867	82,438,096	100.0

IMPORTS OF FOREIGN CEMENT.[1]

The following table shows the quantities of foreign cement imported for consumption into the United States during the years 1878 to 1912, inclusive. Owing to the manner in which import statistics are grouped, the quantities given include not only Portland cement but all other hydraulic cements. The Portland cement, however, probably makes up at least 95 per cent of the total in each year.

The imports in 1912 were approximately 68,503 barrels, valued at $93,558, or about $1.37 a barrel, as compared with 164,670 barrels, valued at $242,722, or $1.47 a barrel in 1911. This decrease in the quantity of cement imported was to be expected in view of the large excess of domestic stocks that was marketed at low prices during the year. It should be stated here that the number of barrels given in the following table is slightly in excess of the true quantity. The imports of cement as reported by the Bureau of Foreign and Domestic Commerce are given in pounds, and include the weights of barrels, sacks, and other packages. There are no data at hand at present to show what proportion of the imports are received in barrels or in sacks, although it is understood that the greater part of the material is imported in sacks, which of course weigh very little.

The table shows a continuous decline in the imports of foreign cement for the last six years. In 1906 and 1907 the imports increased greatly over those of 1905, principally on account of the rebuilding of San Francisco following the fire.

Imports of foreign cement, 1878-1911, in barrels of 380 pounds.[2]

1878	92,000	1890	1,940,186	1902	1,963,023
1879	106,000	1891	2,988,313	1903	2,251,969
1880	187,000	1892	2,440,654	1904	968,409
1881	221,000	1893	2,674,149	1905	896,845
1882	370,406	1894	2,638,107	1906	2,273,493
1883	456,418	1895	2,997,395	1907	2,033,438
1884	585,768	1896	2,989,597	1908	842,121
1885	554,396	1897	2,090,924	1909	443,888
1886	915,255	1898	1,152,861	1910	306,863
1887	1,514,095	1899	2,108,388	1911	164,670
1888	1,835,504	1900	2,386,683	1912	68,503
1889	1,740,356	1901	939,330		

[1] Statistics according to the Bureau of Foreign and Domestic Commerce, Department of Commerce.
[2] The statistics from 1899 to the present represent "Imports for consumption." The figures for all preceding years are for "Total imports."

EXPORTS.[1]

The United States has a comparatively small export trade in cement. In 1912 the total quantity exported was only 4,215,232 barrels, most of which was Portland cement, valued at $6,160,341, or approximately $1.46 a barrel, as compared with 3,135,409 barrels, valued at $4,632,215, or about $1.477 a barrel, in 1911. The quantity exported in 1912 was slightly more than 5 per cent of the total production of hydraulic cements in 1912. The exports in 1910, 1911, and 1912 have shown increases, respectively, of 135 per cent, 27 per cent, and 26 per cent, over those of each preceding year. There are excellent reasons for increasing these exports as rapidly as possible, for, although the export trade in a relatively bulky and low-priced material, such as cement, does not promise large direct profits to the individual producer, indirectly the creation and maintenance of an export trade should benefit the industry at large, through disposing of surplus stocks and thereby tending to maintain steadier prices.

The following table gives the quantity and value of all classes of hydraulic cement exported during the years 1900–1912, inclusive, and the proportion of exports to the total quantity of hydraulic cement manufactured in the United States. The exports are almost wholly of Portland cement at present.

Exports of hydraulic cement, 1900–1912, in barrels.

Year.	Quantity.	Value.	Percentage of total.	Year.	Quantity.	Value.	Percentage of total.
1900	100,400	$225,306	0.6	1907	900,550	$1,450,841	1.7
1901	373,934	679,296	1.9	1908	846,528	1,249,229	1.6
1902	340,821	526,471	1.3	1909	1,056,922	1,417,534	1.6
1903	285,463	433,984	.95	1910	2,475,957	3,477,981	3.2
1904	774,940	1,104,086	2.4	1911	3,135,409	4,632,215	3.9
1905	897,686	1,387,906	2.2	1912	4,215,532	6,160,341	5.1
1906	583,299	944,886	1.1				

PORTLAND CEMENT IN CANADA.

According to the preliminary report on the mineral production in Canada during the calendar year 1912, issued by the Canada Department of Mines, Mines Branch, February 27, 1913, the total quantity of Portland cement manufactured in Canada in 1912 was 7,169,184 barrels of 350 pounds, as compared with 5,677,539 barrels in 1911, an increase of 491,645 barrels, or 26 per cent. The total quantity of Portland cement sold during the year was 7,120,787 barrels, as compared with 5,692,915 barrels sold in 1911, an increase of 1,427,872 barrels, or 25 per cent. The average price per barrel at the mills in 1912 was $1.275, as compared with $1.34 in both 1911 and 1910.

The imports of Portland cement into Canada in 1912 were 1,434,413 barrels of 350 pounds each, at an average price of $1.37 per barrel. The imports in 1911 were 661,916 barrels, at an average price of $1.26. Of the 1912 imports 441,317 barrels were from the United States. The imports in 1912 constituted about 16.74 per cent of the total consumption in Canada, as compared with about 10 per cent in 1911. The total consumption in 1912 was approximately 8,555,200 barrels.

[1] Statistics according to Bureau of Foreign and Domestic Commerce, Department of Commerce.

NATURAL CEMENT.

PRODUCTION.

The natural cement produced in the United States during 1912 amounted to 821,231 barrels, valued at $367,222, as compared with an output of 926,091 barrels, valued at $378,533, in 1911, a decrease in 1912 of 104,860 barrels or 11.3 per cent in quantity and of $11,311 or 3 per cent in value. The average price of natural cement per barrel at the mills in 1912 was 44.7 cents, as compared with 40.9 cents in 1911.

PRODUCTION BY STATES.

Natural cement was produced in 1912 in 15 plants distributed in nine States, there being no change in the situation as compared with 1911, except a decrease in production. In the following table the natural-cement production of 1911 and 1912 is outlined by States:

Production of natural cement in 1911–12, by States.

State.	1911			1912		
	Producing plants.	Quantity (barrels).	Value.	Producing plants.	Quantity (barrels).	Value.
New York	4	429,832	$178,937	4	366,236	$162,376
Pennsylvania	2			2		
Illinois	1			1		
Indiana	1	257,859	86,370	1	229,901	91,787
Ohio	1			1		
Minnesota	2	192,000	86,640	2	213,500	104,625
Kansas	1			1		
Georgia	2	46,400	26,586	2	11,594	8,434
Texas	1			1		
Total	15	926,091	378,533	15	821,231	367,222

THE NATURAL CEMENT INDUSTRY, 1818-1912.

The following table contains statistics of production of natural cement since the beginning of its manufacture in this country in 1818. It will be seen that the natural-cement trade reached its greatest prosperity in the period 1887–1903, inclusive, its year of maximum output being 1899, when 9,868,179 barrels of natural cement were manufactured in the United States. Beginning with 1904, the industry has shown a continuous decline in production each year, and its production for 1912 is the lowest on record since before 1880. See also the curve of production, figure 1.

Production of natural cement in the United States, 1818–1912, in barrels of 265 pounds.

1818–1829	300,000	1895	7,741,077
1830–1839	1,000,000	1896	7,970,450
1840–1849	4,250,000	1897	8,311,688
1850–1859	11,000,000	1898	8,418,924
1860–1869	16,420,000	1899	9,868,179
1870–1879	22,000,000	1900	8,383,519
1880	2,030,000	1901	7,084,823
1881	2,440,000	1902	8,044,305
1882	3,165,000	1903	7,030,271
1883	4,190,000	1904	4,866,331
1884	4,000,000	1905	4,473,049
1885	4,100,000	1906	4,055,797
1886	4,186,152	1907	2,887,700
1887	6,692,744	1908	1,686,862
1888	6,253,295	1909	1,537,638
1889	6,531,876	1910	1,139,239
1890	7,082,204	1911	926,091
1891	7,451,535	1912	821,231
1892	8,211,181		
1893	7,411,815	Total	231,526,464
1894	7,563,488		

PUZZOLAN AND OTHER SLAG CEMENTS.

Puzzolan cement was manufactured during 1912 at three plants in the United States—at North Birmingham, Ala., Struthers, Ohio, and Sharon, Pa.—and Collos cement was made at Buffalo, N. Y. The output of puzzolan and Collos cements in 1912 was 91,867 barrels, valued at $77,363, compared with 93,230 barrels, valued at $77,786, in 1911. This represents a decrease in quantity of 1,363 barrels and in value of $423. The average price per barrel of these slag cements in 1911 and 1912 was 83.4 cents. It is noteworthy that in 1912 the average price of slag cement was 2.1 cents higher than that of Portland cement. It is possible that this situation has never occurred heretofore. One reason for the present high average price of puzzolan cement is that a considerable quantity of this product is of a light color and is considered to be nonstaining; consequently it is sold at a much higher price than ordinary gray or brown cements.

The following table gives the annual production of puzzolan cement in the United States since 1896, when the first output of this cement was reported. The figures for 1912 represent marketed production.

Output of puzzolan cement in the United States, 1896–1912, in barrels of 330 pounds.[1]

1896	12,265	1906	481,224
1897	48,329	1907	557,252
1898	150,895	1908	151,451
1899	335,000	1909	160,646
1900	446,609	1910	95,951
1901	272,689	1911	93,230
1902	478,555	1912	91,864
1903	525,896		
1904	303,045	Total	4,587,348
1905	382,447		

[1] Includes output of Collos cement in 1911 and 1912.

The following table summarizes the number of active plants and the production of puzzolan cement during the last five years:

Statistics of the puzzolan-cement industry, 1908–1912.

	1908	1909	1910	1911	1912
Number of plants reporting production:					
Alabama	1	1	1	1	1
Illinois					
Kentucky					
Maryland					
New Jersey					
New York [a]				1	1
Ohio	2	2	2	1	1
Pennsylvania	1	1	1	1	1
Total	4	4	4	4	4
Production in barrels of 330 pounds	151,451	160,646	95,951	93,230	91,864
Value of production	$95,468	$99,453	$63,286	$77,786	$77,363

[a] Includes production of Collos cement in 1911 and 1912.

BLENDED CEMENT.

A cement which partakes of the natures of both puzzolan and Portland cements, as described more fully in this report for 1910,[1] is being produced in connection with the construction of the Los Angeles Aqueduct in California. It is made by regrinding Portland cement with volcanic tuff, and is called locally "tufa cement." The output of this cement in 1912 was 205,000 barrels, valued at $1.50 per barrel, but it is not included in the total cement production, since the quantity of Portland cement required in the process (50 per cent by volume), and manufactured by the Portland cement mill of the Los Angeles Aqueduct at Monolith, has been included in the total production of Portland cement in the United States.

[1] Cement: Mineral Resources U. S. for 1910, pt. 2, U. S. Geol. Survey, 1911, p. 487.

CLAY-WORKING INDUSTRIES.

By Jefferson Middleton.

INTRODUCTION.

The present report deals with the products of the clay-working industries, with the exception of the section on clay mining; hence the tables are made up to show the products of clay manufactured and not the production of clay.

The year 1912 in the clay-working industries was one of considerable progress in many respects, the total value of all clay products marketed in the year being $172,811,275, compared with $162,236,181 in 1911, an increase of $10,575,094, or 6.52 per cent. Compared with the value of the clay products of 1910, hitherto the year of maximum value, the value in 1912 increased $2,695,301, or 1.58 per cent; compared with 1909, the increase was $6,490,062, or 3.90 per cent; and compared with 1908, the year of general business depression, the increase was $39,613,513, or 29.74 per cent.

Of the two great divisions of the industry (1) brick and tile and (2) pottery, the former showed the larger increase, both actual and proportionate. The increase in the brick industry was $8,589,490, or 6.73 per cent; the increase in the pottery industry was $1,985,604, or 5.75 per cent.

The most important features in the industries in 1912 were the large increase in the value of architectural terra cotta, and also of the brick from the Hudson River region, the large decrease in draintile, and the excellent condition of the pottery industry. Efforts to improve the quality of all varieties of clay goods, from common brick to the highest-grade pottery, are constantly being made by the clay workers of the country, as is evinced by the new shades and texture of building brick, the new forms of hollow building tile or block, and the new effects in terra cotta that are being put on the market, and by a general improvement in the higher grades of pottery.

In the brick and tile industry increase was shown in the quantity and value of common brick, in the quantity and value of front brick, in the value of fancy or ornamental brick, in the value of sewer pipe, of architectural terra cotta, fireproofing, tile (not drain), and in the quantity and value of fire brick. Decrease was recorded in the quantity and value of vitrified paving brick, in the value of enameled brick, of draintile, stove lining, and the miscellaneous items. The increase in the quantity of common brick was less than 1 (0.94) per cent over 1911, but owing to the higher prices prevailing in 1912 for this variety of brick the gain in value was disproportionately greater—3.83 per cent.

The largest decrease sustained by any product was in the drain-tile industry—$816,064, or 9.25 per cent, and the largest increase was in architectural terra cotta—$2,562,635, or 42.58 per cent.

Fire brick being used almost exclusively in the iron and steel and coke-making industries, its production rises and falls with the conditions of those industries, and as they progressed in 1912, so did the fire-brick industry show considerable progress.

In the pottery industry every variety of ware of the classification, except one, showed an increase, and the year was one of notable progress in every way. The value of the imports of pottery decreased over 10 per cent, and the proportion of domestic production to consumption was the highest recorded, 81.45 per cent. The exports of high-grade domestic pottery, though small, increased, and the exports of all clay products increased 36.42 per cent.

In statements to the Survey quantities are reported for common brick, front brick, vitrified paving brick, and fire brick, but not for fancy or ornamental brick or enameled brick. The average price per thousand increased 16 cents on common brick and 26 cents on vitrified paving brick; it decreased 31 cents per thousand on front brick and 29 cents on fire brick. The average value of product per firm reporting in 1912 was $40,339, compared with $35,055 in 1911.

The publicity campaign inaugurated by the brickmakers a few years ago, which was vigorously prosecuted during 1912, and the constant fight against the enormous fire loss—a loss that can best be met by the erection of fireproof structures of burnt clay and steel, not to mention the inherent worth of the material itself—both have a tendency to increase the use of the products of clay, so that except in times of business depression their use is almost sure to increase. The prospects are that the year 1913 will show much greater progress in these industries than the year 1912. The great clay-products expositions of the Middle West have served to call attention to the merits of burnt clay for structural and engineering purposes.

There were no strikes of importance in the clay-working industries in 1912. In Chicago there was a small strike early in the season, also in the Hudson River region. They were quickly settled, however, and had but slight, if any, influence on the industry. The scarcity of labor, however, was felt in many, if not all, sections of the country, and had a serious influence. The higher grades of ware—those that justify distant shipment by rail—suffered from a shortage of cars.

ACKNOWLEDGMENTS.

The writer again desires to thank the clay workers of the country on behalf of the Survey for their cooperation, without which this report would be impossible.

The State geological surveys of Alabama, Georgia, Iowa, Kansas, Maryland, Michigan, Missouri, New Jersey, North Carolina, Oklahoma, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin have cooperated in the collection of the statistics in these States, the completeness of the returns and the earlier publication of the results being due largely to their efforts.

Thanks are also extended to the clay-working press for its support and appreciation and to the officials who have supplied information concerning the building operations of the various cities of the country.

PRODUCTION.

PRODUCTION BY STATES.

In the following table will be found a statement of the value of the clay products in the United States in 1911 and 1912, by States:

Value of the products of clay in the United States in 1911 and 1912, by States and Territories.

State or Territory.	1911			1912		
	Brick and tile.	Pottery.	Total.	Brick and tile.	Pottery.	Total.
Alabama	$1,918,606	$28,496	$1,947,102	$1,912,966	$22,213	$1,935,179
Arizona	106,882	....	106,882	178,564	....	178,564
Arkansas	465,143	15,500	480,643	433,648	28,957	462,605
California	4,757,530	158,336	4,915,866	5,692,797	219,653	5,912,450
Colorado	1,566,636	40,073	1,606,709	1,396,147	41,247	1,437,394
Connecticut and Rhode Island	1,257,339	(a)	1,257,339	1,465,000	(a)	1,465,000
Delaware	200,610	....	200,610	162,216	....	162,216
District of Columbia	227,520	(a)	227,520	217,486	(a)	217,486
Florida	217,535	....	217,535	272,766	....	272,766
Georgia	2,612,050	24,330	2,636,380	2,787,484	19,057	2,806,541
Idaho and Nevada	198,479	....	198,479	176,108	....	176,108
Illinois	13,353,200	979,811	14,333,011	14,279,039	931,951	15,210,990
Indiana	5,996,034	1,004,737	7,000,771	6,858,149	1,077,102	7,935,251
Iowa	4,396,555	36,319	4,432,874	4,492,185	30,141	4,522,326
Kansas	2,360,262	(a)	2,360,262	2,036,500	(a)	2,036,500
Kentucky	2,254,000	114,094	2,368,094	2,329,536	114,204	2,443,740
Louisiana	531,949	(a)	531,949	523,643	(a)	523,643
Maine	619,214	(a)	619,214	534,101	(a)	534,101
Maryland	1,518,023	254,411	1,772,434	1,681,042	184,711	1,865,753
Massachusetts	1,471,761	228,526	1,700,287	1,515,067	252,099	1,767,166
Michigan	1,953,442	130,490	2,083,932	2,350,606	194,892	2,545,498
Minnesota	1,693,478	(a)	1,693,478	1,611,040	(a)	1,611,040
Mississippi	664,176	23,660	687,836	589,093	12,706	601,799
Missouri	6,269,145	5,208	6,274,353	6,409,346	3,515	6,412,861
Montana	260,547	(a)	260,547	314,017	(a)	314,017
Nebraska	795,894	....	795,894	805,398	....	805,398
New Hampshire	430,748	(a)	430,748	492,096	(a)	492,096
New Jersey	9,776,287	8,401,941	18,178,228	10,902,633	8,935,920	19,838,553
New Mexico	174,651	(a)	174,651	185,575	....	185,575
New York	8,006,012	2,178,364	10,184,376	9,653,326	2,405,532	12,058,858
North Carolina	1,271,570	8,556	1,280,126	1,456,703	8,950	1,465,653
North Dakota	210,616	....	210,616	231,245	....	231,245
Ohio	17,888,630	14,775,265	32,663,895	19,302,773	15,508,735	34,811,508
Oklahoma	756,639	....	756,639	535,318	....	535,318
Oregon	1,081,025	(a)	1,081,025	734,226	(a)	734,226
Pennsylvania	18,113,216	2,156,817	20,270,033	19,408,681	2,128,540	21,537,221
Porto Rico	19,528	(a)	19,528	14,294	(a)	14,294
South Carolina	663,674	6,120	669,794	697,802	6,761	704,563
South Dakota	61,365	....	61,365	41,496	....	41,496
Tennessee	1,187,961	197,139	1,385,100	1,327,850	173,166	1,501,016
Texas	2,527,502	132,417	2,659,919	2,739,464	146,604	2,886,068
Utah	548,955	(a)	548,955	724,978	(a)	724,978
Vermont	86,466	....	86,466	79,266	....	79,266
Virginia	1,726,491	13,409	1,739,900	1,874,174	(a)	1,874,174
Washington	2,840,372	(a)	2,840,372	2,388,870	(a)	2,388,870
West Virginia	1,453,218	2,880,202	4,333,420	1,410,708	3,365,166	4,775,874
Wisconsin	1,149,539	8,600	1,158,139	1,036,586	7,900	1,044,486
Wyoming	77,146	....	77,146	45,103	....	45,103
Other States	....	715,739	715,739	....	684,442	684,442
Total	127,717,621	34,518,560	162,236,181	136,307,111	36,504,164	172,811,275
Percentage of total	78.72	21.28	100.00	78.88	21.12	100.00

a Included in "Other States."

This table shows that the brick and tile products as classified by the Survey continue to constitute approximately four-fifths and the pottery products one-fifth of the total value. These approximate proportions have been maintained for many years. Every State is a producer of burned clay. Of the Territories Alaska and Hawaii reported none for 1912. A small production was reported from the District of Columbia and from Porto Rico. In Nevada and Rhode

Island there was not a sufficient number of producers reporting to permit the publication of State totals without disclosing individual returns, so that statistics for these States have been combined with those of contiguous States.

Value of the clay products of the United States, by States and Territories, in 1911 and 1912, showing increase or decrease, with percentage of increase or decrease.

State or Territory.	1911	1912	Increase (+) or decrease (−) in 1912.	Percentage of increase (+) or decrease (−) in 1912.
Alabama	$1,947,102	$1,935,179	− $11,923	− 0.61
Arizona	106,882	178,564	+ 71,682	+67.07
Arkansas	480.643	462.605	− 18,038	− 3.75
California	4,915,866	5,912.450	+ 996,584	+20.27
Colorado	1,606,709	1,437,394	− 169,315	−10.54
Connecticut and Rhode Island	1,257,339	1,465.000	+ 207,661	+16.52
Delaware	200,610	162,216	− 38,394	−19.14
District of Columbia	227,520	217.486	− 10,034	− 4.41
Florida	217,535	272,766	+ 55,231	+25.39
Georgia	2,636,380	2,806,541	+ 170,161	+ 6.45
Idaho and Nevada	198,479	176,108	− 22,371	−11.27
Illinois	14,333.011	15,210,990	+ 877,979	+ 6.13
Indiana	7,000,771	7,935,251	+ 934,480	+13.35
Iowa	4,432,874	4,522,326	+ 89,452	+ 2.02
Kansas	2,360,262	2,036,500	− 323,762	−13.72
Kentucky	2,368,094	2,443,740	+ 75,646	+ 3.19
Louisiana	531,949	523,643	− 8,306	− 1.56
Maine	619,214	534,101	− 85,113	−13.75
Maryland	1,772,434	1,865,753	+ 93,319	+ 5.27
Massachusetts	1,700.287	1,767,166	+ 66,879	+ 3.93
Michigan	2,083,932	2,545.498	+ 461,566	+22.15
Minnesota	1,693,478	1,611,040	− 82,438	− 4.87
Mississippi	687,836	601,799	− 86,037	−12.51
Missouri	6,274,353	6,412,861	+ 138,508	+ 2.21
Montana	260,547	314,017	+ 53,470	+20.52
Nebraska	795,894	805,398	+ 9,504	+ 1.19
New Hampshire	430,748	492,096	+ 61,348	+14.24
New Jersey	18,178.228	19,838,553	+ 1,660,325	+ 9.13
New Mexico	174,651	185,575	+ 10,924	+ 6.25
New York	10,184,376	12,058,858	+ 1,874,482	+18.41
North Carolina	1,280,126	1,465,653	+ 185,527	+14.49
North Dakota	210.616	231,245	+ 20,629	+ 9.79
Ohio	32,663,895	34,811,508	+ 2,147,613	+ 6.57
Oklahoma	756,639	535,318	− 221,321	−29.25
Oregon	1,081,025	734,226	− 346,799	−32.08
Pennsylvania	20,270,033	21,537,221	+ 1,267,188	+ 6.25
Porto Rico	19,528	14,294	− 5,234	−26.80
South Carolina	669,794	704,563	+ 34,769	+ 5.19
South Dakota	61,365	41,496	− 19,869	−32.38
Tennessee	1,385,100	1,501,016	+ 115,916	+ 8.37
Texas	2,659,919	2,886,068	+ 226,149	+ 8.50
Utah	548.955	724,978	+ 176,023	+32.07
Vermont	86,466	79,266	− 7,200	− 8.33
Virginia	1,739,900	1,874,174	+ 134,274	+ 7.72
Washington	2,840,372	2,388,870	− 451,502	−15.90
West Virginia	4,333,420	4,775,874	+ 442,454	+10.21
Wisconsin	1,158,139	1,044,486	− 113,653	− 9.81
Wyoming	77,146	45,103	− 32,043	−41.54
Other States	[a] 715,739	[a] 684,442	− 31,297	− 4.37
Total	162,236,181	172,811,275	+10,575,094	+ 6.52

[a] Includes pottery products which could not be separately classified without disclosing individual figures.

Of the States and Territories represented in this table, 29 showed increase as compared with 1911 and 19 showed decrease. Ohio showed the largest increase, $2,147,613, or 6.57 per cent. The largest proportionate increase was in Arizona, 67.07 per cent. The largest decrease was sustained by Washington, $451,502, or 15.9 per cent, and the largest proportionate decrease was in Wyoming, 41.54 per cent. The State increases or decreases were not confined to any one section of the country. Of the 19 States that showed decrease in 1912, 2 were in New England—Maine and Vermont; 2 in the central

Atlantic region—Delaware and the District of Columbia; 4 in the Southern States—Alabama, Arkansas, Louisiana, and Mississippi; 2 in the Western States—Kansas and Oklahoma; 3 in the northern Central States—Minnesota, South Dakota, and Wisconsin; 3 in the Rocky Mountain region—Colorado, Idaho, and Nevada; 2 on the Pacific coast—Oregon and Washington; and Porto Rico. The first 10 States in value of production all showed increase in 1912.

Value of the products of clay in the United States in 1911 and 1912, with increase or decrease.

Product.	1911	1912	Increase (+) or decrease (−) in 1912.	Percentage of increase (+) or decrease (−) in 1912.
Common brick	$49,885,262	$51,796,266	+$1,911,004	+ 3.83
Vitrified paving brick or block	11,115,742	10,921,575	− 194,167	− 1.75
Front brick	8,648,877	9,455,297	+ 806,420	+ 9.32
Fancy or ornamental brick	177,015	225,367	+ 48,352	+27.32
Enameled brick	1,038,865	1,027,314	− 11,551	− 1.11
Draintile	8,826,314	8,010,250	− 816,064	− 9.25
Sewer pipe	11,454,616	12,147,677	+ 693,061	+ 6.05
Architectural terra cotta	6,017,801	8,580,436	+ 2,562,635	+42.58
Fireproofing	5,660,172	7,174,148	+ 1,513,976	+26.75
Tile (not drain)	5,356,184	5,809,495	+ 453,311	+ 8.46
Stove lining	614,116	516,874	− 97,242	−15.83
Fire brick	16,074,686	17,877,629	+ 1,802,943	+11.22
Miscellaneous	2,847,971	2,764,783	− 83,188	− 2.92
Total brick and tile	127,717,621	136,307,111	+ 8,589,490	+ 6.73
Total pottery	34,518,560	36,504,164	+ 1,985,604	+ 5.75
Grand total	162,236,181	172,811,275	+10,575,094	+ 6.52

This table shows that eight of the brick and tile items showed increase and five decrease in 1912. In general, the increases in these products were large and the decreases small, so that the total increase was considerable. In 1911 the same number of items, though not the identical items, increased and decreased, and the decreases were much greater than the increases, with the result that the net decrease in these items was large.

The greatest of all clay products in point of value and geographic distribution, common brick, which showed decrease in 1910 and 1911, rallied in 1912 and increased $1,911,004, or 3.83 per cent.

Vitrified paving brick, which showed an increase in 1911 of $111,076, or 1.01 per cent, suffered a decrease in 1912 of $194,167, or 1.75 per cent.

Draintile showed the largest decrease, $816,064, or 9.25 per cent. In 1911 this product decreased in value $1,563,508, or 15.05 per cent.

The growing use of high-grade brick in the exterior walls of buildings is manifested in the increasing value of front brick, which gained $806,420, or 9.32 per cent, over the production of 1911. In 1911 this product showed only a slight increase, $58,820, or 0.68 per cent.

Architectural terra cotta showed the largest gain in 1912, $2,562,635, or 42.58 per cent. In 1911 this product showed a decrease of $958,970, or 13.75 per cent.

Fire brick, which in 1911 showed a decrease of $2,036,788, or 11.25 per cent, made an increase in 1912 of $1,802,943, or 11.22 per cent. For 1912 silica brick were reported to the value of $2,923,174, which should be deducted from the figures here given to arrive at the value of the clay fire brick.

The total increase in the brick and tile products was $9,791,702; the total decrease was $1,202,212—a net increase of $8,589,490, or 6.73 per cent. The pottery production showed an increase of $1,985,604, or 5.75 per cent, the total net increase being $10,575,094, or 6.52 per cent. In 1911 the brick and tile production decreased in value $8,613,675, or 6.32 per cent, and pottery production increased $733,882, or 2.17 per cent, the net decrease in that year being $7,879,793, or 4.63 per cent.

The following table shows the value of the products of clay in the United States from 1903 to 1912, 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, 1903–1912, 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.
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
1907	5,536	9,795,698	58,785,461	6.00	876,245	9,654,282	11.02
1908	5,328	7,811,046	44,765,614	5.73	978,122	10,657,475	10.90
1909	5,068	9,791,870	57,251,115	5.85	1,023,654	11,269,586	11.01
1910	4,915	9,221,517	55,219,551	5.99	968,000	11,004,666	11.37
1911	4,628	8,475,277	49,885,262	5.89	948,758	11,115,742	11.72
1912	4,284	8,555,238	51,796,266	6.05	911,869	10,921,575	11.98

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.					
1903	433,016	$5,402,861	$12.48	$328,387	$569,689	a$14,062,369	(a)	$4,639,214
1904	434,351	5,560,131	12.80	300,233	545,397	11,167,972	(a)	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
1907	585,943	7,329,360	12.51	361,243	918,173	14,946,045	627,647	6,864,162
1908	584,482	6,935,600	11.87	259,556	660,862	10,696,216	529,976	8,661,476
1909	816,164	9,712,219	11.90	174,073	993,902	16,620,695	423,583	9,799,158
1910	697,857	8,590,057	12.31	179,505	832,225	18,111,474	503,806	10,389,822
1911	724,911	8,648,877	11.93	177,015	1,038,865	16,074,686	614,116	8,826,314
1912	814,007	9,455,297	11.62	225,367	1,027,314	17,877,629	516,874	8,010,250

Year.	Sewer pipe (value).	Architectural terra cotta (value).	Fireproofing (value).	Tile, not drain (value).	Miscellaneous (value).	Total brick and tile (value).	Pottery (value).	Total value.
1903	$8,525,369	$4,672,028	$3,861,343	$3,505,329	$3,073,856	$105,626,369	$25,436,052	$131,062,421
1904	9,187,423	4,107,473	3,629,101	3,023,428	3,669,282	105,864,978	25,158,270	131,023,248
1905	10,097,089	5,003,158	4,098,793	3,647,726	3,564,111	121,778,294	27,918,894	149,697,188
1906	11,114,967	5,739,460	4,586,538	4,634,898	3,988,394	129,591,838	31,440,884	161,032,722
1907	11,482,845	6,026,977	4,250,618	4,551,881	3,000,201	128,798,895	30,143,474	158,942,369
1908	11,003,731	4,577,367	3,168,037	3,877,780	2,268,517	108,062,207	25,135,555	133,197,762
1909	10,322,324	6,251,625	4,466,708	5,291,963	2,694,821	135,271,772	31,049,441	166,321,213
1910	11,428,696	6,976,771	5,110,597	5,240,644	2,743,482	136,331,296	33,784,678	170,115,974
1911	11,454,616	6,017,801	5,660,172	5,356,184	2,847,971	127,717,621	34,518,560	162,236,181
1912	12,147,677	8,580,436	7,174,148	5,809,495	2,764,783	136,307,111	36,504,164	172,811,275

a Stove lining is included in fire brick in 1903; in miscellaneous in 1904.

This table shows the growth of the clay-working industries during 10 years. The total value of these products ranged from $131,023,248 in 1904 to $172,811,275 in 1912. The increase of 1912 over 1903 was

$41,748,854, or 31.85 per cent. In four years, 1904, 1907, 1908, and 1911, there were decreases. That of 1904 was so small ($39,173) as to be almost negligible. The greatest decrease was in 1908—$25,744,607, or 16.20 per cent, and the greatest increase was in 1909—$33,123,451, or 24.87 per cent. The maximum value was reached in 1912 in but four brick and tile products—sewer pipe, architectural terra cotta, fireproofing, and tile (not drain). Pottery also reached its maximum value in 1912.

The maximum quantity of common brick was reached in 1906 and the maximum value in 1905. The output in 1912 was less than the maximum output by 1,471,801,000 brick, or 14.68 per cent, and less in value by $9,598,117, or 15.63 per cent. The average price per thousand ranged from $5.73 in 1908 to $6.25 in 1905. The average price in 1912 was $6.05, or 16 cents higher than that of 1911.

Vitrified brick reached its maximum quantity and value in 1909, after increasing steadily from 1905. Since 1909 it has decreased steadily in quantity, but in 1911 there was a small increase in value, which was more than offset by the decrease in 1912, so that the value in 1912 was the smallest since 1908. The average price per thousand ranged from $9.86 in 1903 to $11.98 in 1912.

Front brick reached its maximum quantity and value in 1909. It declined in 1910 and increased in 1911 and 1912. The production in 1912 was only 2,157,000 brick, or 0.26 per cent, and the value only $256,922, or 2.65 per cent, less than in 1909. The average price per thousand in 1912 ($11.62) was the lowest in 10 years. The highest in 10 years was $13.12 in 1905.

Enameled brick reached its maximum value in 1911 and showed a slight decline ($11,551), or 1.11 per cent, in 1912. The production in 1912 was nearly twice as great as that of 1903.

Fire brick showed a considerable increase in 1912, and its value in that year was exceeded by that of only one other year, 1910. In 1912 the production was $233,845, or 1.31 per cent, less than that of 1910, but was $7,181,143, or 67.14 per cent, greater than that of 1908, the year of minimum value in the period covered by the table.

Drain tile, after showing a steady increase for 10 years, showed large decreases in 1911 and 1912, so that the value for the latter year was the smallest since 1907, and was $2,379,572, or 22.90 per cent, less than that of 1910, the year of maximum value. The decrease in 1912 was due to dry weather, low prices, and scarcity of labor.

Sewer pipe attained its maximum value in 1912—$12,147,677. The next largest year was 1907—$11,482,845. The value in 1912 was $3,622,308, or 42.49 per cent, greater than that of 1903.

Architectural terra cotta reached its maximum value in 1912, which was more than double its value in 1904.

Fireproofing, including hollow building tile or block, showed a large increase in 1912, and reached its maximum value, $7,174,148. This was an increase of $4,006,111, or 126.45 per cent, in the value of this product since 1908, the year of minimum value in the period covered by the table.

Tile, not drain, which embraces all kinds of tile except drain tile, has varied considerably. It showed a large increase in 1909, a small decrease in 1910, and increases in 1911 and 1912, reaching its maximum value in 1912. Its value in 1912 was $2,786,067, or 92.15 per cent, greater than that of 1904.

The number of operating firms reporting continues to decrease—from 4,628 in 1911 to 4,284 in 1912. This is the largest decrease within the decade, and is probably due to the elimination of the smaller temporary plants. It should be borne in mind, however, that no attempt is made to show the number of yards or plants, or even the number of operators, but merely the number of operators reporting sales of products during the year. The number of plants is considerably larger than the number of firms reporting business during the year, as many operators have more than one plant and some as many as 20 or more.

RANK OF STATES.

The following table shows the rank of States in the value of clay products, the number of operating firms reporting, and the percentage of the total value produced in each State in 1911 and 1912:

Rank of States, value of output, and percentage of total value of clay products in 1911 and 1912.

State or Territory.	1911				1912			
	Rank.	Number of operating firms reporting.	Value.	Percentage of total product.	Rank.	Number of operating firms reporting.	Value.	Percentage of total product.
Ohio	1	633	$32,663,895	20.13	1	596	$34,811,508	20.14
Pennsylvania	2	423	20,270,033	12.49	2	393	21,537,221	12.46
New Jersey	3	162	18,178,228	11.21	3	155	19,838,553	11.48
Illinois	4	330	14,333,011	8.83	4	301	15,210,990	8.80
New York	5	222	10,184,376	6.28	5	219	12,058,858	6.98
Indiana	6	302	7,000,771	4.32	6	278	7,935,251	4.59
Missouri	7	122	6,274,353	3.87	7	110	6,412,861	3.71
California	8	92	4,915,866	3.03	8	91	5,912,450	3.42
West Virginia	10	55	4,333,420	2.67	9	54	4,775,874	2.76
Iowa	9	214	4,432,874	2.73	10	200	4,522,326	2.62
Texas	12	118	2,659,919	1.64	11	104	2,886,068	1.67
Georgia	13	109	2,636,380	1.63	12	96	2,806,541	1.62
Michigan	16	111	2,083,932	1.28	13	101	2,545,498	1.47
Kentucky	14	96	2,368,094	1.46	14	90	2,443,740	1.41
Washington	11	55	2,840,372	1.75	15	50	2,388,870	1.38
Kansas	15	53	2,360,262	1.46	16	46	2,036,500	1.18
Alabama	17	82	1,947,102	1.20	17	74	1,935,179	1.12
Virginia	19	77	1,739,900	1.07	18	75	1,874,174	1.09
Maryland	18	56	1,772,434	1.09	19	55	1,865,753	1.08
Massachusetts	20	68	1,700,287	1.05	20	63	1,767,166	1.02
Minnesota	21	81	1,693,478	1.04	21	79	1,611,040	.93
Tennessee	23	84	1,385,100	.85	22	80	1,501,016	.87
North Carolina	24	163	1,280,126	.79	23	162	1,465,653	.85
Connecticut and Rhode Island	25	42	1,257,339	.78	24	41	1,465,000	.85
Colorado	22	80	1,606,709	.99	25	71	1,437,394	.83
Wisconsin	26	101	1,158,139	.71	26	92	1,044,486	.61
Nebraska	28	68	795,894	.49	27	59	805,398	.47
Oregon	27	63	1,081,025	.67	28	65	734,226	.42
Utah	33	37	548,955	.34	29	32	724,978	.42
South Carolina	31	44	669,794	.41	30	42	704,563	.41
Mississippi	30	63	687,836	.42	31	55	601,799	.35
Oklahoma	29	40	756,639	.47	32	29	535,318	.31
Maine	32	52	619,214	.38	33	47	534,101	.31
Louisiana	34	50	531,949	.33	34	40	523,643	.30
New Hampshire	36	26	430,748	.27	35	26	492,096	.29
Arkansas	35	50	480,643	.30	36	43	462,605	.27
Montana	37	25	260,547	.16	37	23	314,017	.18
Florida	39	21	217,535	.13	38	18	272,766	.16
North Dakota	40	11	210,616	.13	39	12	231,245	.13
District of Columbia	38	9	227,520	.14	40	9	217,486	.13
New Mexico	43	15	174,651	.11	41	12	185,575	.11
Arizona	44	20	106,882	.07	42	17	178,564	.10
Idaho and Nevada	42	36	198,479	.12	43	26	176,108	.10
Delaware	41	21	200,610	.12	44	17	162,216	.09
Vermont	45	7	86,466	.05	45	5	79,266	.05
Wyoming	46	13	77,146	.05	46	10	45,103	.03
South Dakota	47	8	61,365	.04	47	7	41,496	.02
Porto Rico	48	18	19,528	.01	48	14	14,294	.01
Other States			[a] 715,739	.44			[a] 684,442	.40
Total		4,628	162,236,181	100.00		4,284	172,811,275	100.00

[a] Undistributed pottery products.

The value of clay products ranged by States in 1912 from $14,294, or 0.01 per cent of the total, in Porto Rico to $34,811,508, or 20.14 per cent, in Ohio. In 1911 Ohio reported 20.13 per cent of the total. Ohio has been the leading State in the value of clay products since figures were first compiled by the Survey in 1894. It is likely to maintain this position for many years, as its output in 1912 was $13,274,287, or 61.63 per cent, greater than that of Pennsylvania, the second State, whose output was valued at $21,537,221, or 12.46 per cent of the total. In 1911 Pennsylvania reported 12.49 per cent of the total. New Jersey was the third State in both years, reporting 11.21 per cent of the total in 1911 and 11.48 per cent in 1912. There was no change in the relative rank of the first eight States. Iowa, which was ninth in 1911 was tenth in 1912, and West Virginia, which was tenth in 1911, was ninth in 1912. There were but slight changes in the relative ranks of the other States. Michigan rose from sixteenth to thirteenth; Washington fell from eleventh to fifteenth; Colorado fell from twenty-second to twenty-fifth; Utah rose from thirty-third to twenty-ninth; Oklahoma fell from twenty-ninth to thirty-second; and Delaware fell from forty-first to forty-fourth. The first 10 States reported for 1912 wares valued at $133,015,892, or 76.96 per cent of the total; for 1911 the same States reported wares valued at $122,586,827, or 75.56 per cent of the total. The first five States reported wares in 1912 valued at $103,457,130, or 59.86 per cent of the total, as compared with $95,629,543, or 58.94 per cent of the total in 1911.

BRICK AND TILE.

PRODUCTION.

PRODUCTION BY STATES.

The following tables show the output and value of the building brick and other structural products of clay, and of the fire brick, paving brick, and other clay products used in engineering work, the rank of the State in these products, and the percentage of the total value of each State in 1911 and 1912:

Brick and tile products in the United States in 1911.

Rank.	State or Territory.	Common brick.			Vitrified brick or block.		
		Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
		Thousands.			*Thousands.*		
16	Alabama	129,694	$708,903	$5.47	21,444	$246,707	$11.50
44	Arizona	10,249	90,282	8.81			
35	Arkansas	57,398	389,091	6.78	(a)	(a)	8.14
8	California	282,199	1,716,442	6.08	9,186	155,885	16.97
19	Colorado	89,950	559,519	6.22	2,334	31,572	13.53
24	Connecticut and Rhode Island	206,631	1,153,409	5.58	(a)	(a)	15.50
41	Delaware	20,158	165,225	8.20			
38	District of Columbia	25,225	187,690	7.44			
39	Florida	36,207	216,365	5.98			
11	Georgia	325,948	1,692,610	5.19	(a)	(a)	12.22
42	Idaho and Nevada	22,251	189,804	8.53			
3	Illinois	1,074,486	6,126,911	5.70	124,623	1,627,683	13.06
7	Indiana	192,057	1,132,555	5.90	31,198	392,136	12.57
9	Iowa	154,434	1,025,011	6.64	8,879	103,384	11.64
13	Kansas	183,809	694,586	3.78	83,337	823,505	9.88
14	Kentucky	107,771	692,378	6.42	(a)	(a)	12.37
34	Louisiana	83,007	487,322	5.87			
32	Maine	51,444	364,414	7.08	(a)	(a)	24.74
20	Maryland	160,229	999,791	6.24	(a)	(a)	16.98
21	Massachusetts	166,834	1,079,778	6.47	(a)	(a)	11.00
15	Michigan	252,465	1,301,998	5.16	5,597	78,336	14.00
18	Minnesota	153,015	868,037	5.67	(a)	(a)	13.16
30	Mississippi	92,431	584,960	6.33			
6	Missouri	217,466	1,309,164	6.02	44,813	488,299	10.90
37	Montana	16,023	155,715	9.72			
28	Nebraska	102,706	657,001	6.40	(a)	(a)	11.55
36	New Hampshire	57,567	430,748	7.48			
4	New Jersey	429,367	2,401,962	5.59	(a)	(a)	14.99
43	New Mexico	12,416	101,034	8.14	(a)	(a)	11.35
5	New York	1,143,726	5,918,286	5.17	17,035	290,728	17.07
23	North Carolina	178,235	1,076,183	6.04			
40	North Dakota	15,288	108,691	7.11			
2	Ohio	389,515	2,299,194	5.90	315,944	3,200,475	10.13
29	Oklahoma	102,013	528,287	5.18	19,535	201,100	10.29
27	Oregon	66,267	533,652	8.05			
1	Pennsylvania	774,122	4,963,232	6.41	124,125	1,511,061	12.17
48	Porto Rico	1,656	15,278	9.23	(a)	(a)	15.00
31	South Carolina	103,788	624,103	6.01			
47	South Dakota	5,621	42,297	7.52			
25	Tennessee	144,824	842,864	5.82	(a)	(a)	10.41
12	Texas	255,811	1,596,763	6.24	(a)	(a)	15.92
33	Utah	34,407	267,938	7.79	(a)	(a)	10.00
45	Vermont	9,561	55,702	5.83			
17	Virginia	219,035	1,374,439	6.27			
10	Washington	99,588	695,100	6.98	40,291	743,352	18.45
22	West Virginia	59,961	400,916	6.69	56,956	681,747	11.97
26	Wisconsin	151,331	985,824	6.51			
46	Wyoming	7,091	73,808	10.41			
	Other States [b]				43,461	539,772	12.42
	Total	8,475,277	49,885,262	5.89	948,758	11,115,742	11.72
	Percentage of brick and tile products		39.06			8.70	
	Percentage of total of clay products		30.75			6.85	

[a] Included in "Other States." [b] Includes all products made by less than 3 producers in 1 State.

Brick and tile products in the United States in 1911—Continued.

Rank.	State or Territory.	Front brick.			Fancy or ornamental brick.	Drain tile.	Sewer pipe.	Architectural terra cotta.	Fireproofing.
		Quantity.	Value.	Average price per thousand.	Value.	Value.	Value.	Value.	Value.
		Thousands.							
16	Alabama	9,169	$128,403	$14.00	(a)	$3,777	(a)		(a)
44	Arizona	(a)	(a)	19.63					
35	Arkansas	738	8,030	10.88		4,261			(a)
8	California	15,197	381,226	25.09	(a)	34,780	$999,546	$475,647	$200,923
19	Colorado	26,189	294,783	11.26	$1,220	23,655	297,800		(a)
24	Connecticut and Rhode Island	(a)	(a)	12.49	(a)				
41	Delaware	(a)	(a)	19.80		(a)			
38	District of Columbia					(a)	(a)		(a)
39	Florida					(a)			
11	Georgia	12,788	112,675	8.81		5,000	417,267	(a)	(a)
42	Idaho and Nevada	390	7,925	20.32					
3	Illinois	19,786	240,135	12.14	10,281	1,372,049	507,694	1,879,275	552,994
7	Indiana	40,777	480,709	11.79	(a)	2,006,803	455,014	(a)	437,778
9	Iowa	9,241	114,178	12.36	(a)	2,468,962	284,817		374,628
13	Kansas	27,887	213,711	7.66	(a)	35,875	(a)	(a)	15,257
14	Kentucky	8,972	90,330	10.07		64,005	(a)		(a)
34	Louisiana	(a)	(a)	9.53		(a)			
32	Maine	3,139	31,602	10.07		(a)	(a)		
20	Maryland	757	10,574	13.97	(a)	8,048		(a)	
21	Massachusetts	(a)	(a)	18.00					(a)
15	Michigan	2,498	31,572	12.64		313,072	(a)		(a)
18	Minnesota	10,853	135,085	12.45		121,965	(a)		109,812
30	Mississippi	1,012	11,020	10.89		65,196			
6	Missouri	25,491	330,332	12.96	24,269	164,393	1,156,626	402,969	123,499
37	Montana	819	15,234	18.60		(a)	(a)		(a)
28	Nebraska	(a)	(a)	20.00		14,339			(a)
36	New Hampshire								
4	New Jersey	47,606	528,656	11.10	(a)	26,502	103,137	1,669,973	1,728,811
43	New Mexico	753	11,380	15.11		(a)			(a)
5	New York	9,942	133,563	13.43	(a)	112,609	116,184	673,529	227,871
23	North Carolina	(a)	(a)	9.81		11,704	(a)		(a)
40	North Dakota	(a)	(a)	17.28	(a)				
2	Ohio	159,118	1,630,898	10.25	25,340	1,684,420	3,445,601		1,086,287
29	Oklahoma	2,551	24,703	9.68					
27	Oregon	(a)	(a)	26.43		69,857	(a)		(a)
1	Pennsylvania	184,569	2,111,492	11.44	44,883	12,779	560,809	389,000	300,687
48	Porto Rico					(a)	(a)		(a)
31	South Carolina	900	10,400	11.55		(a)			
47	South Dakota	(a)	(a)	10.94	(a)	(a)			(a)
25	Tennessee	9,547	94,733	9.92	(a)	51,721	(a)		(a)
12	Texas	19,331	297,847	15.41		12,817	(a)		47,038
33	Utah	11,978	160,057	13.36		17,596	(a)		(a)
45	Vermont					(a)			
17	Virginia	21,032	314,201	14.94	(a)	10,875	(a)		
10	Washington	5,224	118,615	22.71	(a)	29,314	738,473	283,608	153,180
22	West Virginia	(a)	(a)	14.98		3,487	(a)		(a)
26	Wisconsin	9,920	100,140	10.09		58,547			(a)
46	Wyoming	(a)	(a)	15.04					
	Other States [b]	26,737	474,668	17.75	71,022	17,906	2,371,648	243,800	301,407
	Total	724,911	8,648,877	11.93	c1,215,880	8,826,314	11,454,616	6,017,801	5,660,172
	Percentage of brick and tile products		6.77		.95	6.91	8.97	4.71	4.43
	Percentage of total of clay products		5.33		.75	5.44	7.06	3.71	3.49

a Included in "Other States."
b Includes all products made by less than 3 producers in 1 State.
c Includes enameled brick, valued at $1,038,865, made in the following States: California, Illinois, Maryland, Missouri, New Jersey, and Pennsylvania.

Brick and tile products in the United States in 1911—Continued.

Rank.	State or Territory.	Tile, not drain.	Stove lining.	Fire brick.			Miscellaneous.[a]	Total value.	Percentage of total value.
		Value.	Value.	Quantity.	Value.	Average price per thousand.	Value.		
				Thousands.					
16	Alabama			11,929	$193,375	$16.21	$16,221	$1,918,606	1.50
44	Arizona			(b)	(b)	60.00		106,882	.08
35	Arkansas			(b)	(b)	12.76		465,143	.36
8	California	$90,632	(b)	17,323	468,120	27.02	104,185	4,757,530	3.72
19	Colorado	(b)		8,057	182,766	22.68	65,096	1,566,636	1.23
24	Connecticut and Rhode Island	(b)	(b)	(b)	(b)	22.00		1,257,339	.98
41	Delaware							200,610	.16
38	District of Columbia							227,520	.18
39	Florida							217,535	.17
11	Georgia	(b)	(b)	5,694	86,000	15.10		2,612,050	2.05
42	Idaho and Nevada			(b)	(b)	37.50		198,479	.16
3	Illinois	(b)		19,285	286,039	14.83	48,272	13,353,200	10.46
7	Indiana	(b)	(b)	2,903	76,116	26.22	491,994	5,996,034	4.69
9	Iowa	(b)					7,814	4,390,555	3.44
13	Kansas	(b)		(b)	(b)	20.10	197,667	2,360,262	1.85
14	Kentucky	292,563		52,074	890,810	17.11		2,254,000	1.76
34	Louisiana						27,599	531,949	.42
32	Maine			(b)	(b)	20.00		619,214	.48
20	Maryland	(b)	$28,469	13,161	249,674	18.97		1,518,023	1.19
21	Massachusetts	(b)	167,802	1,955	70,104	35.86		1,471,761	1.15
15	Michigan	(b)	(b)	(b)	(b)	18.08	(b)	1,953,442	1.53
18	Minnesota	(b)		(b)	(b)	21.13		1,693,478	1.33
30	Mississippi						3,000	664,176	.52
6	Missouri	(b)	(b)	86,945	1,763,548	20.28	169,517	6,269,145	4.91
37	Montana			840	31,659	37.69		260,547	.20
28	Nebraska						23,465	795,894	.62
36	New Hampshire							430,748	.34
4	New Jersey	1,197,330	(b)	58,470	1,344,884	23.00	331,276	9,776,287	7.65
43	New Mexico			1,041	25,654	24.64		174,651	.14
5	New York	86,602	82,803	8,453	347,415	41.10	14,837	8,006,012	6.27
23	North Carolina			(b)	(b)	13.85	2,300	1,271,570	1.00
40	North Dakota			(b)	(b)	24.37		210,616	.16
2	Ohio	2,312,482	86,673	93,511	1,539,450	16.46	577,810	17,888,630	14.01
29	Oklahoma						2,549	756,639	.59
27	Oregon			(b)	(b)	26.15	485	1,081,025	.85
1	Pennsylvania	358,913	164,848	294,062	5,555,529	18.89	606,908	18,113,216	14.18
48	Porto Rico	(b)	(b)					19,528	.02
31	South Carolina			(b)	(b)	14.47		663,674	.52
47	South Dakota	(b)						61,365	.05
25	Tennessee			1,365	15,915	11.66	700	1,187,961	.93
12	Texas			4,918	78,230	15.91	49,636	2,527,502	1.98
33	Utah			(b)	(b)	37.99	5,066	548,955	.43
45	Vermont		(b)					86,466	.07
17	Virginia			(b)	(b)	15.15		1,726,491	1.35
10	Washington		(b)	2,250	63,654	28.29	(b)	2,840,372	2.22
22	West Virginia	136,586		10,314	74,596	7.23	45,884	1,453,218	1.14
26	Wisconsin						2,028	1,149,539	.90
46	Wyoming							77,146	.06
	Other States[c]	881,076	83,521	10,471	210,332	20.09	53,662	(d)	
	Total	5,356,184	614,116	[e]809,504	[e]16,074,686	19.86	2,847,971	127,717,621	100.00
	Per centage of brick and tile products	4.20	.48		12.59		2.23	100.00	
	Percentage of total of clay products	3.30	.38		9.91		1.76	78.73	

[a] Including adobes, burnt-clay ballast, charcoal furnaces, chimney pipe and tops, conduits, crucibles, flue lining, gas logs, glasshouse supplies, grave and lot markers, muffles, radial chimney brick and block, retorts, saggers, scorifiers, semienameled brick, silo blocks, vases and ornaments, and wall coping.

[b] Included in "Other States."

[c] Includes all products made by less than 3 producers in 1 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.

[e] In the total quantity and total value of fire brick are included, respectively, 104,483,000 silica brick, valued at $2,520,816, of which 74,674,000, valued at $1,525,086, was produced by Pennsylvania, and the remainder, 29,809,000, valued at $995,730, by Alabama, Colorado, Illinois, Indiana, Missouri, Montana, and Utah.

Brick and tile products in the United States in 1912.

Rank.	State or Territory.	Common brick. Quantity (thousands).	Common brick. Value.	Average price per thousand.	Vitrified brick or block. Quantity (thousands).	Vitrified brick or block. Value.	Average price per thousand.
16	Alabama	136,989	$759,409	$5.54	26,480	$353,303	$13.34
42	Arizona	13,166	114,309	8.68	....	....	....
36	Arkansas	52,986	345,154	6.51	(a)	(a)	8.69
8	California	349,797	2,198,303	6.28	5,443	72,495	13.32
24	Colorado	66,833	407,428	6.10	(a)	(a)	12.04
21	Connecticut and Rhode Island	214,700	1,377,456	6.42	(a)	(a)	17.71
44	Delaware	18,574	147,716	7.95	....	....	....
40	District of Columbia	22,841	182,230	7.98	....	....	....
38	Florida	44,710	262,766	5.88	....	....	....
10	Georgia	315,476	1,634,670	5.18	(a)	(a)	12.00
43	Idaho and Nevada	19,306	155,486	8.05	....	....	....
3	Illinois	1,210,499	6,437,331	5.32	136,708	1,839,721	13.46
6	Indiana	202,056	1,204,494	5.96	55,237	654,341	11.85
9	Iowa	148,472	1,017,097	6.85	15,033	197,035	13.11
15	Kansas	145,986	584,273	4.00	80,906	806,427	9.97
14	Kentucky	99,119	656,373	6.62	(a)	(a)	8.36
34	Louisiana	74,617	473,702	6.35	....	....	....
33	Maine	41,451	297,987	7.19	(a)	(a)	25.00
18	Maryland	154,560	1,053,335	6.82	(a)	(a)	17.93
20	Massachusetts	157,527	1,095,584	6.95	....	....	....
13	Michigan	271,189	1,592,283	5.87	(a)	(a)	13.94
19	Minnesota	129,604	760,983	5.87	(a)	(a)	16.34
31	Mississippi	87,431	522,901	5.98	....	....	....
7	Missouri	188,496	1,243,070	6.59	30,551	342,930	11.22
37	Montana	18,811	185,793	9.88	(a)	(a)	17.33
27	Nebraska	98,895	637,983	6.45	(a)	(a)	15.00
35	New Hampshire	62,135	492,096	7.92	....	....	....
4	New Jersey	429,309	2,592,091	6.04	....	....	....
41	New Mexico	12,120	110,342	9.10	(a)	(a)	10.99
5	New York	1,273,641	7,311,675	5.74	18,634	287,089	15.41
22	North Carolina	193,058	1,236,443	6.40	....	....	....
39	North Dakota	15,031	117,301	7.80	....	....	....
2	Ohio	395,836	2,414,482	6.10	268,271	2,830,309	10.55
32	Oklahoma	67,712	341,589	5.04	18,805	175,905	9.35
28	Oregon	47,174	363,374	7.70	....	....	....
1	Pennsylvania	697,023	4,590,784	6.59	112,372	1,411,096	12.56
48	Porto Rico	1,840	14,294	7.77	....	....	....
30	South Carolina	112,175	663,550	5.92	....	....	....
47	South Dakota	4,239	33,356	7.87	....	....	....
25	Tennessee	154,211	903,032	5.86	(a)	(a)	11.11
11	Texas	242,748	1,590,960	6.55	(a)	(a)	14.56
29	Utah	44,044	294,105	6.68	....	....	....
45	Vermont	8,126	49,167	6.05	....	....	....
17	Virginia	244,541	1,513,338	6.19	....	....	....
12	Washington	78,000	547,061	7.01	(a)	(a)	16.88
23	West Virginia	60,819	393,864	6.48	52,200	633,709	12.14
26	Wisconsin	122,910	830,773	6.76	....	....	....
46	Wyoming	4,455	44,473	9.98	....	....	....
	Other States b	....	....	....	91,229	1,317,215	14.44
	Total	8,555,238	51,796,266	6.05	911,869	10,921,575	11.98
	Percentage of brick and tile products	....	38.00	....	....	8.01	....
	Percentage of total of clay products	....	29.97	....	....	6.32	....

a Included in "Other States."
b Includes all products made by less than 3 producers in 1 State.

Brick and tile products in the United States in 1912—Continued.

Rank.	State or Territory.	Front brick. Quantity (thousands).	Front brick. Value.	Average price per thousand.	Fancy or ornamental brick. Value.	Drain tile. Value.	Sewer pipe. Value.	Architectural terra cotta. Value.	Fireproofing. Value.
16	Alabama	10,629	$132,033	$12.42	(a)	$5,465	(a)	....	(a)
42	Arizona	(a)	(a)	20.00	....	....	(a)	....	(a)
36	Arkansas	2,643	28,068	10.62	....	5,220	....	....	(a)
8	California	18,714	492,617	26.32	(a)	37,377	$1,136,429	$650,637	$250,931
24	Colorado	20,087	233,175	11.61	$3,785	20,250	(a)	(a)	22,213
21	Connecticut and Rhode Island	(a)	(a)	13.25	(a)	....	....	....	....
44	Delaware	(a)	(a)	20.00	....	(a)	....	....	....
40	District of Columbia	....	....	....	....	(a)	(a)	....	(a)
38	Florida	....	....	....	....	10,000	....	....	....
10	Georgia	11,527	114,000	9.89	(a)	(a)	622,627	(a)	(a)
43	Idaho and Nevada	898	16,822	18.73	....	....	....	....	....
3	Illinois	21,894	268,433	12.26	8,785	1,189,910	500,844	2,485,012	507,222
6	Indiana	60,544	659,492	10.89	(a)	1,657,368	544,491	(a)	623,123
9	Iowa	11,912	142,637	11.97	(a)	2,293,084	291,672	....	535,254
14	Kansas	27,972	215,873	7.72	(a)	50,948	(a)	(a)	48,173
15	Kentucky	5,025	46,300	9.21	(a)	71,826	(a)	....	29,530
34	Louisiana	(a)	(a)	10.71	....	(a)		....	....
33	Maine	2,160	20,000	9.26	....	(a)	(a)	....	....
18	Maryland	1,968	39,664	20.15	(a)	3,043	....	(a)	(a)
20	Massachusetts	(a)	(a)	20.00	....	....	....	....	(a)
13	Michigan	3,934	41,476	10.54	....	387,945	(a)	....	1,461
19	Minnesota	11,555	144,125	12.47	....	126,690	(a)	....	160,804
31	Mississippi	1,060	15,746	14.85	....	48,221	....	....	....
7	Missouri	19,963	264,375	13.24	19,838	141,297	1,178,482	654,163	75,551
37	Montana	1,076	17,753	16.50	....	(a)	(a)	....	(a)
27	Nebraska	5,229	80,650	15.42	....	5,260	....	....	60,016
35	New Hampshire	....	....	....	....	....	....	....	....
4	New Jersey	48,852	558,372	11.43	(a)	50,984	(a)	2,330,065	2,031,350
41	New Mexico	2,872	41,388	14.41	....	....	....	....	(a)
5	New York	9,499	123,378	12.99	(a)	51,005	(a)	1,139,291	217,411
22	North Carolina	(a)	(a)	8.92	....	10,745	(a)	....	....
39	North Dakota	5,392	104,396	19.36	(a)	....	....	....	....
2	Ohio	184,405	1,836,989	9.96	16,692	1,546,723	4,022,078	....	1,750,715
32	Oklahoma	1,803	16,924	9.39	....	(a)	....	....	....
28	Oregon	(a)	(a)	24.95	....	74,737	(a)	(a)	40,367
1	Pennsylvania	217,328	2,321,479	10.68	43,186	12,421	829,917	569,943	350,219
48	Porto Rico	....	....	....	....	....	....	....	....
30	South Carolina	(a)	(a)	13.40	....	(a)	....	....	....
47	South Dakota	(a)	(a)	18.33	....	(a)	....	....	(a)
25	Tennessee	11,118	101,575	9.14	(a)	39,459	(a)	....	(a)
11	Texas	24,510	394,524	16.10	....	10,694	(a)	....	57,433
29	Utah	13,473	167,770	12.45	....	34,946	(a)	....	(a)
45	Vermont	....	....	....	....	(a)	....	....	....
17	Virginia	21,755	313,551	14.41	(a)	4,025	(a)	....	....
12	Washington	6,881	146,265	21.26	....	24,676	496,500	365,109	163,077
23	West Virginia	(a)	(a)	12.00	....	(a)	(a)	....	(a)
26	Wisconsin	14,096	135,520	9.61	....	67,993	....	....	....
46	Wyoming	(a)	(a)	14.00	....	....	....	....	....
	Other States[b]	13,233	219,927	16.62	133,081	27,938	2,524,637	386,216	249,298
	Total	814,007	9,455,297	11.62	[c]1,252,681	8,010,250	12,147,677	8,580,436	7,174,148
	Percentage of brick and tile products	....	6.94	....	.92	5.88	8.91	6.29	5.26
	Percentage of total clay products	....	5.47	....	.72	4.64	7.03	4.97	4.15

[a] Included in "Other States."
[b] Includes all products made by less than 3 producers in 1 State.
[c] Includes enameled brick valued at $1,027,314, made in the following States: California, Colorado, Illinois, Maryland, Missouri, New Jersey, Ohio, and Pennsylvania.

Brick and tile products in the United States in 1912—Continued.

Rank.	State or Territory.	Tile, not drain.	Stove lining.	Fire brick.		Average price per thousand.	Miscellaneous. [a]	Total value.	Percentage of total value.
		Value.	Value.	Quantity (thousands).	Value.		Value.		
16	Alabama	...	...	9,930	$240,434	$24.21	(b)	$1,912,966	1.40
42	Arizona	...	...	(b)	(b)	50.78	...	178,564	.13
36	Arkansas	...	...	(b)	(b)	13.50	...	433,648	.32
8	California	$76,358	(b)	19,033	513,583	26.98	$113,277	5,692,797	4.18
24	Colorado	2,200	...	15,519	301,680	19.44	68,197	1,396,147	1.02
21	Connecticut and Rhode Island	(b)	(b)	(b)	(b)	22.00	...	1,465,000	1.08
44	Delaware	...	...	...	...	...	...	162,216	.12
40	District of Columbia	...	...	...	...	...	...	217,486	.16
38	Florida	...	...	...	...	...	...	272,766	.20
10	Georgia	(b)	...	4,250	61,231	14.41	...	2,787,484	2.05
43	Idaho and Nevada	...	...	...	...	...	...	176,108	.13
3	Illinois	(b)	...	19,088	319,619	16.74	43,915	14,279,039	10.48
6	Indiana	(b)	(b)	6,769	114,419	16.90	518,090	6,858,149	5.03
9	Iowa	...	...	(b)	(b)	12.96	13,774	4,492,185	3.30
15	Kansas	(b)	...	(b)	(b)	25.03	3,685	2,036,500	1.49
14	Kentucky	310,945	...	53,162	1,000,056	18.81	2,500	2,329,536	1.71
34	Louisiana	...	...	(b)	(b)	29.73	29,353	523,643	.38
33	Maine	...	...	(b)	(b)	15.00	...	534,101	.39
18	Maryland	...	$26,673	13,986	262,817	18.79	...	1,681,042	1.23
20	Massachusetts	(b)	173,256	2,302	83,454	36.25	...	1,515,067	1.11
13	Michigan	(b)	(b)	(b)	(b)	17.78	(b)	2,350,606	1.73
19	Minnesota	...	...	(b)	(b)	15.00	(b)	1,611,040	1.18
31	Mississippi	...	...	(b)	(b)	35.00	1,875	589,093	.43
7	Missouri	(b)	(b)	97,751	1,941,347	19.86	191,319	6,409,346	4.70
37	Montana	...	...	714	27,555	38.59	...	314,017	.23
27	Nebraska	(b)	...	...	...	...	12,089	805,398	.59
35	New Hampshire	...	...	...	...	...	...	492,096	.36
4	New Jersey	1,255,246	(b)	60,782	1,460,988	24.04	212,287	10,902,633	8.00
41	New Mexico	...	...	604	10,980	18.18	...	185,575	.14
5	New York	45,865	75,751	8,962	328,644	36.67	19,772	9,653,326	7.08
22	North Carolina	...	...	324	4,430	13.67	(b)	1,456,703	1.07
39	North Dakota	...	...	(b)	(b)	25.89	...	231,245	.17
2	Ohio	2,421,783	37,544	94,955	1,629,638	17.16	755,034	19,302,773	14.16
32	Oklahoma	...	...	(b)	(b)	23.08	...	535,318	.39
28	Oregon	(b)	...	85	2,000	23.53	(b)	734,226	.54
1	Pennsylvania	385,952	138,630	335,054	6,178,870	18.44	616,916	19,408,681	14.24
48	Porto Rico	...	...	...	...	...	...	14,294	.01
30	South Carolina	...	...	2,018	29,242	14.49	...	697,802	.51
47	South Dakota	(b)	...	...	...	...	...	41,496	.03
25	Tennessee	...	...	871	10,981	12.61	375	1,327,850	.97
11	Texas	...	...	6,627	112,983	17.05	55,126	2,739,464	2.01
29	Utah	(b)	(b)	(b)	(b)	31.16	6,818	724,978	.53
45	Vermont	...	(b)	...	...	...	...	79,266	.06
17	Virginia	...	...	(b)	(b)	14.37	1,374	1,874,174	1.38
12	Washington	(b)	(b)	1,170	34,293	29.31	(b)	2,388,870	1.75
23	West Virginia	290,390	...	14,421	105,719	7.33	7,112	1,410,708	1.04
26	Wisconsin	...	...	...	...	...	(b)	1,036,586	.76
46	Wyoming	...	...	...	...	...	...	45,103	.03
	Other States [c]	1,110,756	65,020	9,726	179,492	18.45	91,895	(d)	...
	Total	5,869,495	516,874	[e] 913,681	[e] 17,877,629	19.57	2,764,783	136,307,111	100.00
	Percentage of brick and tile products	4.26	.38	...	13.12	...	2.03	100.00	...
	Percentage of total of clay products	3.36	.30	...	10.35	...	1.60	78.88	...

[a] Including adobes, aquarium ornaments, assay furnaces, burnt-clay ballast, charcoal furnaces, chemical brick, chimney pipe and tops, conduits, crucibles, flue pipe and lining, furnaces for heating irons, gas logs, glasshouse supplies, glazed brick, grave and lot markers, muffles, radial chimney brick and block, retorts, saggers, scorifiers, segments, silo blocks, stone pumps, sundials, vases and ornaments, and wall coping.

[b] Included in "Other States."

[c] Includes all products made by less than 3 producers in 1 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.

[e] In the total quantity and total value of fire brick are included, respectively, 135,578,000 silica brick, valued at $2,923,174, of which 101,596,000, valued at $1,950,708, was produced by Pennsylvania and the remainder, 33,982,000, valued at $972,466, by Alabama, Colorado, Idaho, Illinois, Indiana, Missouri, Montana, Ohio, and Utah.

Common brick, as its name implies, is the most widely distributed of the clay products, being reported from every State and Territory except Alaska and Hawaii. There were 8,555,238,000 common brick reported for 1912, valued at $51,796,266, an increase of 79,961,000 brick, or 0.94 per cent. In 1911 there was a decrease from 1910 of 746,240,000 brick, or 8.09 per cent. The value showed an increase in 1912 of $1,911,104, or 3.83 per cent. In 1911 the value decreased $5,334,289, or 9.66 per cent. In 1912, 19 States showed increases in quantity of production of common brick and 29 showed decreases; 22 showed increases and 26 showed decreases in value. Seventeen States showed increases in both production and value, namely, Alabama, Arizona, California, Connecticut and Rhode Island (taken together), Florida, Illinois, Indiana, Michigan, Montana, New Hampshire, New York, North Carolina, Ohio, South Carolina, Tennessee, Utah, and Virginia. Twenty-four States showed decreases in quantity and value; five, Maryland, Massachusetts, New Jersey, New Mexico, and North Dakota, showed decreases in quantity and increases in value; and two, Porto Rico and West Virginia, showed increases in quantity and decreases in value.

In 1912, New York, as for several years, was the largest producer of common brick, reporting 1,273,641,000 brick, valued at $7,311,675, or $5.74 per thousand, an increase in quantity over 1911 of 129,915,000 brick, or 11.36 per cent, and in value of $1,393,389, or 23.54 per cent. This production was 268,911,000 brick, or 17.43 per cent, less than that of 1909, New York's maximum output. Illinois was the second State in 1912 reporting 1,210,499,000 brick, valued at $6,437,331, or $5.32 per thousand; this was an increase of 136,013,000 brick, or 12.66 per cent, in quantity and of $310,420, or 5.07 per cent, in value. The third State in rank was Pennsylvania, which reported 697,023,000 brick, valued at $4,590,784, or $6.59 per thousand, a decrease of 77,099,000 brick, or 9.96 per cent, and of $372,448, or 7.5 per cent. New Jersey was fourth, as in 1911, reporting 429,309,000 brick, valued at $2,592,091, or $6.04 per thousand. This was a decrease in quantity of 58,000 brick, or 0.01 per cent, and an increase in value of $190,129, or 7.92 per cent. Ohio was fifth with an output of 395,836,000 brick in 1912, valued at $2,414,482, or $6.10 per thousand, an increase of 6,321,000 brick, or 1.62 per cent, and in value of $115,288, or 5.01 per cent. Of New York's production 968,764,000 brick, or 76.06 per cent, was from the Hudson River region, and of the output of Illinois, 765,845,000 brick, or 63.27 per cent, was from Cook County. The average price per thousand in 1912 for common brick ranged from $4 in Kansas to $9.98 in Wyoming, the average for the entire country being $6.05. For 1911 these same States reported the extremes in average price of $3.78 and $10.41. There was an increase in New York of 57 cents per thousand, and of 18 cents per thousand in Pennsylvania; in Illinois there was a decrease of 38 cents per thousand. Common brick composed 38 per cent of the value of all brick and tile products and 29.97 per cent of all clay products in 1912.

The total production of vitrified brick in 1912 was 911,869,000 brick or block. It is estimated from incomplete returns from producers that of this production 179,546,000 vitrified brick or block were used in 1912 for structural purposes, and that 732,323,000 brick were used for paving, and that 16,491,297 square yards of paving were laid with these brick.

Vitrified brick was reported from 27 States, a decrease of 3 from 1911, Massachusetts, New Jersey, Porto Rico, and Utah reporting none for 1912, and Montana, which reported none for 1911, again entering the list of producers. Ohio, as in 1911, was the leading State, reporting 268,271,000 brick, valued at $2,830,309, or $10.55 per thousand. This was a decrease of 47,673,000 brick, or 15.09 per cent, from 1911, and of $370,166, or 11.57 per cent, in value. Ohio reported 29.42 per cent of the total production and 25.91 per cent of the value in 1912. Illinois was second, reporting 136,708,000 brick, valued at $1,839,721, or $13.46 per thousand, an increase of 12,085,000 brick, or 9.7 per cent, and in value of $212,038, or 13.03 per cent. Pennsylvania was third and Kansas fourth as in 1911. Both of these States showed decreases in both production and value in 1912. The average price per thousand ranged in the important producing States from $9.35 in Oklahoma to $16.88 in Washington.

As for several years, Pennsylvania was the leading front brick producing State, reporting 26.7 per cent of the total quantity and 24.55 per cent of the total value. Ohio was second, and Indiana third, the latter displacing New Jersey, which was fourth. Next to common brick, front brick is reported from a larger number of States than any other product, 43 States reporting it for 1912, the same as for 1911.

Drain tile was reported from 39 States in 1912, or 1 less than for 1911, New Mexico and Porto Rico reporting none for 1912 and Oklahoma reentering the list. Iowa, Indiana, Ohio, Illinois, and Michigan were the leading States in the order named in 1912, as in 1911. These 5 States together reported drain tile valued at $7,075,030, or 88.32 per cent of the total in 1912; for 1911 these States reported drain tile valued at $7,845,306, or 88.89 per cent of the total. Only one of these leading States, Michigan, showed an increase in 1912. Iowa showed a decrease of $175,878, or 7.12 per cent; Indiana, $349,435, or 17.41 per cent; Ohio, $137,697, or 8.17 per cent; Illinois, $182,139, or 13.27 per cent. The increase of Michigan was $74,873, or 23.92 per cent.

Sewer pipe was reported from 28 States in 1912, the same number as for 1911, Arizona reporting sewer pipe and Porto Rico none. Ohio, as for many years, was the leading State and reported production valued at $4,022,078, or an increase of $576,477, or 16.73 per cent, over that of 1911. The value of Ohio's production was 33.11 per cent of the total for the country. Missouri was second and California third, as in 1911. These three States reported 52.17 per cent of the total for 1912.

Architectural terra cotta was reported from 13 States for 1912, an increase of 2 over 1911, Colorado and Oregon. In only seven States were there a sufficient number of producers to permit the publication of figures without disclosing individual returns. Every one of these States showed increases in the value of production. Illinois was the leading State in 1912, reporting a value of $2,485,012. This was an increase of $605,737, or 32.23 per cent, over 1911. New Jersey was second, with a value of $2,330,065, an increase of $660,092, or 39.53 per cent; New York was third, reporting $1,139,291, an increase of

$465,762, or 69.15 per cent. These three States reported 69.39 per cent of the total.

Fireproofing, including hollow building tile or block, was reported from 31 States in 1912, a decrease of 1. Arizona and Maryland, which reported no fireproofing in 1911, entered the list of producing States in 1912, and North Carolina, Porto Rico, and Wisconsin dropped out. New Jersey continues to be the leading State, reporting a production valued at $2,031,350, or 28.31 per cent of the total. This was an increase of $302,539, or 17.50 per cent. Ohio was second and Indiana third, displacing Illinois, which was fifth in 1912. Iowa was fifth in 1911 and fourth in 1912.

"Tile, not drain," includes roofing, floor, wall, and art tile. These wares were reported from 21 States in 1912, the same number as in 1911, though Nebraska, Oregon, Utah, and Washington appeared as producers, and Iowa, Maryland, Minnesota, and Porto Rico dropped out. Ohio, as for many years, was the leading State, reporting wares valued at $2,421,783, or 41.69 per cent, of the total. This was an increase of $109,301, or 4.73 per cent. New Jersey was second.

Fire brick in 1912, as for several years, was second only to common brick in value. It was reported from 37 States in 1912, an increase of 3 over 1911. Iowa, Louisiana, Mississippi, and Oklahoma appeared as producers, and Idaho and Nevada (taken together) dropped out, though Idaho reported the production of silica brick in 1912. The quantity reported, including silica brick, increased from 809,504,000 9-inch equivalent brick in 1911 to 913,681,000 brick in 1912, an increase of 104,177,000 brick, or 12.87 per cent. The total value was $17,877,629 in 1912, as compared with $16,074,686 in 1911, an increase of $1,802,943, or 11.22 per cent. The average price per 1,000 for all fire brick in 1912 was $19.57, compared with $19.86 in 1911. The total number of clay, 9-inch equivalent fire brick reported for 1912 was 778,103,000, valued at $14,954,455, or $19.22 per 1,000, the same average as in 1911. This was an increase of 73,082,000 brick, or 10.37 per cent, and in value of $1,400,585, or 10.33 per cent. Pennsylvania continues to be the leading producer of clay fire brick, reporting 43.06 per cent of the quantity and 41.32 per cent of the value in 1912. This was an increase of 40,992,000 brick, or 13.94 per cent, and in value of $623,341, or 11.22 per cent. If silica brick be included, Pennsylvania reported 47.79 per cent of the quantity of fire brick and 45.47 per cent of its value. This State reported 74.94 per cent of the quantity of silica brick and 66.73 per cent of its value. Missouri was second in quantity and value of clay fire brick, Ohio was third, New Jersey fourth, and Kentucky fifth in both. All of the first five States showed increases over 1911. The average price per 1,000 ranged in the important States for clay fire brick from $7.33 in West Virginia to $36.67 in New York.

The production of silica brick in 1912 was 135,578,000, 9-inch equivalent brick, valued at $2,923,174, or $21.56 per 1,000, compared with 104,483,000 brick, valued at $2,520,816, or $24.13 per 1,000 in 1911. This was an increase of 31,095,000 brick, or 29.76 per cent, and in value of $402,358, or 15.96 per cent, over 1911.

Pennsylvania was again the leading State in the value of brick and tile products, reporting wares valued at $19,408,681, or 14.24 per cent of the total, an increase over 1911 of $1,295,465, or 7.15 per cent. Ohio, as in 1911, was second with products valued at $19,302,773, or

14.16 per cent of the total. This was an increase of $1,414,143, or 7.91 per cent, over 1911. Illinois continued to be third, reporting wares valued at $14,279,039, or 10.48 per cent of the total, an increase of $925,839, or 6.93 per cent. New Jersey was fourth, reporting 8 per cent of the total; New York was fifth with 7.08 per cent of the total; and Indiana was sixth, displacing Missouri, which was seventh; California was eighth and Iowa ninth, as in 1911; Georgia was tenth in 1912, and Texas eleventh.

HUDSON RIVER REGION.

It is difficult to realize the enormous quantities of brick used annually in Greater New York. During 1912 there were over 1,000,000 thousand used. The principal source of this vast quantity is the Hudson River region, which extends along both sides of the river from New York City to Cohoes and embraces 10 counties, 9 in New York and 1 in New Jersey. Other sources of supply are the Raritan River region of New Jersey, and Connecticut. The principal advantage that the first two regions have is cheap water transportation. Connecticut brick used in New York are brought by rail, and hence can only enter the market when the price is high, which was the case in 1912, and large quantities of these brick were brought in. Second-hand brick were also used in considerable quantities in 1912.

The year 1912 was one of unusual interest in this region. It opened with an increasing demand for brick, and the price in New York for common was $7, as compared with $4.25 in 1911. For several years the use of cement or concrete construction appeared to be displacing brick to some extent, but owing to the strong "back to brick" movement the year 1912 saw in the New York market a change favoring brick as the best building material for many purposes.

The influences that have contributed to this are the failure of some concrete buildings, the advertising campaign carried on by the brickmakers, and the improved quality of the Hudson River brick. The price ranged higher than for several years, and the average is the highest since 1906.

The marketed product in 1912 was larger than that of 1911 and would probably have been still greater but for the scarcity of labor, especially at Haverstraw, and the strike among the brickmakers in the Newburgh district. The strike, however, was of minor importance, as it was of short duration, but the scarcity of labor, drawn away by large construction enterprises, such as the Catskill acqueduct, railroad extensions, and subway operations, was a serious drawback to the Hudson River brickmakers in 1912. This condition was so serious that the operators resorted to night work and rainy-day work in loading barges, and they also imported laborers from the South.

An important development during the year was the large increase in the use of Raritan River brick in New York City, which, for some years, has been drawing on the Raritan River region for brick. In 1912 the demand for this brick was very much greater than ever before, and it seems probable that in the future this region will be drawn on largely for that market.

On the whole, the year may be considered one of prosperity. The demand was good, prices high, and the mild weather toward the end of the year permitted shipments to its very close. The marketed product was not the largest recorded, but it was considerably larger than that of 1911.

The following table shows the production and value of common brick along the Hudron River from 1901 to 1912, with the number of operating firms reporting and the average price received per thousand:

Production of common brick in the Hudson River district from 1901 to 1912, inclusive.

Year.	Number of operating firms reporting.	Quantity.	Value.	Average price per thousand.
		Thousands.		
1901	127	830,154	$3,880,215	$4.67
1902	127	833,065	3,683,379	4.42
1903	115	844,500	3,973,316	4.70
1904	119	987,644	5,810,114	5.88
1905	129	1,297,389	9,063,753	6.99
1906	135	1,274,372	7,672,639	6.02
1907	132	1,064,892	5,515,585	5.18
1908	123	875,979	4,107,382	4.69
1909	127	1,313,760	6,438,642	4.90
1910	135	1,142,284	5,544,600	4.85
1911	125	926,072	4,717,633	5.09
1912	126	1,019,259	5,850,770	5.74
Total	....	12,409,370	66,258,028	5.34

This table shows that the number of brick marketed in this region in 1912 was 1,019,259,000, valued at $5,850,770, as compared with 926,072,000 brick in 1911, valued at $4,717,633. This was an increase of 93,187,000 brick, or 10.06 per cent, in quantity, and of $1,133,137, or 24.02 per cent, in value. Compared with the maximum quantity in 1909 this was a decrease of 294,501,000 brick, or 22.42 per cent, and compared with the maximum value in 1905 it was a decrease of $3,212,983, or 35.45 per cent.

The average price per thousand for the region in 1912 was $5.74, as compared with $5.09 in 1911 and with $4.85 in 1910. The maximum average price was $6.99 in 1905 and the minimum was $4.42 in 1902, with an average for the whole 12-year period of $5.34. The number of operating firms reporting has varied from 115 in 1903 to 135 in 1906 and 1910. In 1912 there were 126 operating firms reporting, an increase of 1 over 1911. As in other branches of the clay-working industry, the number of active firms reporting is not equivalent to the number of yards, as many firms have more than one yard.

The following table shows the production of common brick in the Hudson River district in 1911 and 1912 by counties:

Production of common brick in the Hudson River district from Cohoes to New York City in 1911 and 1912, by counties.

County.	1911				1912			
	Number of operating firms reporting.	Common brick. Quantity.	Common brick. Value.	Average price per thousand.	Number of operating firms reporting.	Common brick. Quantity.	Common brick. Value.	Average price per thousand.
		Thousands.				*Thousands.*		
Albany	12	60,223	$331,847	$5.51	12	71,600	$436,626	$6.10
Columbia	7	59,158	293,561	4.96	7	70,866	354,589	5.00
Dutchess	17	133,890	695,913	5.20	18	129,860	765,788	5.90
Greene	5	30,282	160,641	5.30	6	34,708	196,888	5.67
Orange	8	113,305	517,575	4.57	9	116,304	660,089	5.68
Rensselaer	6	16,334	90,022	5.51	5	15,760	85,797	5.44
Rockland	28	178,184	940,351	5.28	27	207,796	1,221,428	5.88
Ulster	24	213,779	1,049,063	4.91	24	259,480	1,458,554	5.62
Westchester	8	60,355	298,563	4.95	8	62,390	363,098	5.82
Total for New York portion of district	115	865,510	4,377,536	5.06	116	968,764	5,542,857	5.72
Bergen County, N. J.	10	60,562	340,097	5.62	10	50,495	307,913	6.10
Grand total	125	926,072	4,717,633	5.09	126	1,019,259	5,850,770	5.74

New York's portion was 95.05 per cent of the quantity of brick and 94.74 per cent of the value of the output of the region. This portion, consisting of 968,764,000 brick in 1912, showed an increase of 103,254,000 brick, or 11.93 per cent. The value of New York's portion of the region was $5,542,857, an increase of $1,165,321, or 26.62 per cent.

Of the counties included in this region, in 1912, Ulster, as for several years, was first in output and value, reporting 259,480,000 brick, valued at $1,458,554, an increase of 45,701,000 brick, or 21.38 per cent, and in value of $409,491, or 39.03 per cent. Rockland was second with 207,796,000 brick, valued at $1,221,428, an increase of 29,612,000 brick, or 16.62 per cent, and of $281,077, or 29.89 per cent. Dutchess County was third with 129,860,000 brick, valued at $765,788; this was a decrease of 4,030,000 brick, or 3.01 per cent, but an increase in value of $69,875, or 10.04 per cent. The only county showing a decrease in both quantity and value was Rensselaer, which reported the smallest product and value of the counties in the region. This, too, was the only county to show a decrease in the average price per thousand, which fell from $5.51 in 1911 to $5.44 in 1912. The highest average price per thousand in 1912 was $6.10, attained in Albany County. This county, together with Rensselaer, also showed the highest average price in 1911—$5.51. The lowest average in 1912, $5, was in Columbia County. In 1911 the lowest average, $4.57, was in Orange County.

The value of the common brick of New York's portion of this region was 45.97 per cent of all of New York's clay products in 1912, and 57.42 per cent of its brick and tile products.

New Jersey's portion of the production of this region is small, being 50,495,000 brick in 1912, or only 4.95 per cent of the output, and $307,913, or 5.26 per cent of the value. This was a decrease of 10,067,000 brick, or 16.62 per cent, and in value of $32,184, or 9.46 per cent. The average price per thousand increased from $5.62 in 1911 to $6.10 in 1912. This was 38 cents per thousand higher than that for New York's portion of the region and 36 cents higher than the average for the whole region, and equal to the highest average in any county in the region in New York.

POTTERY.

INTRODUCTION.

The following tables show the status of the pottery industry in 1911 and 1912 and the production, imports, and exports of pottery from 1901 to 1912, inclusive. The figures indicate that the industry made considerable progress in 1912. The year opened with bright prospects, and these were so fully realized that the value of the pottery products marketed was the largest in the history of the industry. This was due partly to the general prosperity enjoyed by the country at large, but more especially to the steady improvement in the wares themselves in body, design, and decoration. American pottery is gaining a stronger hold on the market and is becoming more popular every year. Many, if not most, of the best hotels and clubs in the country are now using large quantities of domestic pottery.

The value of all domestic pottery marketed in 1912 was $36,504,164, an increase of $1,985,604, or 5.75 per cent. The imports, which comprise almost exclusively the higher grades of ware, decreased $1,083,086, or 10.18 per cent. For the first time in 10 years the value of pottery imports fell below $10,000,000. With the value of the domestic pottery increasing and the imports decreasing, the outlook for the industry seems to be that 1913 will show even greater progress than 1912. The proportion of domestic production to consumption in 1912 was the highest ever reached—81.45 per cent. This, of course, applies to all pottery products, but the domestic production of general wares alone is nearly two-thirds of the consumption.

Every product, except stoneware and yellow and Rockingham ware, participated in the increase of 1912. The most important variety in value, white earthenware, showed an increase of 3.22 per cent. The value of this variety decreased in 1911, but the increase in 1912 more than offset this decrease, so the value of the product in 1912 was slightly greater than in 1910. Other important products showing a large increase were sanitary ware and porcelain electrical supplies.

The number of operating firms reporting continued to decrease, a loss of 15 appearing for 1912, the decrease being principally in plants making the lower grades of ware. A number of plants making white ware also went out of business, but new plants in contemplation at the close of the year, if erected, will nearly, if not quite, take the place in productive capacity of those that ceased operations.

PRODUCTION.

The following table shows the statistics of the production of pottery in the United States from 1901 to 1912:

Value of pottery products in the United States, 1901–1912, by varieties.

Year.	Number of operating firms reporting.	Red earthenware.	Stoneware and yellow and Rockingham ware.	White ware, including C. C. ware, etc.	China, bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.	Total.
1901	535	$703,698	$2,855,638	$11,608,898	$1,392,864	$2,877,650	$1,141,362	$1,883,750	$22,463,860
1902	518	735,386	3,383,678	12,371,111	1,219,293	3,555,662	1,350,255	1,512,068	24,127,453
1903	546	698,175	3,658,836	12,493,012	1,757,502	3,362,263	1,464,980	2,001,284	25,436,052
1904	556	756,625	3,701,844	11,924,404	1,512,115	3,585,375	1,431,452	2,246,455	25,158,270
1905	533	780,637	3,969,016	12,809,414	1,558,730	4,580,145	2,253,061	1,967,891	27,918,894
1906	540	909,262	4,193,884	14,152,503	1,787,776	5,098,310	2,838,284	2,460,865	31,440,884
1907	509	845,465	4,280,601	13,913,680	1,930,669	4,863,222	2,613,771	1,696,066	30,143,474
1908	497	757,900	3,518,841	11,474,147	1,581,020	4,373,590	2,009,005	1,421,052	25,135,555
1909	466	805,906	3,993,859	13,728,316	[a]1,766,766	5,989,295	3,047,499	[a]1,717,800	31,049,441
1910	463	854,196	3,796,688	14,780,980	1,962,126	6,758,996	3,794,153	1,837,539	33,784,678
1911	449	893,678	4,120,608	14,366,251	2,057,985	7,031,458	4,232,101	1,816,479	34,518,560
1912	434	958,270	3,919,778	14,829,431	2,177,305	7,902,255	4,927,316	1,789,809	36,504,164

[a] China, bone china, delft, and belleek ware for Ohio is included in miscellaneous.

This table shows that the value of the pottery products of the United States in 1912 was $36,504,164, the largest yet reported, exceeding that of 1911 by $1,985,604, or 5.75 per cent, and that of 1910 by $2,719,486, or 8.05 per cent. Only one variety decreased in value in 1912—stoneware—which declined $200,830, or 4.87 per cent. With the exception of stoneware, every product reached its maximum value in 1912, the variety showing the largest gain being sanitary ware, which increased $870,797, or 12.38 per cent. The largest proportional gain was in porcelain electrical supplies, which increased $695,215, or 16.43 per cent.

The value of white ware, including china, but excluding sanitary ware and porcelain electrical supplies, was $17,006,736 in 1912, as compared with $16,424,236 in 1911, an increase of $582,500, or 3.55 per cent. These articles constituted 46.58 per cent of all pottery products in 1912 and 47.58 per cent in 1911. If the value of sanitary ware and porcelain electrical supplies be added, the value for 1912 would be $29,836,307, or 81.73 per cent of all pottery products, an increase of $2,148,512, or 7.76 per cent, over the figures for 1911.

Chinaware showed an increase of $119,320, or 5.80 per cent. The value reported for 1912 was the highest ever recorded. In fact this product has increased almost steadily since 1902, the value in 1912 being $958,012, or 78.57 per cent greater than that for 1902.

In the following tables will be found the statistics of the production of pottery in the United States in 1911 and 1912, by States and varieties of product, the former year being given for comparison:

Value of pottery products in 1911, by varieties of products, by States.

Rank of State.	State.	Number of active firms reporting.	Red earthenware.	Stoneware and yellow or Rockingham ware.	White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware.	China, bone china, delft, and belleek ware.
17	Alabama	18	$11,243	$14,753		
20	Arkansas	5	(a)	11,650		
11	California	9	32,146	48,190		
15	Colorado	4	(a)	(a)		
	Connecticut		(a)	(a)		
	District of Columbia		(a)			
18	Georgia	20	17,530	6,800		
7	Illinois	23	41,875	832,813	(a)	
6	Indiana	14	5,700	81,567	(a)	
16	Iowa	5	6,936	(a)		
	Kansas			(a)		
14	Kentucky	8	12,880	101,214		
	Louisiana					
	Maine			(a)		
8	Maryland	9	8,281	(a)	(a)	
9	Massachusetts	12	150,038	13,541	(a)	
13	Michigan	6	80,580			
	Minnesota		(a)	(a)		
19	Mississippi	7	1,850	21,560		
25	Missouri	6	2,755	2,453		
	Montana		(a)			
	New Hampshire					
2	New Jersey	56	38,910	75,915	$1,148,904	$1,105,278
	New Mexico					
4	New York	22	34,295	40,946	(a)	730,983
23	North Carolina	19	1,333	7,223		
1	Ohio	110	233,060	1,758,785	9,612,315	
	Oregon		(a)	(a)		
5	Pennsylvania	31	159,420	304,998	(a)	216,724
	Porto Rico					
24	South Carolina	4	3,281	2,839		
10	Tennessee	7	3,938	38,759		
12	Texas	14	8,963	123,454		
	Utah		(a)	(a)		
21	Virginia	3				
	Washington		(a)	(a)		
3	West Virginia	13		(a)	1,920,294	(a)
22	Wisconsin	3	8,600			
	Other States b		30,064	633,148	1,684,783	5,000
	Total	c 449	893,678	4,120,608	14,366,251	2,057,985
	Percentage of pottery products		2.59	11.94	41.62	5.96
	Percentage of total clay products		.55	2.54	8.86	1.27
	Number of firms reporting each variety		160	175	61	15

a Included in "Other States."
b Includes all products made by less than 3 producers in 1 State.
c Includes 21 firms not distributed.

Value of pottery products in 1911 by varieties of products, by States—Continued.

Rank of State.	State.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Percentage of total.
17	Alabama			$2,500	$28,496	0.08
20	Arkansas			3,500	15,500	.04
11	California	(b)		(b)	158,336	.46
15	Colorado			3,573	40,073	.12
	Connecticut		(b)	(b)	(c)	
	District of Columbia				(c)	
18	Georgia				24,330	.07
7	Illinois	(b)	(b)	9,700	979,811	2.84
6	Indiana	$549,470	(b)		1,004,737	2.91
16	Iowa			(b)	36,319	.11
	Kansas				(c)	
14	Kentucky				114,094	.33
	Louisiana			(b)	(c)	
	Maine				(c)	
8	Maryland	(b)		2,000	254,411	.74
9	Massachusetts		(b)	13,832	228,526	.66
13	Michigan		(b)	(b)	130,490	.38
	Minnesota				(c)	
19	Mississippi			250	23,660	.07
25	Missouri				5,208	.02
	Montana				(c)	
	New Hampshire			(b)	(c)	
2	New Jersey	4,898,588	$913,921	220,425	8,401,941	24.34
	New Mexico			(b)	(c)	
4	New York	(b)	988,716	51,686	2,178,364	6.31
23	North Carolina				8,556	.02
1	Ohio	378,779	1,610,925	1,181,401	14,775,265	42.80
	Oregon				(c)	
5	Pennsylvania	215,590	(b)	11,108	2,156,817	6.25
	Porto Rico			(b)	(c)	
24	South Carolina				6,120	.02
10	Tennessee			(b)	197,139	.57
12	Texas				132,417	.38
	Utah				(c)	
21	Virginia	(b)		(b)	13,409	.04
	Washington				(c)	
3	West Virginia	814,599	(b)	79,173	2,880,202	8.34
22	Wisconsin				8,600	.03
	Other States[d]	174,432	718,539	237,331	[e]715,739	2.07
	Total	7,031,458	4,232,101	1,816,479	34,518,560	100.00
	Percentage of pottery products	20.37	12.26	5.26	100.00	
	Percentage of total clay products	4.33	2.61	1.12	21.28	
	Number of firms reporting each variety	36	36	68		

[a] Including art and chemical pottery, craquelle porcelain, faïence, Guernsey earthenware, Hampshire, Indian, Pewabic, and Teco pottery, handmade tile, jardinieres, pins, stilts, and spurs for potters' use, porcelain door knobs, filter stones and tubes, shuttle eyes and thread guides, porcelain hardware trimmings, porcelain lighting appliances, tobacco pipes, toy marbles, turpentine cups, umbrella stands, and vases.
[b] Included in "Other States."
[c] Included in [e] ($715,739).
[d] Includes all products made by less than 3 producers in 1 State.
[e] Made up of State totals of Connecticut, District of Columbia, Kansas, Louisiana, Maine, Minnesota, Montana, New Hampshire, New Mexico, Oregon, Porto Rico, Utah, and Washington.

Value of pottery products in 1912, by varieties of products, by States.

Rank of State.	State.	Number of active firms reporting.	Red earthenware.	Stoneware and yellow or Rockingham ware.	White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware.	China, bone china, delft, and belleek ware.
18	Alabama	15	$10,990	$11,223		
17	Arkansas	5	(a)	12,123		
9	California	12	36,091	54,087	(a)	
15	Colorado	5	(a)	(a)		
	Connecticut		(a)	(a)		
	District of Columbia		(a)			
19	Georgia	18	11,472	7,510		
7	Illinois	24	35,827	675,244	(a)	
6	Indiana	10	(a)	46,100	(a)	
16	Iowa	4	(a)	(a)		
	Kansas			(a)		
14	Kentucky	8	22,523	91,681		
	Louisiana		(a)			
	Maine			(a)		
11	Maryland	8	8,451	(a)	(a)	
8	Massachusetts	12	163,010	26,300	(a)	
10	Michigan	6	99,555		(a)	
	Minnesota			(a)		
20	Mississippi	6	1,561	11,145		
24	Missouri	4	(a)	2,015		
	Montana		(a)			
	New Hampshire					
2	New Jersey	52	36,655	48,297	$1,090,683	$1,155,766
4	New York	24	31,497	(a)	(a)	691,065
21	North Carolina	21	778	8,172		
1	Ohio	106	263,085	1,832,266	9,969,491	
	Oregon		(a)	(a)		
5	Pennsylvania	29	162,137	281,526	902,585	280,472
	Porto Rico					
23	South Carolina	4	4,567	(a)		
12	Tennessee	9	1,205	44,089		
13	Texas	12	9,351	137,253		
	Utah		(a)	(a)		
	Virginia					
	Washington		(a)	(a)		
3	West Virginia	14		(a)	2,051,987	50,002
22	Wisconsin	3	7,900			
	Other States b		51,615	630,747	814,685	
	Total	c 434	958,270	3,919,778	14,829,431	2,177,305
	Percentage of pottery products		2.63	10.74	40.62	5.96
	Percentage of total clay products		.55	2.27	8.58	1.26
	Number of firms reporting each variety		145	163	63	16

a Included in "Other States."
b Includes all products made by less than 3 producers in 1 State.
c Includes 23 firms not distributed.

Value of pottery products in 1912, by varieties of products, by States—Continued.

Rank of State.	State.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Percentage of total.
18	Alabama				$22,213	0.06
17	Arkansas			(b)	28,957	.08
9	California	(b)	(b)	$6,126	219,653	.60
15	Colorado			4,247	41,247	.11
	Connecticut		(b)	(b)	(c)	
	District of Columbia				(c)	
19	Georgia			(b)	19,057	.05
7	Illinois	(b)	(b)	23,812	931,951	2.55
6	Indiana	$633,578	(b)		1,077,102	2.95
16	Iowa			(b)	30,141	.08
	Kansas				(c)	
14	Kentucky				114,204	.31
	Louisiana			(b)	(c)	
	Maine				(c)	
11	Maryland			2,500	184,711	.51
8	Massachusetts		(b)	12,789	252,099	.69
10	Michigan		(b)	(b)	194,892	.53
	Minnesota				(c)	
20	Mississippi				12,706	.04
24	Missouri				3,515	.01
	Montana				(c)	
	New Hampshire			(b)	(c)	
2	New Jersey	5,199,278	$1,146,467	258,774	8,935,920	24.48
4	New York	(b)	1,269,108	51,988	2,405,532	6.59
21	North Carolina				8,950	.03
1	Ohio	451,971	1,827,290	1,164,632	15,508,735	42.49
	Oregon				(c)	
5	Pennsylvania	185,000	307,636	9,184	2,128,540	5.83
	Porto Rico			(b)	(c)	
23	South Carolina				6,761	.02
12	Tennessee			(b)	173,166	.47
13	Texas				146,604	.40
	Utah				(c)	
	Virginia			(b)	(c)	
	Washington				(c)	
3	West Virginia	1,156,478	(b)	36,444	3,365,166	9.22
22	Wisconsin				7,900	.02
	Other States [d]	275,950	376,815	219,313	[e] 684,442	1.88
	Total	7,902,255	4,927,316	1,789,809	36,504,164	100.00
	Percentage of pottery products	21.65	13.50	4.90	100.00	
	Percentage of total clay products	4.57	2.85	1.04	21.12	
	Number of firms reporting each variety	40	34	70		

a Including aquarium ornaments, art and chemical pottery, art tile, craquelle porcelain, faïence, Guernsey earthenware, Hampshire pottery, jardinieres, lamps, pins, stilts, and spurs for potters' use, porcelain door knobs, filter stones, shuttle eyes and thread guides, porcelain hardware trimmings, porcelain lighting appliances, razor hones, tobacco pipes, toy marbles, turpentine cups, umbrella stands, and vases.
b Included in "Other States."
c Included in e ($684,442).
d Includes all products made by less than 3 producers in 1 State.
e Made up of State totals of Connecticut, District of Columbia, Kansas, Louisiana, Maine, Minnesota, Montana, New Hampshire, Oregon, Porto Rico, Utah, Virginia, and Washington.

The number of States reporting for 1912 ware classed as pottery in this report was 37, a decrease of 1, New Mexico reporting no pottery for that year. The important producing States, especially those reporting production of the higher grades of ware, are few. White earthenware was reported from 11 States, an increase of 2, California and Michigan reporting for 1912; china from 4, the same as for 1911; sanitary ware from 8, a decrease of 2, Maryland and Virginia; porcelain electrical supplies from 11, an increase of 1, California.

Red earthenware, the commonest of pottery products, was reported from 30 States, the same number as for 1911; but Minnesota reported none, and Louisiana once again entered the list of producers. Ohio was the leading State in 1912, as in 1911, reporting products valued at $263,085, an increase of $30,025, or 12.88 per cent. Massachusetts was second, displacing by a narrow margin Pennsylvania, which was third. In 1912 the value of the product of Massachusetts increased $12,972, or 8.65 per cent, while that of Pennsylvania increased but 1.70 per cent. These three States reported 61.38 per cent of the total value of this product in 1912, as compared with 60.71 per cent in 1911 and 57.25 per cent in 1910. Red earthenware was reported by 145 producers in 1912, by 160 in 1911, and by 159 in 1910, In 1912 it constituted 2.63 per cent of the total value of pottery, and in 1911, 2.59 per cent.

Stoneware, including yellow and Rockingham ware, was reported from 29 States in 1912, the same as for 1911. Ohio, in 1912, as for many years, was the leading State, reporting an output valued at $1,832,266, or 46.74 per cent of the total. This was an increase of $73,481, or 4.18 per cent. Illinois, as in 1911, was second, showing a decrease of $157,569, or 18.92 per cent. The number of producers reporting this variety of pottery continues to decrease, 163 reporting for 1912 as compared with 175 for 1911, 180 for 1910, and 196 for 1909. Stoneware constituted 10.74 per cent of the value of pottery in 1912, 11.94 per cent in 1911, and 11.24 per cent in 1910.

The tables show that the pottery products of greatest value are embraced under the heading white ware, which represents general household wares. Ohio has been the leading producer of these wares for many years, and reported for 1912 white ware valued at $9,969,491, an increase of $357,176, or 3.72 per cent. Ohio's output in 1912 was 67.23 per cent of the value of the entire product, as against 66.91 per cent in 1911 and 65.83 per cent in 1910. West Virginia was second, as for several years, and reported wares valued at $2,051,987, an increase of $131,693, or 6.86 per cent over 1911. New Jersey was third in both years, reporting wares valued at $1,090,683 in 1912, a decrease of $58,221, or 5.07 per cent. White ware constituted 40.62 per cent of all pottery products in 1912, 41.62 in 1911, and 43.75 per cent in 1910. The number of producers reporting white ware in 1912 was 63, the same as in 1910 and 2 greater than in 1911.

China was reported from four States in 1912, as in 1911. New Jersey was the leading State, as in 1911, and reported china valued at $1,155,766, an increase of $50,488, or 4.57 per cent. The output of New Jersey in 1912 constituted 53.08 per cent of the entire product. New York was second and Pennsylvania third. The production of china, the most beautiful pottery ware, is still of little commercial importance, but has made steady progress, and no doubt will in time be an important branch of the industry. The value of the china made in 1912 was only 5.96 per cent of the value of the pottery products of the country, the same as in 1911; in 1910 it was 5.81 per cent of the total value. The number of operators reporting china in 1912 was 16, an increase of 1 over 1911.

In the production of sanitary ware New Jersey is the leading State, reporting ware valued at $5,199,278, an increase of $300,690, or 6.14 per cent. New Jersey's output was 65.79 per cent of the total for 1912. West Virginia was second, reporting wares valued at $1,156,478, an increase of $341,879, or 41.97 per cent. Indiana was third, reporting an increase of $84,108, or 15.31 per cent, over 1911. The number of producers reporting increased by 4 in 1912. Sanitary ware was 21.65 per cent of the value of pottery products in 1912, 20.37 per cent in 1911, and 20 per cent in 1910.

Ohio was the largest producer of porcelain electrical supplies in 1912, as in 1911, reporting an output valued at $1,827,290, or 37.08 per cent of the total. This was an increase of $216,365, or 13.43 per cent. New York was second and New Jersey third, as in 1911 New York's output increased $280,392, or 28.36 per cent, and New Jersey's $232,546, or 25.44 per cent. These three States contributed 86.11 per cent of the total value of porcelain electrical supplies in 1912. The number of producers reporting this variety was 34, a decrease of 2. This variety constituted 13.50 per cent of the value of all pottery in 1912, 12.26 per cent in 1911, and 11.23 per cent in 1910.

Ohio continued to be the leading pottery-producing State of the Union, reporting for 1912 wares valued at $15,508,735, or 42.49 per cent of the total, an increase of $733,470, or 4.96 per cent. Ohio's principal pottery product is white ware, which constituted 64.28 per cent of its entire pottery output in 1912. New Jersey is the second largest pottery-producing State. For 1912 it reported wares valued at $8,935,920, or 24.48 per cent of the total, an increase of $533,979, or 6.36 per cent. New Jersey's principal pottery product is sanitary ware, which was 58.18 per cent of its total for 1912. West Virginia was third in 1912, reporting ware valued at $3,365,166, or 9.22 per cent of the total, an increase of $484,964, or 16.84 per cent. New York was fourth, as in 1911, and Pennsylvania fifth, the former reporting 6.59 per cent of the total and the latter 5.83 per cent. Indiana and Illinois maintained their relative ranks of sixth and seventh with 2.95 per cent and 2.55 per cent of the total, respectively. The first five States—Ohio, New Jersey, West Virginia, New York, and Pennsylvania—reported 88.61 per cent of the total production in 1912; in 1911, these States reported 88.04 per cent, and in 1910, 88.60 per cent.

In considering the rank of States it should be borne in mind that the small number of producers in many of them in 1912, which prevents the publication of State totals without disclosing individual returns, makes the rank of all but the first few the relative and not the actual rank.

CONSUMPTION.

The pottery imported into the United States in 1912 was valued at $9,555,530, and the production at $36,504,164, a total of $46,059,694. After deducting exports, domestic $1,177,784 and foreign $61,883, the net consumption was valued at $44,820,027, of which the domestic production was 81.45 per cent. In 1911 this percentage was 78.93 and in 1910 it was 77.08, and the next highest was in 1902, when it was 72.91.

POTTERY INDUSTRY BY STATES.

Alabama.—The pottery industry of Alabama is of minor importance. Production was reported by 15 operators, whose total output was valued in 1912 at $22,213, which was a decrease of $6,283 from 1911. The products consist entirely of red earthenware and stoneware in nearly equal proportions.

Arkansas.—In Arkansas there were five operators reporting pottery products which were valued at $28,957 in 1912. This was an increase of $13,457 over 1911. The product consists of stoneware and art pottery, with a small quantity of red earthenware.

California.—Pottery products of California were reported by 12 operators in 1912. The value of the products was $219,653, which was an increase of $61,317 over 1911. The product of greatest value was sanitary ware made in Contra Costa County, though red earthenware, stoneware, etc., white ware, razor hones, art pottery, and porcelain electrical supplies were also made. Two interesting developments in the year were the establishing of an American works by an old English tile and pottery company in the southern part of the State, and the successful operation of an art pottery in connection with the Arequipa Sanitorium, Marin County.

Colorado.—Colorado's pottery production was reported by five operators and was valued at $41,247, an increase of $1,174 over 1911. The principal product is stoneware, etc., made in Denver County. Art pottery and chemical china are also made in the State.

Connecticut.—The principal pottery product of Connecticut is porcelain electrical supplies made at Hartford, though small quantities of red earthenware and stoneware, etc., are also made in the State.

District of Columbia.—There were but two establishments in the District of Columbia reporting pottery for 1912; they made red earthenware exclusively.

Georgia.—Georgia's pottery products were valued at $19,057, a decrease from 1911 of $5,273. Georgia's products consist almost entirely of red earthenware and stoneware. Efforts to establish white-ware potteries in this and other Southern States have been unsuccessful. There were 18 firms reporting production.

Illinois.—There were 24 operators reporting production in Illinois for 1912, with products valued at $931,951, a decrease of $47,860 from 1911. The principal pottery product (72.45 per cent of the total) is stoneware made in Brown, Greene, La Salle, McDonough, Tazewell, and Warren counties. White ware in small quantities is also made in this State, as are filter stones, clay pipes, and art pottery.

Indiana.—Indiana's principal pottery product in 1912 was sanitary ware. This ware (value $633,578, or 58.82 per cent of the State's total) was reported from Kokomo and Evansville. The total value in 1912 was $1,077,102, an increase of $72,365. There were 10 firms reporting production.

Iowa.—The pottery industry of Iowa is of comparatively small importance. The total value of these products in 1912 was $30,141, a decrease of $6,178. The principal pottery product was stoneware.

Kansas.—There was but one operating potter reporting for 1912 from Kansas. The only pottery product made in Kansas in 1912 was stoneware. A new plant was about to begin operations at Pittsburg, Crawford County, at the close of the year.

Kentucky.—There were eight firms reporting pottery products in Kentucky for 1912. The output, valued at $114,204, consists entirely of red earthenware and stoneware, about one-fifth being the former and four-fifths the latter. The product in 1912 increased only $110 in value over $1911.

Louisiana.—Louisiana is the home of the Newcomb pottery, located at New Orleans, where the famous Newcomb art ware is made.

Owing, however, to the fact that there is but one other producer of pottery in the State, figures of production can not be published.

Maine.—Stoneware is the only pottery product of Maine. There being only one producer, figures are not published.

Maryland.—Maryland's principal pottery product is white ware. The other products are stoneware, red earthenware, and tobacco pipes. There were eight active firms reporting, and the value of the products was $184,711, a decrease of $69,700, or 27.40 per cent, from 1911.

Massachusetts.—The principal pottery product of Massachusetts was, in 1912, red earthenware, considerably more than one-half of its total output being of this variety. Stoneware, white ware, porcelain electrical supplies, art pottery, and shuttle eyes and thread guides were also made in Massachusetts in 1912. The value of pottery in Massachusetts in 1912 was $252,099, an increase of $23,573 over 1911. There were 12 operators reporting production.

Michigan.—Michigan's pottery products in 1912 were valued at $194,892, an increase of $64,402 over 1911. The principal pottery product of this State is red earthenware. Porcelain electrical supplies, white ware, and art pottery and tile are also made there. Six operators reported production for 1912.

Minnesota.—The only pottery product of this State is stoneware, made at Red Wing, Goodhue County. There being but one operator reporting for 1912, figures of production are not published.

Mississippi.—Mississippi's pottery products, red earthenware, stoneware, etc., were valued at $12,706, a decrease of $10,954 from 1911. There were six active plants reporting.

Missouri.—Missouri is the leading Southern State in the production of clay wares, but its pottery products are unimportant, their total value for 1912 being but $3,515, a decrease of $1,693 form 1911. There were four operators reporting production for 1912. The value of Missouri's pottery has decreased very rapidly within the last few years. In 1907 it was $78,187; in 1908, $68,908; in 1909, $73,122; in 1910, $29,061; and in 1911, $5,208.

Montana and New Hampshire.—Montana and New Hampshire had only one operator each in 1912, so that statistics of production are not published separately.

New Jersey.—New Jersey was the second largest producer of pottery in the United States, reporting wares valued at $8,935,920, or 24.48 per cent of the total. This was an increase of $533,979, or 6.36 per cent, over 1911. New Jersey's leading product is sanitary ware, though every variety of pottery as classified by the Survey and in addition, chemical ware, tobacco pipes, door knobs, stilts, spurs and pins, and art pottery were reported from this State. Mercer County, in which Trenton is located, reported over 90 per cent of the value of the pottery of the entire State—$8,069,694. All of the white ware and china and nearly all of the porcelain electrical supplies and 90 per cent of the sanitary ware were made in 1912 in that county. No red earthenware or stoneware, etc., was made in Mercer County. There were 52 active plants reporting for 1912.

New York.—New York was fourth in value of pottery produced in 1912, 24 operators reporting wares valued at $2,405,532, or 6.59 per cent of the total. This was an increase of $227,168, or more than 10 per cent, over 1911. New York's principal product in 1912 was porcelain electrical supplies manufactured chiefly in Schenectady County;

also in Kings, Livingston, Onondaga, and Ontario counties. These were valued at $1,269,108, or 52.76 per cent of the total for the State. China was second in importance, being valued at $691,065 and constituting 28.73 per cent of the total. The principal china-making center is in Onondaga County, though it is also made in Kings County. In addition to these wares, every other variety of pottery as classified in this report, and art pottery, smoking pipes, faïence, and hardware trimmings were reported for 1912.

North Carolina.—North Carolina has a comparatively large number (21) of active operators reporting for 1912, but the industry is of little importance, the total value of the output in 1912 being but $8,950, an increase of $394. Red earthenware and stoneware, etc., were the only pottery products reported from North Carolina in 1912.

Ohio.—Ohio is the leading State in the production of pottery. The value of its output in 1912, reported by 106 operators, was $15,508,735, or 42.49 per cent of the value of that of the entire country. Every variety of pottery, as classified by the Survey, except china, was reported for 1912, and in addition architectural faïence, art pottery, door knobs, gas-mantle supplies, jardiniers, kitchen and utility ware, stilts and pins, umbrella stands, and toy marbles were reported. White ware is the variety of chief value ($9,969,491), constituting 64.28 per cent of the total for the State. Columbiana is the leading county, reporting this variety to the value of $6,445,640, or 64.65 per cent of the State total of this variety. Mahoning County was the second, reporting ware valued at $1,947,332, or 19.53 per cent of the State total of this variety. Stoneware, yellow and Rockingham ware (taken together), were the products of second importance in 1912, followed closely by porcelain electrical supplies, the former being valued at $1,832,266, or 11.81 per cent of the total, and the latter at $1,827,290, or 11.78 per cent of the total. Columbiana is the leading pottery-producing county of the State, reporting wares valued at $7,866,329, or 50.72 per cent of the total. East Liverpool is the principal pottery center of the State. From this city the industry has spread not only to other parts of the State, but to adjacent States. The pottery industry in Hancock County, W. Va., just across the river from East Liverpool, is the direct outgrowth of the East Liverpool enterprise, the majority of the West Virginia operators also having plants in Ohio.

Oregon.—In Oregon there were but two potters reporting production in 1912, so that the figures can not be published without disclosing individual operations. Nothing is made in this State but red earthenware and stoneware.

Pennsylvania.—Pennsylvania was the fifth State in pottery in 1912, its output being valued at $2,128,540, a decrease of $28,277, or 1.31 per cent, from 1911. This decrease was principally in porcelain electrical supplies, though stoneware and sanitary ware also decreased in value. The output of red earthenware, white ware, and china increased in value. White ware, valued at $902,585, was Pennsylvania's leading pottery product in 1912, this variety constituting 42.4 per cent of the total value of the State. Porcelain electrical supplies were second in value, stoneware third, and china fourth. There were 29 active operators reporting for 1912.

Porto Rico.—There was but one potter reporting from Porto Rico, located in Ponce district. The ware is designated by the maker as "single pottery made of ordinary clay." By this is probably meant unglazed red earthenware.

South Carolina.—The pottery industry of South Carolina is of but little importance. There were three firms reporting wares valued at $6,761 for 1912, an increase of $641 over 1911. Red earthenware and stoneware are the only products made.

Tennessee.—There were nine firms reporting pottery production in Tennessee for 1912. The principal product is turpentine cups, made in Hamilton County. Tennessee pottery was valued at $173,166 in 1912, a decrease of $23,973 from 1911.

Texas.—Though Texas has some of the finest kaolin in the country, its pottery products are confined to the lowest grades of ware—red earthenware and stoneware. The total value of Texas pottery in 1912 was $146,604, an increase of $14,187 over 1911. There were 12 active operators in the State reporting for 1912.

Utah.—There were but two potters in Utah who reported production for 1912, so that no figures can be published. Red earthenware and stoneware are the only wares made in the State.

Virginia.—In Virginia there were but two potters who reported production for 1912. Tobacco pipes was the only product reported.

Washington.—Washington pottery products are confined to red earthenware and stoneware and are comparatively unimportant.

West Virginia.—West Virginia was third in the value of pottery in 1912 and is rapidly increasing in importance as a pottery-producing State, its products being valued at $3,365,166, or 9.22 per cent of the total for the country. This was an increase of $484,964, or 16.84 per cent, over 1911. West Virginia's product of chief value was white ware, of which it is the second largest producer in the country. The value of the white ware made in 1912 was $2,051,987, or 60.98 per cent of the value of the pottery of the State, an increase of $131,693, or 6.86 per cent. This product is made principally in Hancock County, opposite East Liverpool, Ohio. The pottery business in this county is the outgrowth of the industry in East Liverpool, and is interesting by reason of its rapid growth and because the production of white ware there has more than offset decreased production in other parts of the State. The pottery products of this county in 1912 were valued at $1,913,404, or 56.86 per cent of that of the entire State. The contemplated erection of two new plants in this county in the near future will add largely to its productive capacity and increase its importance as a pottery-producing center. Sanitary ware was second in value in this State in 1912, being valued at $1,156,478, an increase of $341,879, or 41.97 per cent. There were but 14 operators reporting production from this State, which makes the average value of output per operator very high—$240,369—compared with $146,308 for Ohio, $171,845 for New Jersey, $73,398 for Pennsylvania, and $100,231 for New York.

Wisconsin.—Wisconsin's pottery production in 1912, of red earthenware only, was valued at $7,900, and was reported by three potters.

IMPORTS AND EXPORTS.

The following tables show the imports and exports of clay products from 1901 to 1912:

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1901–1912.

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.		
1901	$51,551	$1,094,078	$8,385,514	$9,531,143	$150,268	$9,681,411
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
1907	113,477	1,315,591	12,156,544	13,585,612	225,320	13,810,932
1908	70,629	1,142,444	9,309,718	10,522,791	162,341	10,685,132
1909	98,716	1,245,479	9,263,017	10,607,212	189,536	10,796,748
1910	154,614	1,293,986	9,682,558	11,131,158	222,183	11,353,341
1911	164,871	1,221,756	9,251,989	10,638,616	166,133	10,804,749
1912	152,166	1,094,152	8,309,212	9,555,530	166,322	9,721,852

[a] Including Rockingham ware.

The imports of all clay products in 1912 decreased $1,082,897, or 10.02 per cent; in 1911 there was a decrease of $548,592, or 4.83 per cent. Of the imports for 1912, 98.29 per cent was pottery and 1.71 per cent brick and tile. Of the pottery imports, 98.41 per cent was of the higher grades and 1.59 per cent was of the lower grades. The pottery imports decreased $1,083,086, or 10.18 per cent, in 1912, and the brick and tile imports remained practically stationary, increasing $189, or 0.11 per cent. For the first time in 10 years the imports of pottery fell below $10,000,000 and were the lowest since 1901. The imports of pottery in 1912 showed a decrease from 1907, the year of maximum imports, of $4,030,082, or nearly 30 per cent.

Value of exports of clay wares of domestic manufacture from the United States, 1905–1912.

Year.	Brick.					Pottery.			Grand total.
	Building.	Fire.	Tile (except drain).	All other.	Total.	Earthen and stone ware.	China.	Total.	
1905		$536,002		[a]$263,876	$799,878	$882,069	$101,485	$983,554	$1,783,432
1906		637,441		[a] 247,625	885,066	1,003,969	114,481	1,118,450	2,003,516
1907		631,779		[a] 185,192	816,971	1,022,730	108,911	1,131,641	1,948,612
1908		[b] 550,243		113,243	663,486	906,266	77,494	983,760	1,647,246
1909		[b]1,002,270		147,622	1,149,892	776,842	86,853	863,695	2,013,587
1910		[c] 634,775		968,138	1,602,913	928,475	113,214	1,041,689	2,644,602
1911		1,057,725		1,206,629	2,264,354	1,278,892	122,474	1,401,366	3,665,720
1912	[c]$448,939	1,117,161	[c]$539,116	1,717,895	3,823,111	1,037,637	140,147	1,177,784	5,000,895

[a] Building brick only.
[b] Includes all brick, other than building brick.
[c] Figures cover period from July 1 to Dec. 31.

The exports of domestic clay products in 1912 were valued at $5,000,895, an increase of $1,335,175, or 36.42 per cent; in 1911 they increased $1,021,118, or 38.61 per cent. Of these exports, 76.45 per cent was brick and tile and 23.55 per cent was pottery. These are approximately the proportions of 1911, when 61.77 per cent of the exports was brick and 38.23 per cent was pottery. Brick and tile exports increased $1,558,757, or 68.84 per cent, in 1912; the pottery exports decreased $223,582, or 15.95 per cent. This decrease was entirely in the lower-grade wares. The exports of china increased $17,673, or 14.43 per cent; the exports of earthenware and stoneware decreased $241,255, or 18.86 per cent. Of the pottery exports, china constituted 11.90 per cent and the lower grades 88.10 per cent.

CLAY PRODUCTS BY STATES.

In the following pages the statistics of the clay-working industry from 1908 to 1912, inclusive, are given for some of the more important States. Owing to the changes in the classification of the products in some of the minor items, the figures do not always represent solely the value of the products named, though the classification as given in the tables is sufficiently correct for comparative analysis. The item "Miscellaneous" under each State includes all products not otherwise classified and those that could not be published separately without disclosing individual returns. For details concerning the production of pottery in the several States, the reader is referred to the section of this report on pottery.

ALABAMA.

The total value of all clay products in Alabama in 1912 was $1,935,179, a decrease of $11,923, or 0.61 per cent, from 1911. The principal product is common brick, this item in 1912 being valued at $759,409 and representing 39.24 per cent of the value of all of Alabama's clay products in that year. Vitrified, fire, and front brick combined represent a value approximating that of common brick alone, so that the output of the brickyards made up nearly 80 per cent of the State's total. Clays suitable for tile and pottery are available in the State, but these branches of the industry have not been extensively developed, the value of the pottery production being only $22,213 in 1912.

Jefferson County is the principal clay-working county, reporting a production valued at $1,135,339, or 58.67 per cent, of the value reported for the State. All of the fire brick produced in the State is reported from Jefferson County, though vitrified brick is the principal product. Only one other county in the State, St. Clair, produces vitrified brick. The leading counties in the manufacture of common brick are Jefferson, Montgomery, and Russell.

Clay products of Alabama, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	120,237,000	146,180,000	135,785,000	129,694,000	136,989,000
Value	$690,963	$799,693	$746,961	$708,903	$759,409
Average per M	$5.75	$5.47	$5.50	$5.47	$5.54
Vitrified—					
Quantity	18,248,000	20,444,000	19,772,000	21,444,000	26,480,000
Value	$244,084	$262,376	$236,516	$246,707	$353,303
Average per M	$13.38	$12.83	$11.96	$11.50	$13.34
Front—					
Quantity	(a)	(a)	(a)	9,169,000	10,629,000
Value	(a)	(a)	(a)	$128,403	$132,033
Average per M	$17.89	$16.19	$15.96	$14.00	$12.42
Fancy ... value	(a)	(a)	...	(a)	(a)
Fire ... do	$122,354	$196,887	$163,672	$193,375	$240,434
Draintile ... do	$2,046	(a)	$3,773	$3,777	$5,465
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	$15,058	$11,886	$3,475	$11,243	$10,990
Stoneware and yellow and Rockingham ware .. value	$9,031	$24,453	$16,371	$14,753	$11,223
Miscellaneous ... do	$476,070	$404,832	$496,791	$639,941	$422,322
Total value	$1,559,606	$1,700,127	$1,667,559	$1,947,102	$1,935,179
Number of operating firms reporting	103	100	87	82	74
Rank of State	19	22	22	17	17

[a] Included in "Miscellaneous."

CALIFORNIA.

California is one of the important clay-working States. It was the eighth State in value of products in 1912. It was the sixth State in the production and value of common brick; fifth in the value of front and fancy brick, and terra cotta; third in the production of sewer pipe; and sixth in the value of fire brick. There were 91 active operators reporting for 1912, 1 less than for 1911.

The total value of all of California's clay products in 1912 was $5,912,450, an increase of $996,584, or 20.27 per cent, over 1911. California's principal clay product is common brick, which was valued at $2,198,303, or 37.18 per cent of all clay products, in 1912. This was an increase of $481,861 over 1911. The output of common brick also increased from 282,199,000 brick in 1911 to 349,797,000 in 1912, an increase of 67,598,000 brick. The average price per thousand in 1912 was $6.28, an increase of 20 cents over 1911. Sewer pipe, made largely in Alameda and Los Angeles counties, is the second most important clay product in California, $1,136,429 worth being reported for 1912, an increase of $136,883 over 1911. Architectural terra cotta, made principally in Placer County, was the product of third importance, its production being valued at $650,637, an increase of $174,990. Vitrified brick and drain tile were the only products that showed decreases. Pottery production was valued at $219,653 in 1912.

Los Angeles and Alameda are the leading clay-working counties in the State, the former leading in and owing its supremacy to the manufacture of common brick. Alameda County leads in the manufacture of sewer pipe.

Clay products of California, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	236,383,000	276,396,000	280,265,000	282,199,000	349,797,000
Value	$1,593,814	$1,749,209	$1,694,312	$1,716,442	$2,198,303
Average per M	$6.74	$6.33	$6.05	$6.08	$6.28
Vitrified—					
Quantity	3,499,000	7,180,000	8,538,000	9,186,000	5,443,000
Value	$66,214	$135,203	$140,130	$155,885	$72,495
Average per M	$18.92	$18.83	$16.41	$16.97	$13.32
Front—					
Quantity	12,393,000	10,359,000	11,475,000	15,197,000	18,714,000
Value	$283,701	$309,770	$285,468	$381,226	$492,617
Average per M	$22.89	$29.90	$24.88	$25.09	$26.32
Fancy or ornamental. value	$34,947	(a)	$48,572	(a)	(a)
Enameled do	(a)	$57,914	$100,531	$113,407	$134,646
Fire do	$325,760	$297,577	$371,017	$468,120	$513,583
Stove lining do	(a)	(a)	(a)	(a)	(a)
Draintile do	$34,457	$29,620	$55,386	$34,780	$37,377
Sewer pipe do	$1,036,320	$904,473	$1,031,061	$999,546	$1,136,429
Architectural terra cotta do	$500,130	$345,402	$678,249	$475,647	$650,637
Fireproofing do	$188,221	$128,447	$151,503	$200,923	$250,931
Tile, not drain do	$84,484	$130,941	$97,685	$90,632	$76,358
Pottery:					
Red earthenware do	$42,962	$42,464	$34,367	$32,146	$36,091
Stoneware and yellow and Rockingham ware value	$29,300	$59,907	$42,726	$48,190	$54,087
White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware value					(a)
Sanitary ware do	(a)	(a)	(a)	(a)	(a)
Porcelain, electrical supplies, value					(a)
Miscellaneous do	$303,435	$246,238	$111,384	$198,922	$258,896
Total value	$4,523,745	$4,437,165	$4,842,391	$4,915,866	$5,912,450
Number of operating firms reporting	119	99	107	92	91
Rank of State	8	9	9	8	8

a Included in "Miscellaneous."

COLORADO.

The total value of Colorado's clay products in 1912 was $1,437,394, a decrease of $169,315, or 10.54 per cent, from 1911. Colorado's principal clay product is common brick, of which it reported 66,833,000 for 1912, valued at $407,428, a decrease of 23,067,000 brick and of $152,091 in value. Fire brick, second in importance in 1912, was valued at $301,680, an increase of $118,914. Denver County is the principal clay-working county, reporting over one-half of the State's product. It reported more than one-half of the quantity and value of the common brick made in 1912 and is the leading producer of vitrified brick, front brick, sewer pipe, and fireproofing. It was the only producer of terra cotta. Pueblo County is the leading county in the production of fire brick. The pottery production was valued at $41,247 in 1912.

Clay products of Colorado, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	112,859,000	121,908,000	128,711,000	89,950,000	66,833.000
Value	$795,733	$601,833	$852,986	$559,519	$407,428
Average per M	$7.05	$6.58	$6.63	$6.22	$6.10
Vitrified—					
Quantity	2,372,000	(a)	(a)	2,334,000	(a)
Value	$30,262	(a)	(a)	$31,572	(a)
Average per M	$12.76	$14.12	$14.15	$13.53	$12.04
Front—					
Quantity	31,667,000	38,782,000	30,334,000	26,189,000	20,087,000
Value	$364,367	$473,039	$368,538	$294,783	$233,175
Average per M	$11.51	$12.20	$12.15	$11.26	$11.61
Fancy ... value	$34,777	....	(a)	$1,220	$3,785
Enameled ... do	....	....	....	....	(a)
Fire ... do	$206,161	$265,089	$205,550	$182,766	$301,680
Draintile ... do	$16,472	$13,626	$18,066	$23,655	$20,250
Sewer pipe ... do	(a)	(a)	(a)	$297,800	(a)
Architectural terra cotta ... do	(a)	....	....	....	(a)
Fireproofing ... do	(a)	(a)	$32,565	(a)	$22,213
Tile, not drain ... do	(a)	(a)	(a)	(a)	$2,200
Pottery:					
Red earthenware ... do	$11,250	(a)	(a)	(a)	(a)
Stoneware and yellow and Rockingham ware ... value	(a)	(a)	(a)	(a)	(a)
Miscellaneous ... do	$511,059	$495,437	$556,009	$215,394	$446,663
Total value	$1,970,081	$2,049,024	$2,033,714	$1,606,709	$1,437,394
Number of operating firms reporting	80	73	77	80	71
Rank of State	15	16	17	22	25

a Included in "Miscellaneous."

CONNECTICUT AND RHODE ISLAND.

It being impossible to publish figures for Rhode Island without disclosing individual returns, as there are but two clay workers in the State, its figures are combined with those of Connecticut. The value of the products of these States in 1912 was $1,465,000, an increase of $207,661, or 16.52 per cent, over 1912. Connecticut's only products are common brick, stove lining, and fire brick. Rhode Island makes common, vitrified, front, and fancy brick, and tile (not drain). Common brick composed 94.02 per cent of the total value of the clay products of the two States in 1912. Hartford is the leading county in Connecticut, reporting common brick valued at $740,927, or more than one-half of the value of the entire State. Middlesex and New Haven counties are also large producers of common brick. Fire brick is made only in New Haven County.

Clay products of Connecticut and Rhode Island, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	131,760,000	242,000,000	240,234,000	206,631,000	214,700,000
Value	$749,093	$1,408,033	$1,454,471	$1,153,409	$1,377,456
Average per M	$5.69	$5.82	$6.05	$5.58	$6.42
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$16.25	$13.00	$14.62	$15.50	$17.71
Front—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$15.75	$14.00	$15.75	$12.49	$13.25
Fancy or ornamental. value	....	(a)	(a)	(a)	(a)
Fire......do	(a)	(a)	(a)	(a)	(a)
Stove lining......do	(a)	(a)	(a)	(a)	(a)
Tile, not drain......do	....	....	....	(a)	(a)
Pottery: [b]					
Red earthenware......do	(a)	(b)	(b)	(b)	(b)
Stoneware and yellow and Rockingham ware..value	(a)	(b)	(b)	(b)	(b)
Porcelain electrical supplies, ...value	(a)	(b)	(b)	(b)	(b)
Miscellaneous......do	$152,468	$107,562	$114,015	$103,930	$87,544
Total value	$901,561	$1,515,595	$1,568,486	$1,257,339	$1,465,000
Number of operating firms reporting	41	42	42	42	41
Rank of Connecticut and Rhode Island	27	24	23	25	24

a Included in "Miscellaneous."
b Produced by Connecticut alone. In 1909, 1910, 1911, and 1912 the value of pottery products for Connecticut could not be included in the State totals without disclosing the operations of individual establishments.

GEORGIA.

The total value of all clay products in Georgia in 1912 was $2,806,541, an increase of $170,161, or 6.45 per cent, over 1911. The principal product is common brick. It was valued at $1,634,670 in 1912, a decrease of $57,940 from 1911. The quantity decreased from 325,948,000 brick in 1911 to 315,476,000 in 1912. The value of common brick composed 58.25 per cent of the value of all clay products of the State in 1912. Sewer pipe is second to common brick, with a production valued at $622,627 in 1912, an increase of $205,360, or nearly 50 per cent. Bibb County is the leading clay working county of the State and the leading producer of common and front brick and sewer pipe. Richmond and Fulton counties are also large producers of common brick. Architectural terra cotta was reported only from Fulton County, and tile (not drain) from Liberty County. Pottery production was valued at $19,057 in 1912.

Clay products of Georgia, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	248,585,000	275,809,000	305,025,000	325,948,000	315,476,000
Value	$1,335,349	$1,469,839	$1,620,174	$1,692,610	$1,634,670
Average per M	$5.37	$5.33	$5.31	$5.19	$5.18
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$15.50	$12.00	$11.11	$12.22	$12.00
Front—					
Quantity	2,929,000	7,188,000	13,649,000	12,788,000	11,527,000
Value	$34,385	$61,131	$129,393	$112,675	$114,000
Average per M	$11.74	$8.50	$9.48	$8.81	$9.89
Fancy or ornamental. value	....	(a)	(a)	....	(a)
Fire do	$53,466	$62,452	$67,622	$86,000	$61,231
Stove lining do	....	....	....	(a)	....
Draintile do	(a)	$4,820	$8,920	$5,000	(a)
Sewer pipe do	$253,664	$351,492	$373,387	$417,267	$622,627
Architectural terra cotta do	(a)	(a)	(a)	(a)	(a)
Fireproofing do	(a)	(a)	$19,354	(a)	(a)
Tile, not drain do	(a)	(a)	$51,800	(a)	(a)
Pottery:					
Red earthenware do	$5,710	$12,945	$10,558	$17,530	$11,472
Stoneware and yellow and Rockingham ware. value	$4,941	$16,435	$10,740	$6,800	$7,510
Miscellaneous do	$241,096	$315,387	$240,090	$298,498	$355,031
Total value	$1,928,611	$2,294,501	$2,532,038	$2,636,380	$2,806,541
Number of operating firms reporting	108	105	109	109	96
Rank of State	16	15	15	13	12

a Included in "Miscellaneous."

ILLINOIS.

Illinois which makes every variety of clay product as classified by the Survey except china and stove lining is the leading State in the production of architectural terra cotta, second in the production of common and vitrified brick, and third in the production of enameled brick.

The total value of its clay products in 1912 was $15,210,990, an increase of $877,979, or 6.13 per cent, over 1911. The principal product of the State is common brick, the production of which in 1912 amounted to 1,210,499,000 brick, valued at $6,437,331, against 1,074,486,000 brick, valued at $6,126,911, in 1911, and constituted 42.32 per cent of the value of all the clay products of the State. Of the common brick production, Cook County reported 765,845,000, or 63.27 per cent of the quantity, and $3,692,119, or 57.35 per cent of the value. This county is the second largest common brick making region of the United States, being surpassed only by the Hudson River region of New York. The average price per thousand for common brick in 1912 was $5.32, or 38 cents lower than that of 1911. The average price in Cook County was $4 82. Second in importance of the clay products of Illinois is architectural terra cotta, which was valued in 1912 at $2,485,012, or 16.34 per cent of the value of all clay products of the State. Third in point of value was vitrified brick, of which 136,708,000 were reported in 1912, valued at $1,839,721. Knox was the leading county in the production of vitrified brick, with Livingston County second. In the production of front brick, Madison was the leading county. Enameled brick was produced only in Kankakee County. La Salle is the leading county in draintile production, and sewer pipe is produced most largely in McDonough County.

Cook County is by far the largest producer of architectural terra cotta and of common brick. Fireproofing and fire brick are produced principally in La Salle County. Pottery to the value of $931,951, principally stoneware, was reported for 1912.

Cook County, owing to the large Chicago market, was the leading clay working county in 1912, reporting products valued at $6,181,651, or 40.64 per cent of the total for the State in 1912. La Salle County was second with a production valued at $931,802.

Illinois has been fourth among the States in value of clay products for several years, and reported 8.8 per cent of the total value of the whole country for 1912. There were 301 active operators reporting for 1912 and 330 for 1911. The concentration of the industry into fewer and larger units is shown in the following table giving the statistics of the clay working industries in Illinois during the last five years. In 1908, the first year of the period, there were 400 operating firms which reported a total value of products of $11,559,114. The number of firms has decreased each year until in 1912 there were only 301, with an increase in the value of the products to over $15,200,000.

Clay products of Illinois, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	1,119,224,000	1,257,025,000	1,196,526,000	1,074,486,000	1,210,499,000
Value	$4,834,652	$5,927,054	$6,896,836	$6,126,911	$6,437,331
Average per M	$4.32	$4.72	$5.76	$5.70	$5.32
Vitrified—					
Quantity	138,362,000	140,105,000	115,903,000	124,623,000	136,708,000
Value	$1,622,496	$1,562,373	$1,415,355	$1,627,683	$1,839,721
Average per M	$11.73	$11.15	$12.21	$13.06	$13.46
Front—					
Quantity	22,851,000	32,416,000	22,138,000	19,786,000	21,894,000
Value	$301,515	$385,170	$274,699	$240,135	$268,433
Average per M	$13.19	$11.88	$12.41	$12.14	$12.26
Fancy or ornamental .value	(a)	$12,223	$10,875	$10,281	$8,785
Enameled ...do	(a)	(a)	(a)	(a)	(a)
Fire ...do	$250,444	$682,793	$368,730	$286,039	$319,619
Stove lining ...do	(a)	...	...	...	...
Draintile ...do	$1,421,878	$1,613,593	$1,613,698	$1,372,049	$1,189,910
Sewer pipe ...do	$514,386	$394,461	$538,633	$507,694	$500,844
Architectural terra cotta ..do	(a)	$1,898,865	$1,680,438	$1,879,275	$2,485,012
Fireproofing ...do	$264,986	$439,796	$552,905	$552,994	$507,222
Tile, not drain ...do	$124,425	$335,020	(a)	(a)	(a)
Pottery:					
Red earthenware ...do	$24,821	$31,771	$25,658	$41,875	$35,827
Stoneware and yellow and Rockingham ware..value	$733,373	$702,411	$708,958	$832,813	$675,244
White ware, including C. C. ware, white granite, semi-porcelain ware, and semi-vitreous porcelain ware, value	(a)	(a)	...	(a)	(a)
Sanitary ware ...value	...	(a)	(a)	(a)	(a)
Porcelain electrical supplies, ...value	...	...	...	(a)	(a)
Miscellaneous ...do	$1,466,138	$358,923	$1,089,376	$855,262	$943,042
Total value	$11,559,114	$14,344,453	$15,176,161	$14,333,011	$15,210,990
Number of operating firms reporting	400	379	346	330	301
Rank of State	4	4	4	4	4

a Included in "Miscellaneous."

INDIANA.

Indiana is one of the most important clay-working States, ranking sixth among the States in this regard. It reported for 1912 every variety of clay wares as classified by the Survey, except enameled brick and china. It is the leading State in the production of fancy brick, second in the production of draintile, third in the production of front brick, fireproofing, and tile (not drain), and fifth in the production of vitrified brick.

The total value of Indiana's clay products in 1912 was $7,935,251, an increase of $934,480, or 13.35 per cent, over 1911. The flat character of the country and the necessity for drainage creates a demand for draintile, and this product is the principal output of the kilns in Indiana. It was reported to the value of $1,657,368, in 1912, and constituted 20.89 per cent of Indiana's total. Draintile is produced in 69 counties, of which Vermilion is the most important. Indiana is the second State in the value of draintile in 1912, being surpassed only by Iowa. The second product in this State in value was common brick, 202,056,000 being reported for 1912, valued at $1,204,494, or 15.18 per cent of the State total. Lake County is the principal county in the production of common brick and is the second county in the value of all clay products. Clay is the principal clay-working county of the State, reporting for 1912 wares valued at $1,177,128. The principal pottery product of Indiana is sanitary ware, the value of pottery in the State in 1912 being $1,077,102.

There were 278 active operators reporting from this State in 1912, and the total value of the products was approximately $8,000,000. Five years earlier, in 1908, there were 369 active operators and the value of the products was less than $6,750,000. In 1912 the average value of output for each operating firm was $28,524; in 1908, it was $18,266.

Clay products of Indiana, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	224,454,000	251,227,000	234,297,000	192,057,000	202,056,000
Value	$1,221,910	$1,579,185	$1,402,154	$1,132,555	$1,204,494
Average per M	$5.44	$6.29	$5.98	$5.90	$5.96
Vitrified—					
Quantity	57,748,000	53,597,000	61,034,000	31,198,000	55,237,000
Value	$776,533	$559,201	$682,888	$392,136	$654,341
Average per M	$13.45	$10.44	$11.19	$12.57	$11.85
Front—					
Quantity	34,336,000	50,135,000	46,691,000	40,777,000	60,544,000
Value	$403,545	$511,171	$478,627	$480,709	$659,492
Average per M	$11.75	$10.20	$10.25	$11.79	$10.89
Fancy or ornamental.value	(a)	(a)	(a)	(a)	(a)
Fire....do	$115,895	$280,921	$166,217	$76,116	$114,419
Stove lining....do	....	....	(a)	(a)	(a)
Draintile....do	$1,797,329	$2,018,401	$2,071,564	$2,006,803	$1,657,368
Sewer pipe....do	$486,949	$332,449	$406,543	$455,014	$544,491
Architectural terra cotta..do	(a)	(a)	(a)	(a)	(a)
Fireproofing....do	$359,817	$410,500	$466,877	$437,778	$623,123
Tile, not drain....do	$505,908	(a)	$622,726	(a)	(a)
Pottery:					
Red earthenware....do	$7,450	$10,090	$12,650	$5,700	(a)
Stoneware and yellow and Rockingham ware..value	$37,020	$59,598	$89,423	$81,567	$46,100
White ware, including C. C. ware, white granite, semi-porcelain ware, and semi-vitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
Sanitary ware....value	$350,000	(a)	$468,301	$549,470	$633,578
Porcelain electrical supplies, ...value	(a)	(a)	(a)	(a)	(a)
Miscellaneous....do	$677,814	$1,883,707	$1,232,040	$1,382,923	$1,797,845
Total value	$6,740,167	$7,645,223	$8,100,010	$7,000,771	$7,935,251
Number of operating firms reporting	369	348	249	302	278
Rank of State	6	6	6	6	6

a Included in "Miscellaneous."

IOWA.

The total value of Iowa's clay products in 1912 was $4,522,326, an increase of $89,452, or 2.02 per cent over 1911. Iowa is the premier State in the manufacture of draintile, the principal clay product of the State. In 1912 the draintile product of the State was valued at $2,293,084 and constituted 50.71 per cent of the value of Iowa's clay products. Iowa's clay product of second value is common brick, which in 1912 was valued at $1,017,097, or 22.49 per cent of the total. Fireproofing is third among Iowa's clay products, and Iowa ranks fourth among the States in its production. The principal increase among the clay products of Iowa in 1912 was in the manufacture of vitrified brick, which showed a gain of 69.2 per cent in quantity and of 90.59 per cent in value.

Cerro Gordo County is the leading producer of draintile, reporting draintile valued at $621,224 in 1912, or more than one-fourth of the production of the entire State. Webster, the second county, reported draintile valued at $587,808. These two counties reported more than one-half of the production of the entire State. Woodbury County is the leading producer of common brick.

Webster County, whose principal product is draintile, is the leading county in the State in the value of all clay products, reporting in 1912 wares valued at $946,058, or 20.92 per cent of the value for the State. Cerro Gordo is the county of second rank in the output of clay products, reporting in 1912 wares valued at $884,337, or 19.55 per cent of the total for the State.

Clay products of Iowa, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	135,678,000	153,065,000	149,914,000	154,434,000	148,472,000
Value	$904,308	$1,072,340	$1,088,266	$1,025,011	$1,017,097
Average per M	$6.67	$7.01	$7.26	$6.64	$6.85
Vitrified—					
Quantity	16,672,000	18,586,000	19,887,000	8,879,000	15,033,000
Value	$185,112	$198,780	$239,283	$103,384	$197,035
Average per M	$11.10	$10.70	$12.03	$11.64	$13.11
Front—					
Quantity	7,900,000	12,015,000	8,142,000	9,241,000	11,912,000
Value	$86,232	$138,218	$103,276	$114,178	$142,637
Average per M	$10.92	$11.50	$12.68	$12.36	$11.97
Fancy or ornamental...value	(a)	(a)	....	(a)	(a)
Fire...do	....	(a)	(a)	....	(a)
Draintile...value	$2,509,505	$2,830,910	$3,337,851	$2,468,962	$2,293,084
Sewer pipe...do	$211,044	$282,637	$313,430	$284,817	$291,672
Fireproofing, terra-cotta lumber, and hollow building block or tile...value	$129,003	$304,398	$200,965	$374,628	$535,254
Pottery:					
Red earthenware...do	$8,161	$8,175	$6,290	$6,936	(a)
Stoneware and yellow and Rockingham ware...value	$7,549	(a)	(a)	(a)	(a)
Miscellaneous...do	$28,583	$63,238	$38,880	$54,958	$45,547
Total value	$4,069,497	$4,898,696	$5,328,241	$4,432,874	$4,522,326
Number of operating firms reporting	263	247	232	214	200
Rank of State	9	8	8	9	10

a Included in "Miscellaneous."

KANSAS.

The total value of clay products in Kansas in 1912 was $2,036,500, a decrease of $323,762, or 13.72 per cent, from 1911. The principal feature of the clay-working industries of this State in recent years has been the unusually low prices received for common and vitrified brick, this State reporting the lowest average in the country for these products. This has been largely due to the cheap fuel available in the supply of natural gas from the Mid-Continent field. Vitrified brick is the principal clay product of Kansas. It was reported, in 1912, to the value of $806,427, or 39.6 per cent of the total. Kansas was the fourth State in the production and value of vitrified brick in 1912. Common brick was second in importance, being reported to the value of $584,273 in 1912, or 28.69 per cent of the total. The production of vitrified and common brick was less in 1912 than in 1911, but front brick, draintile, and fireproofing increased in value, the last quite considerably, or from $15,257 in 1911 to $48,173 in 1912. The principal vitrified brick-producing county in Kansas in 1912 is Wilson County, which reported 24,819,000 brick or blocks, valued at $235,464, or nearly one-third of the quantity and value of this product of the State. Montgomery County was second in this product and Crawford County third. These three counties reported nearly 80 per cent of the total for the State. Common brick was produced most largely in Wilson County, with Montgomery County second and Allen County third.

Montgomery was the leading clay-working county, its products being valued at $678,491 in 1912, or one-third of the output of the entire State. Vitrified brick is the principal clay product of the county, which is also the leading county in the production of front brick. Wilson County is second in importance, the principal product in this county also being vitrified brick.

Clay products of Kansas, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	225,820,000	254,890,000	218,353,000	183,809,000	145,986,000
Value	$896,542	$1,160,877	$922,940	$694,586	$584,273
Average per M	$3.97	$4.55	$4.22	$3.78	$4.00
Vitrified—					
Quantity	102,922,000	103,264,000	118,950,000	83,337,000	80,906,000
Value	$862,019	$932,419	$1,089,978	$823,505	$806,427
Average per M	$8.38	$9.03	$9.16	$9.88	$9.97
Front—					
Quantity	29,477,000	26,170,000	25,814,000	27,887,000	27,972,000
Value	$233,578	$235,875	$223,875	$213,711	$215,873
Average per M	$7.92	$9.01	$8.67	$7.66	$7.72
Fancy or ornamental . value	(a)	(a)	(a)	(a)	(a)
Fire ... do	(a)	(a)	....	(a)	(a)
Draintile ... do	$22,359	$37,862	$50,726	$35,875	$50,948
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	(a)	(a)	$15,257	$48,173
Tile, not drain ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Stoneware and yellow and Rockingham ware .. value	(b)	(b)	(b)	(b)	(b)
Miscellaneous ... do	$234,307	$342,789	$374,008	$577,328	$330,806
Total value	$2,248,805	$2,709,822	$2,661,527	$2,360,262	$2,036,500
Number of operating firms reporting	65	58	59	53	46
Rank of State	11	13	13	15	16

[a] Included in "Miscellaneous."
[b] The value of pottery products for Kansas could not be included in the State totals without disclosing the operations of individual establishments.

KENTUCKY.

The value of Kentucky's clay products in 1912 was $2,443,740, an increase of $75,646, or 3.19 per cent, over 1911. Kentucky's leading clay product is fire brick, which was valued at $1,000,056 in 1912, an increase of $109,246. The quantity of 9-inch equivalent fire brick marketed in Kentucky in 1912 was 53,162,000, compared with 52,074,000 in 1911. The value of fire brick constituted 40.92 per cent of the value of all of Kentucky's clay products in 1912. This State was fifth in the production and value of fire brick reported for 1912. Common brick was second in importance among Kentucky's clay products, being valued at $656,373 in 1912. Kentucky's third clay product is tile, not drain, which showed an increase in 1912 over 1911, but was less than the value of this product in 1910. Kentucky's pottery production was valued at $114,204 in 1912.

Carter County is the chief fire brick producing county, reporting 27,909,000 9-inch equivalent brick, valued at $550,572, or over one-half of the output and value of the State. The entire clay product of the county is fire brick. Jefferson County is second in the manufacture of fire brick and the leading county in the production of common brick, reporting 26,133,000 brick, valued at $178,512.

Jefferson County is first in value of products, reporting wares in 1912 valued at $597,782. Carter County was second. These two counties reported nearly one-half of the value of the clay products of the entire State. Kenton County is third with products valued at $251,745.

Clay products of Kentucky, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	110,545,000	119,183,000	115,890,000	107,771,000	99,119,000
Value	$687,365	$741,115	$743,732	$692,378	$656,373
Average per M	$6.22	$6.22	$6.42	$6.42	$6.62
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$13.26	$12.69	$12.74	$12.37	$8.36
Front—					
Quantity	11,067,000	11,626,000	10,238,000	8,972,000	5,025,000
Value	$119,785	$104,022	$99,532	$90,330	$46,300
Average per M	$10.82	$8.95	$9.72	$10.07	$9.21
Fancy ... value		(a)	(a)		(a)
Fire ... do	$770,221	$899,363	$955,557	$890,810	$1,000,056
Stove lining ... do		(a)			
Draintile ... do	$53,308	$53,213	$66,217	$64,005	$71,826
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta ... do		(a)			
Fireproofing ... do	$7,263	(a)	(a)	(a)	$29,530
Tile, not drain ... do	$215,000	$296,179	$318,966	$292,563	$310,945
Pottery:					
Red earthenware ... do	$23,448	$20,225	$10,004	$12,880	$22,523
Stoneware and yellow and Rockingham ware ... value	$130,200	$126,172	$139,417	$101,214	$91,681
Miscellaneous ... do	$232,518	$238,583	$234,112	$223,914	$214,506
Total value	$2,239,108	$2,478,872	$2,567,537	$2,368,094	$2,443,740
Number of operating firms reporting	116	99	95	96	90
Rank of State	12	14	14	14	14

[a] Included in "Miscellaneous."

MARYLAND.

Maryland's clay products were valued in 1912 at $1,865,753, an increase of $93,319, or 5.27 per cent over 1911. Maryland's principal clay product is common brick, 154,560,000 brick being reported, valued at $1,053,335. This was a decrease of $5,669,000 brick in quantity and an increase of $53,544 in value. The average value per thousand increased 58 cents, or from $6.24 in 1911 to $6.82 in 1912. Common brick constituted 56.46 per cent of the value of Maryland's clay products in 1912. Fire brick is Maryland's second clay product in point of value. There were 13,986,000 9-inch equivalent fire brick reported for 1912, valued at $262,817, compared with 13,161,000 brick, valued at $249,674, in 1911, an increase in 1912 of 825,000 brick and of $13,143 in value. Maryland's pottery production was valued at $184,711 in 1912, principally of the higher grades of ware. The chief center of production of common brick was in the city of Baltimore and in Baltimore County. These two localities reported 119,125,000 common brick, valued at $746,847, or 77.07 per cent and 70.90 per cent of the production and value of the State, respectively. Frederick County was also a large producer of common brick in 1912, reporting 14,921,000 brick, valued at $100,571. Allegany County was the leading fire brick producing county, reporting 12,757,000 9-inch equivalent brick, or 91.21 per cent of the production of the State, which was valued at $231,270, or 88 per cent of the value of fire brick for the State.

Baltimore City and Baltimore County, whose chief product is common brick, were the principal clay-working centers, reporting products valued at $1,200,137, or 64.32 per cent of the total for the State for 1912.

Clay products of Maryland, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	141,071,000	148,673,000	164,795,000	160,229,000	154,560,000
Value	$828,981	$914,420	$1,051,381	$999,791	$1,053,335
Average per M	$5.88	$6.15	$6.38	$6.24	$6.82
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$13.06	$13.10	$16.96	$16.98	$17.93
Front—					
Quantity	936,000	1,350,000	260,000	757,000	1,968,000
Value	$13,498	$20,582	$3,953	$10,574	$39,664
Average per M	$14.42	$15.25	$15.20	$13.97	$20.15
Fancy or ornamental..value	$1,463	(a)	(a)	(a)	(a)
Enameled..do	(a)	(a)	(a)	(a)	(a)
Fire..do	$179,469	$278,777	$296,541	$249,674	$262,817
Stove lining..do	$23,538	$25,925	$23,067	$28,469	$26,673
Draintile..do	$3,895	$5,695	$5,899	$8,048	$3,043
Architectural terra cotta..do	(a)	(a)	(a)	(a)	(a)
Fireproofing..do					(a)
Tile, not drain..do	(a)			(a)	
Pottery:					
Red earthenware..do	$9,267	$8,034	$9,171	$8,281	$8,451
Stoneware and yellow and Rockingham ware..value	(a)	(a)		(a)	(a)
White ware, including C. C. ware, white granite ware, semiporcelain and semivitreous porcelain ware, ..value	(a)	(a)	(a)	(a)	(a)
Sanitary ware..do		(a)	(a)	(a)	
Miscellaneous..do	$380,988	$467,379	$458,261	$467,597	$471,770
Total value	$1,441,099	$1,720,812	$1,848,273	$1,772,434	$1,865,753
Number of operating firms reporting	65	59	55	56	55
Rank of State	22	21	19	18	19

a Included in "Miscellaneous."

MASSACHUSETTS.

The value of clay products in Massachusetts in 1912 was $1,767,166, an increase of $66,879, or 3.93 per cent, over 1911. The chief clay product is common brick. There were 157,527,000 common brick reported for 1912, valued at $1,095,584. This was a decrease of 9,307,000 brick in quantity and an increase of $15,806 in value, compared with 1911. The average value per thousand increased 48 cents (from $6.47 in 1911 to $6.95 in 1912). The value of common brick constituted 62 per cent of the value of all clay products in Massachusetts in 1912. Stove lining was second in value among clay products in this State, being reported to the value of $173,256. Massachusetts is the leading State in this variety of clay product, reporting 33.52 per cent of the total value for the country. Pottery products to the value of $252,099 were reported for 1912.

Middlesex County is the leading common brick producing county in the State, with Hampden second and Hampshire third. These three counties reported more than one-half of the common brick of the State. Bristol County reported practically all of the stove lining of the State. This county was also the leading fire brick producing county.

Clay products of Massachuestts, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	141,591,000	183,584,000	165,315,000	166,834,000	157,527,000
Value	$950,921	$1,177,281	$1,120,924	$1,079,778	$1,095,584
Average per M	$6.72	$6.41	$6.78	$6.47	$6.95
Front—					
Quantity	1,899,000	1,790,000	(a)	(a)	(a)
Value	$34,055	$45,050	(a)	(a)	(a)
Average per M	$17.93	$25.17	$15.44	$18.00	$20.00
Fancy or ornamental. value	(a)	(a)			
Fire ... do	$63,241	$75,160	$71,780	$70,104	$83,454
Stove lining ... do	$169,811	$159,530	$166,018	$167,802	$173,256
Architectural terra cotta ... do		(a)			
Fireproofing ... do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ... do	$104,386	$69,837	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	$150,148	$154,887	$148,909	$150,038	$163,010
Stoneware and yellow and Rockingham ware..value	$15,409	$14,380	$9,654	$13,541	$26,300
White ware, including C. C. ware, white granite ware, semiporcelain and semivitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
Porcelain electrical supplies, value	(a)	(a)	(a)	(a)	(a)
Miscellaneous ... do	$159,391	$191,761	$190,128	$219,024	$225,562
Total value	$1,647,362	$1,887,886	$1,707,413	$1,700,287	$1,767,166
Number of operating firms reporting	76	72	71	68	63
Rank of State	18	19	21	20	20

a Included in "Miscellaneous."

MICHIGAN.

The value of Michigan's clay products in 1912 was $2,545,498, an increase of $461,566, or 22.15 per cent, over 1911. Michigan's leading clay product is common brick, of which there were 271,189,000, valued at $1,592,283, reported for 1912. The average price per thousand advanced 71 cents in 1912, or from $5.16 in 1911 to $5.87 in 1912. The value of common brick constituted 62.55 per cent of the value of all clay products in Michigan in 1912. Draintile is the clay product of second value in this State in 1912. It was valued at $387,945, an increase of $74,873 over 1911. Michigan was the only one of the leading five States in the production of draintile to show an increase in 1912. Michigan's pottery products in 1912 were valued at $194,892.

Wayne County, in which Detroit is located, was the leading clay-working county, reporting 205,786,000 common brick, valued at $1,193,598, in 1912, and a total value for all clay products of $1,438,790, or 56.52 per cent of the total value for the State. Eaton County, the second in value of all clay products, is the principal draintile-producing county, and draintile is its chief product.

Clay products of Michigan, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	181,049,000	219,820,000	232,551,000	252,465,000	271,189,000
Value	$994,525	$1,250,787	$1,363,316	$1,301,998	$1,592,283
Average per M	$5.49	$5.69	$5.86	$5.16	$5.87
Vitrified—					
Quantity	6,165,000	10,473,000	9,080,000	5,597,000	(a)
Value	$76,630	$129,283	$116,446	$78,336	(a)
Average per M	$12.43	$12.34	$12.82	$14.00	$13.94
Front—					
Quantity	1,896,000	2,379,000	2,209,000	2,498,000	3,934,000
Value	$19,496	$18,654	$27,533	$31,572	$41,476
Average per M	$10.28	$7.84	$12.46	$12.64	$10.54
Fire ... value	....	....	....	(a)	(a)
Stove lining ... do	....	....	(a)	(a)	(a)
Draintile ... do	$327,630	$364,006	$348,205	$313,072	$387,945
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing, terra-cotta lumber, and hollow building tile, or block ... value	$4,100	(a)	....	(a)	$1,461
Tile, not drain ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	$54,659	$60,939	$90,450	$80,580	$99,555
Whiteware, including C. C. ware, white graniteware, semiporcelain ware, and semivitreous porcelain ware ... value	....	....	....	....	(a)
Porcelain electrical supplies, ... value	....	....	(a)	(a)	(a)
Miscellaneous ... do	$251,750	$218,829	$250,272	$278,374	$422,778
Total value	$1,728,790	$2,042,498	$2,196,222	$2,083,932	$2,545,498
Number of operating firms reporting	132	122	118	111	101
Rank of State	17	17	16	16	13

a Included in "Miscellaneous."

MINNESOTA.

The value of clay products in Minnesota, exclusive of pottery, was $1,611,040 in 1912, a decrease of $82,438, or 4.87 per cent. Minnesota's principal clay product is common brick. In 1912 there were 129,604,000 common brick reported, valued at $760,983, a decrease of 23,411,000 brick and of $107,054 in value. The value of common brick constituted 47.24 per cent of all of Minnesota's brick and tile products in 1912. Sewer pipe is second among Minnesota's clay products, but as it was made by less than three producers, figures of production are not published. Fireproofing is third, this product being valued at $160,804 in 1912, an increase of $50,992 over 1911. The rapid increase in the manufacture of this product has been remarkable. It was valued at $45,940 in 1908. The increase in 1912 over 1908 was $114,864, or 250.03 per cent.

Carver County was the largest producer of common brick in 1912, this county reporting 41,000,000 brick, valued at $227,500, or 31.63 per cent of the production and 29.9 per cent of the value of common brick in the State.

Goodhue County is the leading clay-working county of the State, reporting brick and tile products valued at $268,038 in 1912. Hennepin County was second, with products valued at $239,945.

Clay products of Minnesota, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	145,712,000	161,585,000	182,895,000	153,015,000	129,604,000
Value	$869,532	$969,729	$1,104,898	$868,037	$760,983
Average per M	$5.97	$6.00	$6.04	$5.67	$5.87
Vitrified—					
Quantity	(a)	(a)	....	(a)	(a)
Value	(a)	(a)	....	(a)	(a)
Average per M	$9.00	$9.00	....	$13.16	$16.34
Front—					
Quantity	9,900,000	14,350,000	7,240,000	10,853,000	11,555,000
Value	$118,860	$171,600	$88,000	$135,085	$144,125
Average per M	$12.01	$11.96	$12.15	$12.45	$12.47
Fancy or ornamental . value	(a)	....	....	....	....
Fire ... do	(a)	....	(a)	(a)	(a)
Draintile ... do	$70,161	$109,371	$160,706	$121,965	$126,690
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	$45,940	$53,398	$93,731	$109,812	$160,804
Tile, not drain ... do	....	(a)	....	(a)	....
Pottery:					
Earthenware and stoneware, ... value	(b)	(b)	(b)	(b)	(b)
Miscellaneous ... do	$404,217	$451,340	$453,961	$458,579	$418,438
Total value	$1,508,710	$1,755,438	$1,901,296	$1,693,478	$1,611,040
Number of operating firms reporting	92	80	84	81	79
Rank of State	20	20	18	21	21

a Included in "Miscellaneous."

b The value of pottery products for Minnesota could not be included in the State totals without disclosing the operations of individual establishments.

MISSOURI.

Missouri is one of the important clay-working States of the country, and is the leading Southern State. It reported for 1912 every variety of brick and tile products as classified by the Survey, and is the seventh State in value of clay products. It was thirteenth in the production and value of common brick, eighth in the production and ninth in the value of vitrified brick, tenth in the production and ninth in the value of front brick, third in the value of fancy brick, second in enameled brick and sewer pipe, fourth in terra cotta, and second in the production and value of fire brick.

The total value of the clay products of Missouri in 1912 was $6,412,861, an increase of $138,508, or 2.21 per cent over 1911. Fire brick is the product of chief value. There were 97,751,000 9-inch equivalent fire brick reported from Missouri for 1912, valued at $1,941,347, an increase of 10,806,000 brick and of $177,799 in value. The value of fire brick constituted 30.27 per cent of the value of all clay products in the State in 1912. Common brick is the product of second value. There were 188,496,000 brick, valued at $1,243,070, reported for 1912. This was a decrease of 28,970,000 brick and of $66,094 in value. The average price per thousand increased from $6.02 in 1911 to $6.59 in 1912, or 57 cents.

Sewer pipe is third in value of products, $1,178,482 being reported as the value for 1912, an increase of $21,856 over 1911. Architectural terra cotta is fourth, the output in 1912 being valued at $654,163, an increase of $251,194 over 1911. Pottery production to the value of only $3,515 was reported for 1912.

The leading county in the production of fire brick in 1912 was St. Louis County, which reported 38,985,000 9-inch equivalent brick. St. Louis City was second, with 32,993,000 brick. In value, however, St. Louis City was first and St. Louis County second, the values being $800,142 and $731,285, respectively. These two localities reported 73.63 per cent of the quantity and 78.88 per cent of the value of the fire brick of the State in 1912. They are also the leading localities in the manufacture of common brick. St. Louis City reported 85,502,000 brick, valued at $539,469, and St. Louis County reported 43,434,000 brick, valued at $299,114. These two localities reported 68.40 per cent of the total quantity and 67.46 per cent of the total value of common brick for the State in 1912, and constitute the fourth largest common-brick-making center of the country. St. Louis City is the leading district in the production of sewer pipe and terra cotta. As may be judged from the foregoing, St. Louis City is the leading clay-working locality in the State. It reported for 1912 clay products, valued at $3,726,606, or more than one-half of the value of clay products for the entire State. St. Louis County was next, reporting products valued at $1,035,028; Jackson County was third, Henry County fourth, and Audrian fifth. St. Louis County and St. Louis City reported 74.25 per cent of the value of the clay products of the State in 1912.

In the five years from 1908 to 1912 the number of active operators has steadily decreased from 161 to 110, whereas the value of the products in 1912 exceeded those of 1908 by nearly $800,000.

Clay products of Missouri, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	219,526,000	276,403,000	201,281,000	217,466,000	188,496,000
Value	$1,465,311	$1,961,805	$1,284,997	$1,309,164	$1,243,070
Average per M	$6.67	$7.10	$6.38	$6.02	$6.59
Vitrified—					
Quantity	56,805,000	59,863,000	56,703,000	44,813,000	30,551,000
Value	$647,097	$781,706	$647,441	$488,299	$342,930
Average per M	$11.39	$13.06	$11.42	$10.90	$11.22
Front—					
Quantity	32,136,000	36,194,000	38,428,000	25,491,000	19,963,000
Value	$356,758	$589,782	$516,505	$330,332	$264,375
Average per M	$11.10	$16.30	$13.44	$12.96	$13.24
Fancy or ornamental.value	$25,035	$29,683	$23,673	$24,269	$19,838
Enameled do	(a)	(a)	(a)	(a)	(a)
Fire do	$1,357,387	$1,598,302	$2,059,845	$1,763,548	$1,941,347
Stove lining do	(a)	(a)	(a)	(a)	(a)
Draintile do	$76,865	$127,166	$121,068	$164,393	$141,297
Sewer pipe do	$962,116	$1,162,730	$1,210,348	$1,156,626	$1,178,482
Architectural terra cotta do	(a)	(a)	(a)	$402,969	$654,163
Fireproofing, terra-cotta lumber, and hollow building tile or block value	$105,136	$110,464	$146,931	$123,499	$75,551
Tile, not drain do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware do	$3,719	$4,792	$3,080	$2,755	(a)
Stoneware and yellow and Rockingham ware value	$62,689	$66,830	$25,981	$2,453	$2,015
Miscellaneous do	$569,343	$1,006,923	$1,047,897	$506,046	$549,793
Total value	$5,631,456	$7,440,183	$7,087,766	$6,274,353	$6,412,861
Number of operating firms reporting	161	156	150	122	110
Rank of State	7	7	7	7	7

a Included in "Miscellaneous."

NEW JERSEY.

New Jersey is one of the most important clay-working States of the Union. It is third in value of production, and second only to Pennsylvania in variety of products. It is second in value of pottery products and fourth in the value of brick and tile products. In 1912, it was first in the production of china and sanitary ware. It was fourth in the production and value of common and front brick, fifth in the value of fancy brick, first in enameled brick and fireproofing; second in architectural terra cotta and tile (not drain), and fourth in the production and value of fire brick. It reported no vitrified brick for 1912.

The value of New Jersey's clay products in 1912 was $19,838,553—$10,902,633 in brick and tile, and $8,935,920 in pottery. This was an increase of $1,660,325, or 9.13 per cent, over 1911. New Jersey's leading clay product is sanitary ware. This was reported to the value of $5,199,278, an increase of $300,690 over 1911. The value of sanitary ware constituted 26.21 per cent of the value of all of New Jersey's clay products in 1912. Common brick is the second product in value. There were 429,309,000 common brick reported for 1912, valued at $2,592,091, a decrease of 58,000 brick in quantity and an increase of $190,129 in value, compared with 1911. The average price per thousand advanced 45 cents, or from $5.59 in 1911 to $6.04 in 1912. The value of common brick was 13.07 per cent of the value of all of New Jersey's clay products in 1912. Architectural terra cotta ranks third among New Jersey's clay products. It was valued at $2,330,065 in 1912, an increase of $660,092 over 1911. In 1912, fireproofing, New Jersey's fourth product, was valued at $2,031,350, which was 28.31 per cent of the value of the output for the country. Tile (not drain) is also an important product in this State, being reported to the value of $1,255,246 in 1912.

Mercer County, in which Trenton is located, is the most important clay-working county, and the leading product of the county is sanitary ware, of which the value reported was $4,662,768 in 1912, or 89.68 per cent of the State's total for this variety. The value of all of Mercer County's clay products in 1912 was $8,773,047, or 44.22 per cent of the State's total. Middlesex County, second in importance, is the principal producer of common brick, reporting 213,928,000 brick, valued at $1,282,407, and total clay products to the value of $8,415,504, or 42.42 per cent of the State's total. Middlesex County is also the leading producer of architectural terra cotta, of fireproofing and tile (not drain), and of fire brick. This county reported in 1912 an output of architectural terra cotta valued at $2,014,842, or 86.47 per cent of the value of this variety for the entire State. It reported fireproofing to the value of $1,818,241 and of tile (not drain), to the value of $664,848. This was 89.51 per cent of the production of the former and 52.97 per cent of the latter in the State. Its production of fire brick was 54,808,000 9-inch equivalent brick, valued at $1,283,668.

Bergen County is second in the manufacture of common brick with 50,495,000 brick, valued at $307,913 in 1912. The market for Bergen County common brick (its only clay product) is Greater New York City. A larger proportion of New Jersey brick went to the New York market in 1912 than ever before.

If brick and tile products only be considered, Middlesex County was first with products valued at $8,062,219, and Mercer second with products valued at $703,353. If pottery only be considered Mercer was first with products valued at $8,069,694, and Middlesex second with products valued at $353,285. In other words, Mercer County's products are nearly all pottery and Middlesex's are nearly all brick and tile.

Clay products of New Jersey, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	300,544,000	460,966,000	401,103,000	429,367,000	429,309,000
Value	$1,579,835	$2,609,605	$2,215,628	$2,401,962	$2,592,091
Average per M	$5.26	$5.66	$5.52	$5.59	$6.04
Vitrified—					
Quantity	(a)	(a)	....	(a)	....
Value	(a)	(a)	....	(a)	....
Average per M	$11.43	$11.41	....	$14.99	....
Front—					
Quantity	64,302,000	80,855,000	47,451,000	47,606,000	48,852,000
Value	$667,682	$862,245	$609,845	$528,656	$558,372
Average per M	$10.38	$10.66	$12.85	$11.10	$11.43
Fancy or ornamental. value	$3,619	$8,578	(a)	(a)	(a)
Enameled ... do	(a)	(a)	(a)	(a)	(a)
Fire ... do	$800,987	$907,276	$1,001,063	$1,344,884	$1,460,988
Stove lining ... do	(a)	....	(a)	(a)	(a)
Draintile ... do	$30,325	$37,211	$23,147	$26,502	$50,984
Sewer pipe ... do	(a)	(a)	(a)	$103,137	(a)
Architectural terra cotta ... do	$1,039,856	$1,637,705	$2,000,039	$1,669,973	$2,330,065

a Included in "Miscellaneous."

Clay products of New Jersey, 1908–1912—Continued.

Product.	1908	1909	1910	1911	1912
Fireproofing, terra-cotta lumber, and hollow building tile or block....value..	$826,224	$1,299,540	$1,582,101	$1,728,811	$2,031,350
Tile, not drain....do....	$835,499	$992,606	$1,199,113	$1,197,330	$1,255,246
Pottery:					
Red earthenware....do....	$20,100	$36,573	$26,529	$38,910	$36,655
Stoneware and yellow and Rockingham ware.value..	(a)	$66,293	$55,734	$75,915	$48,297
White ware, including C. C. ware, white granite semi-porcelain ware, and semi-vitreous porcelain ware, value....	$1,137,701	$1,242,361	$1,345,156	$1,148,904	$1,090,683
China, bone china, delft, and belleek ware....value..	$876,259	$1,082,398	$1,131,412	$1,105,278	$1,155,766
Sanitary ware....do....	$3,182,772	$4,341,040	$4,955,066	$4,898,588	$5,199,278
Porcelain electrical supplies, ...value..	$559,556	$823,056	$874,013	$913,921	$1,146,467
Miscellaneous....do....	$753,281	$1,225,607	$815,463	$995,457	$882,311
Total value....	$12,313,696	$17,172,094	$17,834,309	$18,178,228	$19,838,553
Number of operating firms reporting....	165	165	167	162	155
Rank of State....	3	3	3	3	3

a Included in "Miscellaneous."

NEW YORK.

New York is the fifth State in the value of clay products and reports every variety as classified by the Survey, except enameled brick. Its most interesting feature is the remarkable production of common brick along Hudson River. This is the largest brick-producing region in the country and probably in the world. New York is the leading State in the production and value of common brick, second in the production of china and porcelain electrical supplies, and third in the production of terra cotta and stove lining. It was the fifth State in the production of brick and tile products and fourth in pottery.

The value of clay products in New York in 1912 was $12,058,858—$9,653,326 in brick and tile and $2,405,532 in pottery. This was an increase of $1,874,482, or 18.41 per cent. Common brick is New York's principal clay product. For 1912 there were 1,273,641,000 brick reported, valued at $7,311,675—an increase over 1911 of 129,915,000 brick, or 11.36 per cent, and in value of $1,393,389, or 23.54 per cent. The average price per thousand for common brick in New York advanced 57 cents, or from $5.17 in 1911 to $5.74 in 1912. The value of common brick constituted 60.63 per cent of the value of all of New York's clay products in 1912. Next to common brick among New York's clay products are porcelain electrical supplies, which were valued in 1912 at $1,269,108. The third is architectural terra cotta, valued at $1,139,291 in 1912—an increase of $465,762 over 1911. China ranks fourth, with a value in 1912 of $691,065.

Ulster County is the leading county in the production of common brick, reporting 259,480,000 brick in 1912, valued at $1,458,554. Rockland County was second with 207,796,000 brick, valued at $1,221,428. Their large production of common brick makes these two counties the leading ones in all clay products.

Onondaga County is third with products in 1912 valued at $946,521, of which pottery was $819,712 and brick and tile $126,809. Schenectady and Ontario Counties are the principal producers of porcelain electrical supplies, reporting together a production valued at $858,845, or more than two-thirds of the State total for this variety.

Clay products of New York, 1908–1912.

Products.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	1,055,006,000	1,542,552,000	1,380,084,000	1,143,726,000	1,273,641,000
Value	$5,066,084	$7,760,746	$6,897,438	$5,918,286	$7,311,675
Average per M	$4.80	$5.03	$5.00	$5.17	$5.74
Vitrified—					
Quantity	14,570,000	16,063,000	21,662,000	17,035,000	18,634,000
Value	$211,290	$238,697	$334,432	$290,728	$287,089
Average per M	$14.50	$14.86	$15.44	$17.07	$15.41
Front—					
Quantity	9,721,000	9,815,000	9,229,000	9,942,000	9,499,000
Value	$135,342	$148,126	$137,748	$133,563	$123,378
Average per M	$13.92	$15.09	$14.93	$13.43	$12.99
Fancy or ornamental..value	(a)	....	(a)	(a)	(a)
Fire..do	$436,847	$491,872	$514,990	$347,415	$328,644
Stove lining..do	$102,985	$79,653	$86,248	$82,803	$75,751
Draintile..do	$275,681	$125,640	$272,836	$112,609	$51,005
Sewer pipe..do	$133,716	$126,908	$136,576	$116,184	(a)
Architectural terra cotta..do	$709,360	$998,535	$1,108,371	$673,529	$1,139,291
Fireproofing..do	$122,395	$199,999	$210,954	$227,871	$217,411
Tile, not drain..do	$40,066	$62,795	$72,815	$86,602	$45,865
Pottery:					
Earthenware..value	$31,645	$30,200	$26,863	$34,295	$31,497
Stoneware and yellow and Rockingham ware..value	$44,713	$46,905	$43,325	$40,946	(a)
White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
China, bone China, delft, and belleek ware..value	$622,548	$592,611	$642,592	$730,983	$691,065
Sanitary ware..do	(a)	(a)	(a)	(a)	(a)
Porcelain electrical supplies, ..value	$560,754	$752,185	$957,101	$988,716	$1,269,108
Miscellaneous..do	$435,798	$502,564	$429,660	$399,846	$487,079
Total value	$8,929,224	$12,157,436	$11,871,949	$10,184,376	$12,058,858
Number of operating firms reporting	241	243	240	222	219
Rank of State	5	5	5	5	5

[a] Included in "Miscellaneous."

NORTH CAROLINA.

The value of clay products in North Carolina in 1912 was $1,465,653, an increase of $185,527, or 14.49 per cent, over 1911. The clay product of chief value is common brick, of which there were 193,058,000 reported for 1912, valued at $1,236,443, an increase of 14,823,000 brick and of $160,260 in value over 1911. The value of common brick in 1912 constituted 84.36 per cent of the value of all clay products in North Carolina. Front brick, draintile, and fire brick are also made in small quantities. Sewer pipe is made in considerable quantity by one firm, and the figures are not published. Pottery production was valued at $8,950 in 1912.

Guilford is the principal clay-working county in the State, reporting for 1912 products valued at $268,462. This county reports common brick, draintile, sewer pipe, and flue pipe and lining. Wayne County is the principal common-brick-producing county and second in rank for all clay products, reporting 23,600,000 brick, valued at $161,400 in 1912. Wake is the second county in the production of common brick (third for all clay products) and reported in 1912, 12,000,000 brick, valued at $69,000.

Clay products of North Carolina, 1908–1912.

NORTH CAROLINA.

Products.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	144,192,000	188,313,000	167,966,000	178,235,000	193,058,000
Value	$900,611	$1,140,727	$1,039,319	$1,076,183	$1,236,443
Average per M	$6.25	$6.06	$6.19	$6.04	$6.40
Vitrified—					
Quantity	(a)				
Value	(a)				
Average per M	$8.00				
Front—					
Quantity	300,000	725,000	550,000	(a)	(a)
Value	$2,700	$9,250	$5,800	(a)	(a)
Average per M	$9.00	$12.76	$10.55	$9.81	$8.92
Fire ... value	$7,560			(a)	$4,430
Draintile ... do	$1,635	$8,890	$9,555	$11,704	$10,745
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)		(a)	(a)	
Pottery:					
Red earthenware ... do	$775	$1,780	$1,961	$1,333	$778
Stoneware and yellow and Rockingham ware ... value	$12,587	$16,929	$13,029	$7,223	$8,172
Miscellaneous ... do	$18,100	$125,035	$154,000	$183,683	$205,085
Total value	$943,968	$1,302,611	$1,223,664	$1,280,126	$1,465,653
Number of operating firms reporting	216	187	184	163	162
Rank of State	26	25	25	24	23

[a] Included in "Miscellaneous."

OHIO.

Ohio is the leading State of the Union in the value of clay products. For 1912 it reported every variety of brick and tile products as classified by the Survey, except terra cotta, and all the pottery products except china. It was the leading State in the production of vitrified brick, sewer pipe, tile (not drain), red earthenware, stoneware and yellow and Rockingham ware, white ware, and porcelain electrical supplies. It was second in the production of front brick and fireproofing; third in draintile and fire brick; fourth in fancy brick and stove lining; and fifth in common brick.

The value of clay products in 1912 was $34,811,508, or 20.14 per cent of the total for the country. This was an increase of $2,147,613, or 6.57 per cent, over 1911. Ohio's brick and tile production in 1912 was valued at $19,302,773, and pottery production at $15,508,735. The principal clay product is white ware, which was reported to the value of $9,969,491 in 1912, an increase of $357,176, or 3.72 per cent, over 1911. The value of white ware constituted 28.64 per cent of the value of all of Ohio's clay products in 1912. Sewer pipe is the second product, being reported to the value of $4,022,078, an increase of $576,477, or 16.73 per cent. The production of vitrified brick decreased from 315,944,000 brick, valued at $3,200,475, in 1911 to 268,271,000 brick, valued at $2,830,309, in 1912, but retained its place as third among the State's products. The fourth product is tile (not drain), which was reported to the value of $2,421,783 in 1912, an increase of $109,301, or 4.73 per cent. Common brick is the fifth product in Ohio, there being 395,836,000 brick reported for 1912, valued at $2,414,482, or $6.10 per thousand. This was an increase of 6,321,000 brick and of $115,288 in value over 1911.

Columbiana County, the most important clay-working county, is the principal producer of white ware in Ohio. The total clay products for the county in 1912 were valued at $8,280,827, or 23.79 per cent of the State's total. The value of the white ware produced in 1912 was $6,445,640, or 64.65 per cent of this product for the entire State. Sewer pipe is produced most largely in Summit County, which reported sewer pipe valued at $1,323,489 in 1912; Jefferson County is a close second, reporting sewer pipe to the value of $1,288,880. These two counties produced over 64.95 per cent of this product for the State. The leading county in the production of vitrified brick in 1912 is Stark, which reported 69,798,000 brick or block, valued at $631,424, or nearly one-fourth of the production of the State. Cuyahoga County is second, reporting 36,509,000 brick, valued at $388,368. Cuyahoga County leads in the production of common brick, the output in 1912 amounting to 106,146,000 brick, valued at $605,752, or 26.82 per cent of the quantity and 25.09 per cent of the value for the entire State. The city of Cleveland furnishes the principal market for the output. Lucas County was second, reporting 46,726,000 brick, valued at $280,626.

Muskingum County, the second county in the State in the value of all clay products, reported wares valued at $3,484,162, or 10.01 per cent of the State's total. Of the value of Muskingum's clay products in 1912, $2,246,116 was brick and tile, principally tile (not drain) and vitrified brick, and $1,238,046 was pottery, principally stoneware. Summit County, third in importance, had in 1912 products valued at $3,022,378, of which brick and tile was valued at $1,963,783 and pottery at $1,058,595. Summit County's principal brick and tile product is sewer pipe ($1,323,489 in 1912); its principal pottery product is porcelain electrical supplies ($453,795 in 1912). Jefferson County, fourth in the value of clay products, reported for 1912 wares valued at $2,504,465, of which $2,129,912 was brick and tile and $374,553 was pottery. Jefferson County's principal brick and tile product is sewer pipe ($1,288,880 in 1912), and its principal pottery product is white ware.

There were 596 active operators reporting for 1912 and 633 for 1911. The same tendency toward concentration into fewer and larger units that has been noted in the other important clay-working States is shown in the statistics of Ohio's production during the last five years. In 1908 there were 706 operating firms, and the total value of all clay products was $26,622,490, an average for each firm of $37,709. In 1912 there were 596 operating firms (110 less than in 1908); the value of the product was $34,811,508 (over $8,000,000 more than in 1908), and the average value for each firm was $58,409, a gain over 1908 of $20,700, or 54.89 per cent.

Clay products of Ohio, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	369,410,000	420,999,000	409,773,000	389,515,000	395,836,000
Value	$2,105,910	$2,429,879	$2,507,742	$2,299,194	$2,414,482
Average per M	$5.70	$5.77	$6.12	$5.90	$6.10
Vitrified—					
Quantity	327,718,000	324,530,000	289,817,000	315,944,000	268,271,000
Value	$3,232,335	$3,113,128	$2,876,157	$3,200,475	$2,830,309
Average per M	$9.86	$9.59	$9.92	$10.13	$10.55
Front—					
Quantity	94,435,000	130,684,000	134,759,000	159,118,000	184,405,000
Value	$1,067,888	$1,393,787	$1,489,094	$1,630,898	$1,836,989
Average per M	$11.31	$10.67	$11.05	$10.25	$9.96
Fancy or ornamental . value	$39,309	$24,367	$32,995	$25,340	$16,692
Enameled . . . do	....	....	....	....	(a)
Fire . . . do	$1,339,810	$1,730,401	$1,709,039	$1,539,450	$1,629,638
Stove lining . . . do	(a)	$23,803	(a)	$86,673	$37,544
Draintile . . . do	$1,725,462	$2,032,528	$1,869,823	$1,684,420	$1,546,723
Sewer pipe . . . do	$3,918,971	$3,009,798	$3,289,537	$3,445,601	$4,022,078
Architectural terra cotta . . . do	....	(a)	....	....	....
Fireproofing, terra-cotta lumber, and hollow building tile or block . . . value	$552,887	$804,637	$934,960	$1,086,287	$1,750,715
Tile, not drain . . . do	$1,438,042	$1,912,343	$1,896,572	$2,312,482	$2,421,783
Pottery:					
Red earthenware . . . do	$138,431	$145,137	$161,799	$233,060	$263,085
Stoneware and yellow and Rockingham ware . . value	$1,468,197	$1,806,798	$1,664,572	$1,758,785	$1,832,266
White ware, including C. C. ware, white granite, semi-porcelain ware, and semi-vitreous porcelain ware, value	$7,228,663	$8,884,189	$9,730,408	$9,612,315	$9,969,491
China, bone china, delft, and belleek ware . . . value	(a)	(a)	....	....	....
Sanitary ware . . . do	$233,000	$310,254	$327,438	$378,779	$451,971
Porcelain electrical supplies, . . . value	$719,034	$1,146,694	$1,277,144	$1,610,925	$1,827,290
Miscellaneous . . . do	$1,414,578	$1,578,498	$1,758,668	$1,759,211	$1,960,452
Total value	$26,622,490	$30,346,241	$31,525,948	$32,663,895	$34,811,508
Number of operating firms reporting	706	685	683	633	596
Rank of State	1	1	1	1	1

a Included in "Miscellaneous."

PENNSYLVANIA.

Pennsylvania is the second State in the value of clay products, reporting every variety of ware, as classified by the Survey. It is first in the production of brick and tile products and fifth in the production of pottery. In 1912 it was the leading producer of front and fire brick, reporting about one-fourth of the former for the whole country and nearly one-half of the latter. It was second in the production of fancy brick and stove lining, third in the production and value of common brick, and fourth in the production of sewer pipe.

Pennsylvania's clay products in 1912 were valued at $21,537,221, an increase of $1,267,188, or 6.25 per cent. This was 12.46 per cent of the value of all clay products of the country. Its brick and tile production was valued at $19,408,681 and its pottery production at $2,128,540. Its principal brick and tile product is fire brick and its chief pottery product is white ware.

Pennsylvania's chief clay product is fire brick. Including silica brick, Pennsylvania reported 436,650,000 9-inch equivalent brick for 1912, valued at $8,129,578, or $18,62 per thousand. This was an increase of 67,914,000 brick and of $1,048,963 in value over 1911.

Of clay fire brick Pennsylvania reported 335,054,000, valued at $6,178,870, an increase of 40,992,000 brick and of $623,341 in value over 1911. This was 43.06 per cent of the quantity of clay fire brick of the entire country and 41.32 per cent of its value. Pennsylvania reported 101,596,000 9-inch equivalent silica fire brick in 1912, valued at $1,950,708, or $19.20 per thousand. This was an increase of 26,922,000 brick and of $425,000 in value over 1911. The value of fire-brick production in the State composed 37.75 per cent of all of Pennsylvania's clay products in 1912. Pennsylvania's second clay product in point of value is common brick. The quantity reported for 1912 was 697,023,000, valued at $4,590,784, or $6.59 per thousand. This was a decrease of 77,099,000 brick, or 9.96 per cent in quantity, and of $372,448, or 7.50 per cent, in value. Its third product is front brick. In 1912 the quantity reported was 217,328,000, valued at $2,321,479, or $10.68 per thousand. This was an increase of 32,759,000 brick and of $209,987 in value over 1911. The average value per thousand declined 76 cents.

Philadelphia County, the third largest common-brick-producing center of the country, with the city of Philadelphia for a market, is the principal producer of common brick, reporting 177,144,000 brick for 1912, valued at $1,259,131, and Allegheny County, the home of "Greater Pittsburgh," is second with 89,201,000 brick, valued at $560,913, in 1912. Vitrified brick is produced principally in Lawrence County, with Clearfield County second. Front brick is made chiefly in Armstrong County, 76,405,000 brick being reported from that county for 1912, valued at $855,491, or more than one-third of the production and value of the State. Clearfield County is the largest producer of clay fire brick, reporting 97,559,000 9-inch equivalent brick, valued at $1,868,406. Clinton County is the second largest producer of this variety of brick, 43,643,000 brick being reported from that county in 1912, valued at $809,751. Huntingdon County is the largest producer of silica brick, reporting 58,150,000 9-inch equivalent brick, valued at $1,143,446, or over one-half of the quantity and value for the whole State.

Clearfield County is the most important clay-working county in the State, reporting wares valued at $2,250,983. Clearfield's principal product is fire brick, though considerable quantities of vitrified and front brick are made there.

Philadelphia County is second in value of production, its clay products in 1912 having been valued at $2,177,591. Philadelphia County's principal clay product is common brick, with considerable quantities of fire brick. Architectural terra cotta is also an important product in this county, and pottery to the value of $161,007 was reported.

There were 393 active operators reporting for 1912 from Pennsylvania and 423 for 1911. The operating firms were 30 fewer in 1912 than in 1911, and the value of the products increased more than $1,250,000. If the statistics of 1912 are compared with 1908, these differences are still more striking.

Clay products of Pennsylvania, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	717,016,000	872,658,000	828,703,000	774,122,000	697,023,000
Value	$4,539,978	$5,607,490	$5,371,707	$4,963,232	$4,590,784
Average per M	$6.33	$6.43	$6.48	$6.41	$6.59
Vitrified—					
Quantity	90,044,000	116,735,000	101,330,000	124,125,000	112,372,000
Value	$1,038,254	$1,329,317	$1,204,724	$1,511,061	$1,411,096
Average per M	$11.53	$11.39	$11.89	$12.17	$12.56
Front—					
Quantity	124,642,000	194,695,000	171,415,000	184,569,000	217,328,000
Value	$1,403,594	$2,111,556	$2,001,967	$2,111,492	$2,321,479
Average per M	$11.26	$10.85	$11.68	$11.44	$10.68
Fancy or ornamental. value	$49,199	$27,963	$35,768	$44,883	$43,186
Enameled do	(a)	(a)	(a)	(a)	(a)
Fire do	$4,252,325	$8,107,807	$6,454,928	$5,555,529	$6,178,870
Stove lining do	$129,686	$97,270	$132,567	$164,848	$138,630
Draintile do	$14,904	$14,668	$11,480	$12,779	$12,421
Sewer pipe do	$578,800	$445,594	$583,418	$560,809	$829,917
Architectural terra cotta do	$389,596	$428,522	$472,150	$389,000	$569,943
Fireproofing, terra-cotta lumber, hollow building tile or block value	$241,175	$324,860	$300,187	$300,687	$350,219
Tile, not drain do	$337,948	$441,243	$413,047	$358,913	$385,952
Pottery:					
Red earthenware do	$138,181	$159,796	$178,348	$159,420	$162,137
Stoneware and yellow and Rockingham ware value	$259,095	$297,029	$323,990	$304,998	$281,526
White ware, including C. C. ware, white granite ware, semiporcelain ware, and semivitreous porcelain ware value	$623,544	$812,338	(a)	(a)	$902,585
China, bone china, delft, and belleek ware value	$69,994	$91,757	$188,122	$216,724	$280,472
Sanitary ware do	$175,384	$252,951	$254,747	$215,590	$185,000
Porcelain electrical supplies, value	....	(a)	(a)	(a)	$307,636
Miscellaneous do	$601,325	$636,552	$4,167,135	$3,400,068	$2,585,368
Total value	$14,842,982	$21,186,713	$22,094,285	$20,270,033	$21,537,221
Number of operating firms reporting	466	457	451	423	393
Rank of State	2	2	2	2	2

a Included in "Miscellaneous."

TENNESSEE.

The total value of all of Tennessee's clay products in 1912 was $1,501,016, an increase of $115,916, or 8.37 per cent, over 1911. The principal product is common brick. There were 154,211,000 brick, valued at $903,032, or $5.86 per thousand, in 1912. This was an increase of 9,387,000 brick and of $60,168 in value over 1911. Common brick constituted 60.16 per cent of the value of all clay products in the State in 1912.

Hamilton County, the chief clay-working county, is the largest producer of common brick in the State, reporting 31,190,000 brick in 1912, valued at $159,640. The total value of all clay products in Hamilton County was $467,512. Shelby County, with a smaller production, 25,921,000 brick, was the first county in value of this product, $185,068. Front brick was reported principally from Davidson County. Davidson County's total production was worth $273,821.

Clay products of Tennessee, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	134,171,000	159,328,000	140,878,000	144,824,000	154,211,000
Value	$767,773	$1,022,282	$826,533	$842,864	$903,032
Average per M	$5.72	$6.42	$5.87	$5.82	$5.86
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$11.46	$13.08	$10.80	$10.41	$11.11
Front—					
Quantity	9,494,000	11,397,000	10,119,000	9,547,000	11,118,000
Value	$103,228	$125,661	$98,450	$94,733	$101,575
Average per M	$10.87	$11.03	$9.73	$9.92	$9.14
Fancy ... value	$1,505	(a)	(a)	(a)	(a)
Fire ... do	$21,029	(a)	$14,907	$15,915	$10,981
Draintile ... do	$36,114	$67,472	$29,707	$51,721	$39,459
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	(a)	(a)	$4,540	$3,938	$1,205
Stoneware and yellow and Rockingham ware .. value	$56,532	$35,100	$44,640	$38,759	$44,089
Miscellaneous ... do	$250,253	$398,357	$395,511	$337,170	$400,675
Total value	$1,236,434	$1,648,872	$1,414,288	$1,385,100	$1,501,016
Number of operating firms reporting	104	100	97	84	80
Rank of State	23	23	24	23	22

a Included in "Miscellaneous."

TEXAS.

The value of clay products in Texas in 1912 was $2,886,068, an increase of $226,149, or 8.5 per cent, over 1911. The principal product is common brick, valued in 1912 at $1,590,960. Common brick constituted 55.13 per cent of the value of the clay products of Texas in 1912. The pottery production was valued at $146,604.

Clay products of Texas, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	194,551,000	293,660,000	271,640,000	255,811,000	242,748,000
Value	$1,285,857	$1,890,601	$1,779,062	$1,596,763	$1,590,960
Average per M	$6.61	$6.44	$6.55	$6.24	$6.55
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$10.81	$10.32	$13.67	$15.92	$14.56
Front—					
Quantity	10,411,000	26,726,000	21,646,000	19,331,000	24,510,000
Value	$154,298	$407,023	$325,074	$297,847	$394,524
Average per M	$14.82	$15.23	$15.02	$15.41	$16.10
Fancy or ornamental. value	....	(a)	....	....	....
Fire ... do	$69,039	$123,393	$75,950	$78,230	$112,983
Draintile ... do	$5,275	$28,414	$18,408	$12,817	$10,694
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	$20,170	(a)	$47,038	$57,433
Tile, not drain ... do	(a)	....	....	....	....
Pottery:					
Red earthenware ... do	$10,267	$10,889	$6,481	$8,963	$9,351
Stoneware and yellow and Rockingham ware .. value	$114,879	$111,539	$112,604	$123,454	$137,253
Miscellaneous ... do	$427,120	$556.434	$546,351	$494,807	$572,870
Total value	$2,066.735	$3,148,463	$2,863,930	$2,659,919	$2,886,068
Number of operating firms reporting	122	113	124	118	104
Rank of State	14	11	12	12	11

a Included in "Miscellaneous."

VIRGINIA.

The total value of Virginia's clay products in 1912 was $1,874,174, an increase of $134,274, or 7.72 per cent, over 1911. Virginia's principal clay product is common brick from the Coastal Plain region. It was valued at $1,513,338 in 1912. This product constituted 80.75 per cent of the value of the State's clay products in 1912. Front brick is the only other product of any importance from Virginia's kilns. In 1912 it was valued at $313,555, a decrease from $314,201 in 1911. The average price per thousand declined 53 cents.

Alexandria County was the principal common brick-producing county, reporting 53,671,000 brick, valued at $294,590, or $5.49 per thousand. Henrico was a close second in quantity and first in value, reporting 53,232,000 brick, valued at $334,108, or $6.28 per thousand. These two counties are the principal sources of supply of common brick of Washington, D. C., and Richmond, Va., respectively. Front brick is also largely made in Alexandria County.

Clay products of Virginia, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	185,738,000	249,794,000	229,982,000	219,035,000	244,541,000
Value	$1,219,946	$1,540,648	$1,460,460	$1,374,439	$1,513,338
Average per M	$6.57	$6.17	$6.35	$6.27	$6.19
Front—					
Quantity	17,858,000	24,717,000	20,813,000	21,032,000	21,755,000
Value	$246,623	$333,057	$294,348	$314,201	$313,551
Average per M	$13.81	$13.47	$14.14	$14.94	$14.41
Fancy or ornamental. value	(a)	(a)	(a)	(a)	(a)
Fire do	(a)	(a)	(a)	(a)	(a)
Draintile do	$7,100	$6,298	$5,276	$10,875	$4,025
Sewer pipe do	(a)	(a)	(a)	(a)	(a)
Sanitary ware do				(a)	
Porcelain electrical supplies, value	(b)	(a)	(a)		
Miscellaneous do	$25,461	$76,514	$79,603	$40,385	$43,260
Total value	$1,499,130	$1,956,517	$1,839,687	$1,739,900	[b] $1,874,174
Number of operating firms reporting	80	89	84	77	75
Rank of State	21	18	20	19	18

[a] Included in "Miscellaneous."
[b] The value of pottery products for Virginia for 1908 and 1912 could not be included in the State total without disclosing individual figures. The entire product for 1912 was classified as miscellaneous pottery.

WASHINGTON.

The total value of the clay products marketed in Washington in 1912 was $2,388,870, a decrease of $451,502, or 15.9 per cent, from 1911. This decrease was principally in the value of common brick, vitrified brick, and sewer pipe. The production of front brick, architectural terra cotta, and fireproofing increased. Washington's principal clay product is vitrified brick, but figures for this product in 1912 can not be published as there were less than three producers. Common brick is the variety of second importance, the output in 1912 being valued at $547,061. Common brick constituted 22.9 per cent of the value of all of Washington's clay products in 1912. Sewer pipe is third in importance, though its value decreased $241,973, or from

$738,473 in 1911 to $496,500 in 1912. Architectural terra cotta, the next product in value, on the other hand, showed an increase of $81,501, or from $283,608 to $365,109.

King County, adjacent to the markets of Seattle and Tacoma, is the leading clay-working county in the State, reporting in 1912 products valued at $1,321,978, or 55.34 per cent of the State total. The principal products of the county are vitrified and common brick, sewer pipe, and terra cotta.

Clay products of Washington, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	107,638,000	143,198,000	130,634,000	99,588,000	78,000,000
Value	$817,962	$1,081,579	$956,510	$695,100	$547,061
Average per M	$7.60	$7.55	$7.32	$6.98	$7.01
Vitrified—					
Quantity	(a)	(a)	(a)	40,291,000	(a)
Value	(a)	(a)	(a)	$743,352	(a)
Average per M	$19.82	$18.72	$18.87	$18.45	$16.88
Front—					
Quantity	4,011,000	7,802,000	5,570,000	5,224,000	6,881,000
Value	$112,749	$155,600	$124,952	$118,615	$146,265
Average per M	$28.11	$19.94	$22.43	$22.71	$21.26
Fancy ... value				(a)	
Fire ... do	$42,045	$103,531	$25,017	$63,654	$34,293
Stove lining ... do				(a)	(a)
Draintile ... do	$28,551	$18,495	$34,128	$29,314	$24,676
Sewer pipe ... do	$493,165	$737,847	$817,086	$738,473	$496,500
Architectural terra cotta ... do	$171,845	$206,324	$198,358	$283,608	$365,109
Fireproofing ... do	$45,205	$71,067	$114,501	$153,180	$163,077
Tile, not drain ... do					(a)
Pottery:					
Red earthenware ... do	$2,450	(a)	(b)	(b)	(b)
Stoneware and yellow and Rockingham ware ... value	(a)	(a)	(b)	(b)	(b)
Miscellaneous ... do	$390,317	$686,043	$753,302	$758,428	$611,889
Total value	$2,104,289	$3,060,486	$3,023,854	$2,840,372	$2,388,870
Number of operating firms reporting	67	65	65	55	50
Rank of State	13	12	11	11	15

a Included in "Miscellaneous."
b The value of pottery products for Washington for 1910, 1911, and 1912 could not be included in the State totals without disclosing the operations of individual establishments.

WEST VIRGINIA.

The total value of clay products in West Virginia in 1912 was $4,775,874, an increase of $442,454, or 10.21 per cent, over 1911. West Virginia has made great gains in the value of clay products during the last few years owing principally to the development of the pottery industry in Hancock County. Its principal product is white ware, of which West Virginia is the second largest producer. In 1912 it was reported to the value of $2,051,987, or 42.97 per cent of the State's total. Next in importance is sanitary ware, of which it is also the second producer, which in 1912 was valued at $1,156,478. The total value of West Virginia's pottery products in 1912 was $3,365,166, or 70.46 per cent of all clay products in the State. Brick and tile production was valued at $1,410,708 in 1912. The principal brick and tile product of West Virginia is vitrified brick, which in 1912 was valued at $633,709. Common brick, of which the production in 1912 was 60,819,000 brick, valued at $393,864, showed an increase in quantity of 858,000 brick as compared with 1912, and a decrease in value of $7,052.

Hancock County is the largest producer of vitrified brick, reporting 43,939,000 brick for 1912, valued at $536,530, or 84.17 per cent of the quantity and 84.67 per cent of the value for the entire State. Hancock County is the leading clay-working county in the State, its total output in 1912 being valued at $2,630,870, or 55.09 per cent of the whole State. West Virginia is the third State in value of pottery production.

Clay products of West Virginia, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	47,402,000	53,983,000	77,916,000	59,961,000	60,819,000
Value	$300,776	$327,141	$508,422	$400,916	$393,864
Average per M	$6.35	$6.06	$6.53	$6.69	$6.48
Vitrified—					
Quantity	70,924,000	45,661,000	46,098,000	56,956,000	52,200,000
Value	$718,017	$565,218	$564,578	$681,747	$633,709
Average per M	$10.12	$12.38	$12.25	$11.97	$12.14
Front—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$14.18	$14.74	$10.00	$14.98	$12.00
Fire value	$38,943	$80,773	$32,003	$74,596	$105,719
Draintile do	$2,645	(a)	$2,330	$3,487	(a)
Sewer pipe do	(a)	(a)	(a)	(a)	(a)
Fireproofing do	(a)	(a)	(a)	(a)	(a)
Tile, not drain do	$49,220	$82,461	$104,633	$136,586	$200,390
Pottery:					
Stoneware and yellow and Rockingham ware value	(a)	(a)	(a)	(a)	(a)
White ware, including C. C. ware, white granite ware, semiporcelain ware, and semivitreous porcelain ware value	$1,612,321	$1,769,808	$1,894,429	$1,920,294	$2,051,987
China, bone china, delft, and belleek ware value	....	....	....	(a)	$50,002
Sanitary ware do	$385,000	$500,432	$618,868	$814,599	$1,156,478
Porcelain electrical supplies, value	(a)	....	(a)	(a)	(a)
Miscellaneous do	$154,814	$184,264	$272,782	$301,195	$183,725
Total value	$3,261,736	$3,510,097	$3,998,045	$4,333,420	$4,775,874
Number of operating firms reporting	60	50	56	55	54
Rank of State	10	10	10	10	9

a Included in "Miscellaneous."

WISCONSIN.

The value of all clay products in Wisconsin in 1912 was $1,044,486, a decrease of $113,653, or 9.81 per cent, from 1911. Wisconsin's clay product of chief value is common brick. It was valued in 1912 at $830,773 and represented nearly 80 per cent of the State's total output. Milwaukee is the leading clay-working county with products in 1912 valued at $266,267, nearly all of which was common brick, this county alone reporting 37,351,000 brick for 1912, valued at $256,967, or 30.39 per cent of the quantity and 30.93 per cent of the value of this product for the State.

Clay products of Wisconsin, 1908–1912.

Product.	1908	1909	1910	1911	1912
Brick:					
Common—					
Quantity	129,041,000	147,741,000	161,083,000	151,331,000	122,910,000
Value	$830,249	$956,232	$1,071,457	$985,824	$830,773
Average per M	$6.43	$6.47	$6.65	$6.51	$6.76
Front—					
Quantity	4,646,000	7,788,000	2,400,000	9,920,000	14,096,000
Value	$41,569	$74,120	$29,900	$100,140	$135,520
Average per M	$8.95	$9.52	$12.46	$10.09	$9.61
Fancy or ornamental. value	(a)	(a)	(a)		
Fire do		(a)			
Draintile do	$74,702	$95,899	$64,391	$58,547	$67,993
Fireproofing do	(a)	(a)		(a)	
Tile, not drain do	(a)				
Pottery:					
Earthenware do	$9,300	$9,109	$8,965	$8,600	$7,900
Stoneware do		(a)			
Miscellaneous do	$2,575	$4,229	$2,170	$5,028	$2,300
Total value	$958,395	$1,139,589	$1,176,883	$1,158,139	$1,044,486
Number of operating firms reporting	121	106	112	101	92
Rank of State	24	27	26	26	26

a Included in "Miscellaneous."

CLAY.

INTRODUCTION.

Clay available for the manufacture of clay products is one of the most widely spread of our minerals. Hence, there are clay-working plants scattered over every State and Territory in the Union. Miners of the lower-grade clays are usually also the manufacturers, but as the higher grades of ware are reached, the rule is that fewer and fewer manufacturers are also miners, until in the highest grades of ware the rule is that the manufacturer buys and does not mine the clays he uses. The figures given in the following tables represent clay that is mined and not manufactured by the miner, but is sold as clay. The clay thus sold is small in quantity compared with the total production and includes mainly clay used for high-grade pottery, for paper making, and for refractory products.

The clay-mining industry, after showing decreased production in 1911, rallied in 1912, overcame that decrease, and made considerable progress; the quantity and value of clay reported exceeded the production and value of 1910, the year of maximum quantity and value prior to 1912. But two varieties in 1912 decreased in value, kaolin ($298) and stoneware clay ($50,229). In 1911, but two showed increase. In 1912, three varieties showed decrease in quantity, kaolin (1,548 tons), ball clay (133 tons), and stoneware clay (26,975 tons). The net increase in 1912 was 347,567 tons in quantity and $465,257 in value. The production of kaolin, which was less in 1911 than in 1910, showed a further but small decrease in 1912, and paper clay showed considerable increase in both quantity and value. It may be, however, that the decrease in kaolin is more apparent than real, as the line between kaolin and paper clay is not well defined and these clays may not be properly classified by the producers in making their reports. Only white-burning residual clays are included in "kaolin" in this chapter. The average price per ton for four of the varieties of clay increased in 1912, and for two it decreased. The general average price decreased 3 cents per ton.

PRODUCTION.

The following table shows the production of clay in 1911 and 1912 by varieties:

Production of clay in the United States in 1911 and 1912, by varieties, in short tons.

Variety.	1911			1912		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Kaolin	27,400	$221,045	$8.07	25,852	$220,747	$8.54
Paper clay	99,265	454,435	4.58	119,857	522,924	4.36
Slip clay	8,393	16,770	2.00	16,339	27,573	1.69
Ball clay	65,072	220,710	3.39	64,939	227,545	3.50
Fire clay	1,526,921	2,112,827	1.38	1,695,337	2,363,357	1.39
Stoneware clay	151,384	165,751	1.09	124,409	115,522	.93
Brick clay	142,020	123,900	.87	229,306	204,504	.89
Miscellaneous	162,243	165,325	1.02	254,226	263,848	1.04
Total	2,182,698	3,480,763	1.59	2,530,265	3,946,020	1.56

This table shows that the total quantity of clay mined and sold as such in 1912 was 2,530,265 short tons, as compared with 2,182,698 short tons in 1911, an increase of 347,567 short tons, or 15.92 per cent. The value of the clay mined in 1912 was $3,946,020, or $1.56 per ton, as compared with $3,480,763, or $1.59 per ton, in 1911. This was an increase of $465,257, or 13.37 per cent. Every variety, except kaolin and stoneware clay, showed an increase in value, and all except kaolin, ball clay, and stoneware clay showed an increase in quantity. Ball clay showed a small decrease of 133 tons in quantity, and an increase in value of $6,835. Fire clay showed the largest increase in quantity, 168,416 tons, or 11.03 per cent. Brick clay showed an increase of 87,286 tons, or 61.46 per cent. Paper clay increased 20,592 tons, or 20.74 per cent. Stoneware showed the largest decrease in quantity, 26,975 tons, or 17.82 per cent. Kaolin showed a decrease of 1,548 short tons, or 5.65 per cent. Fire clay showed the largest increase in value, $250,530, or 11.86 per cent. Fire clay in 1912, as for several years, was the principal variety, constituting 67 per cent of the quantity and 59.89 per cent of the value of all clay marketed as such in 1912. Paper clay was the second variety in point of value of production, its value in 1912 constituting 13.25 per cent of the value of all clay mined and sold. The average price per ton varied but slightly in 1912 compared with 1911, the greatest changes being in kaolin, which advanced 47 cents per ton; slip clay, which declined 31 cents per ton; and paper clay, which declined 22 cents per ton. The general average declined 3 cents per ton from the averages for 1911.

Clay mined and sold in the United States, 1905–1912, in short tons.

Year.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1905	44,675	$326,835	76,339	$307,238	24,565	$33,384	61,345	$167,212	1,229,647	$1,529,468
1906	51,937	369,452	75,963	342,708	21,427	31,546	54,173	199,073	1,380,472	1,878,011
1907	47,645	340,311	66,191	293,943	20,325	37,925	52,413	195,515	1,474,462	2,054,698
1908	28,649	216,243	64,510	310,943	10,087	22,370	40,838	133,770	1,101,579	1,486,139
1909	31,227	241,060	81,586	386,764	18,010	30,527	49,074	214,194	1,463,919	2,082,193
1910	34,221	255,873	85,949	420,476	17,696	29,962	70,637	257,265	1,638,931	2,157,720
1911	27,400	221,045	99,265	454,435	8,393	16,770	65,072	220,710	1,526,921	2,112,827
1912	25,852	220,747	119,857	522,924	16,339	27,573	64,939	227,545	1,695,337	2,363,357

Year.	Stoneware clay.		Brick clay.[a]		Miscellaneous clay.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1905	181,485	$219,767	....	....	188,077	$184,102	1,806,133	$2,768,006
1906	146,861	150,774	....	....	296,619	273,692	2,027,452	3,245,256
1907	125,060	136,576	136,515	$112,003	261,068	277,577	2,183,679	3,448,548
1908	124,192	102,390	210,556	154,575	143,490	173,556	1,723,901	2,599,986
1909	130,757	137,264	222,686	171,183	162,388	186,522	2,159,647	3,449,707
1910	152,942	153,044	173,625	128,039	215,228	223,106	2,389,229	3,625,485
1911	151,384	165,751	142,020	123,900	162,243	165,325	2,182,698	3,480,763
1912	124,409	115,522	229,306	204,504	254,226	263,848	2,530,265	3,946,020

[a] Included in miscellaneous in 1905 and 1906.

This table shows that the maximum quantity and value of clay mined and sold in the period covered were attained in 1912. The production rose steadily, except in 1908 and 1911, from 1,806,133 short tons in 1905 to 2,530,265 in 1912, and in value from $2,768,006 to $3,946,020. This was an increase in production of 724,132 tons, or 40.09 per cent, and in value of $1,178,014, or 42.56 per cent. Kaolin reached its maximum production and value in 1906, and its minimum in quantity in 1912 and in value in 1908. Paper clay, fire clay, and brick clay reached their greatest quantity and value in 1912. Ball clay reached its maximum quantity and value in 1910.

Clay mined and sold in the United States in 1911, by States, in short tons.

State.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.		Stoneware clay.		Brick clay.		Miscellaneous clay.[a]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama									35,203	$29,909							35,203	$29,909
California									48,264	63,000	21,795	$20,100	16,918	$28,847	279	$369	87,256	112,316
Colorado									82,729	68,593	(b)	(b)	10,848	13,260			95,127	83,636
Delaware	(b)	(b)							(b)	(b)							7,950	46,024
Florida							24,167	$114,751									24,167	114,751
Georgia			45,076	$199,135					11,363	8,866			(b)	(b)	11,655	15,261	68,161	223,462
Idaho c	(d)	(d)							171	1,328					569	1,075	7,425	46,792
Illinois									71,479	91,623	30,402	29,473	(b)	(b)	64,155	37,530	182,836	183,826
Indiana									59,611	53,377	675	749			1,706	792	61,992	54,918
Iowa									(b)	(b)			(b)	(b)			9,643	3,965
Kentucky							(b)	(b)	117,745	98,796			(b)	(b)	352	612	131,808	126,457
Maryland	(b)	(b)	(e)	(e)					6,763	17,079	(b)	(b)	1,150	1,050	e 1,410	e 2,044	12,323	28,123
Massachusetts									(b)	(b)	(b)	(b)	(b)	(b)			1,187	2,972
Michigan					1,744	$5,090							(b)	(b)	(b)	(b)	1,764	5,272
Missouri	130	$1,270							215,468	498,179	(b)	(b)	(b)	(b)	(b)	(b)	227,691	512,088
Montana									3,571	8,946			(b)	(b)			4,912	9,617
New Jersey							(b)	(b)	282,777	471,695	29,392	64,068	32,040	20,326	60,454	96,353	405,912	658,875
New Mexico									8,514	12,800							8,514	12,800
New York					(b)	(b)			(b)	(b)			(b)	(b)	1,262	677	4,882	10,308
North Carolina	14,822	130,554									81	56					14,903	130,610
Ohio					(b)	(b)			197,324	154,816	51,460	33,592	31,150	10,879	2,601	2,488	285,735	206,668
Oregon									730	6,637	(b)	(b)			(b)	(b)	1,283	7,053
Pennsylvania			23,549	135,288					281,212	411,884	3,802	2,820	14,230	13,789	6,404	3,841	329,197	567,622
South Carolina			30,640	120,012					(b)	(b)					200	399	31,585	124,063
Tennessee							29,896	74,326	19,600	29,793	(b)	(b)					49,653	104,277
Texas									2,068	9,460					(b)	(b)	2,070	9,480
Utah									3,776	9,241							3,776	9,241
Virginia									(b)	(b)					(b)	(b)	10,666	3,087
Washington					(b)	(b)			(b)	(b)			(b)	(b)			1,187	2,753
West Virginia									71,704	47,776			(b)	(b)			73,304	48,576
Wisconsin											(b)	(b)	(b)	(b)	(b)	(b)	586	1,222
Other States f	12,439	89,221			6,649	11,680	11,009	31,633	6,849	19,029	13,777	14,893	35,684	35,756	11,196	3,884	(g)	(g)
Total	27,400	221,045	99,265	454,435	8,393	16,770	65,072	220,710	1,526,921	2,112,827	151,384	165,751	142,020	123,900	162,243	165,325	2,182,698	3,480,763

a Including bentonite, modeling clay, pipe clay, terra-cotta clay, and clay for medicinal use.
b Included in "Other States."
c Including North Dakota, Vermont, and Wyoming.
d Produced by Vermont alone, and included in "Other States."
e Paper clay for Maryland is included in "Maryland miscellaneous."
f Includes all products which could not be published separately without disclosing individual figures.
g The total of "Other States" is distributed among the States to which it belongs in order that they may be fully represented in the totals.

Clay mined and sold in the United States in 1912, by States, in short tons.

State.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.		Stoneware clay.		Brick clay.		Miscellaneous clay.[a]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama									38,552	$31,414					4,500	$2,000	43,052	$33,414
California	(b)	(b)							59,492	77,955	(b)	(b)	31,913	$51,548	6,620	6,000	102,520	139,919
Colorado									22,157	37,512	(b)	(b)	49,476	33,590			72,435	72,105
Delaware	(b)	(b)							(b)	(b)					85	64	13,688	61,754
Florida							(b)	(b)									(c)	(c)
Georgia			48,482	$210,908	(b)	(b)			12,863	8,196			(b)	(b)	13,427	19,941	75,815	244,953
Idaho									(b)	(b)							(c)	(c)
Illinois									92,963	110,204	29,761	$22,605	(b)	(b)	32,150	27,328	176,558	192,663
Indiana									49,915	46,171	(b)	(b)			31,700	24,720	82,035	71,391
Iowa													4,192	1,866	(b)	(b)	7,192	2,166
Kentucky							(b)	(b)	83,789	82,412					(b)	(b)	91,097	93,560
Maryland			(d)	(d)					21,264	32,437	(b)	(b)	370	495	d 2,845	d 2,755	25,279	36,687
Massachusetts									(b)	(b)			(b)	(b)			1,350	2,678
Michigan					2,034	$6,164							(b)	(b)			2,043	6,173
Minnesota											(b)	(b)			(b)	(b)	(c)	(c)
Missouri	740	$3,874			(b)	(b)			287,925	552,514	2,025	2,492	(b)	(b)	(b)	(b)	295,701	562,306
Montana									4,200	4,657							4,200	4,657
New Jersey							2,649	$9,152	291,474	502,053	20,031	39,905	50,186	33,168	74,543	117,730	438,883	702,008
New Mexico									1,943	4,214							1,943	4,214
New York					(b)	(b)			(b)	(b)					1,897	4,924	7,845	18,718
North Carolina	14,950	139,717									88	74	(b)	(b)			15,058	139,821
North Dakota									(b)	(b)							(c)	(c)
Ohio					2,880	3,640			224,600	192,400	62,881	39,998	32,489	17,855	23,598	8,862	356,448	262,755
Oregon									(b)	(b)	(b)	(b)					(c)	(c)
Pennsylvania			27,003	154,799					372,944	537,898	(b)	(b)	35,756	31,075	26,251	16,736	462,605	741,484
South Carolina			44,372	157,217					(b)	(b)			(b)	(b)			47,638	162,974
Tennessee							30,792	87,705	24,060	34,276	1,291	1,322			110	220	56,253	123,523
Texas									1,241	6,038					101	404	1,342	6,442
Utah									(b)	(b)							(c)	(c)
Vermont	(b)	(b)							(b)	(b)							(c)	(c)
Virginia									(b)	(b)					(b)	(b)	2,599	2,006
Washington					(b)	(b)			(b)	(b)							1,570	5,000
West Virginia									(b)	(b)	(b)	(b)					82,768	58,776
Wisconsin													(b)	(b)	(b)	(b)	836	1,172
Wyoming															(b)	(b)	(c)	(c)
Other States[e]	10,162	77,156			11,425	17,769	31,498	130,688	95,955	103,006	8,332	9,126	24,924	34,907	36,399	32,164	f 61,512	f 192,701
Total	25,852	220,747	119,857	522,924	16,339	27,573	64,939	227,545	1,695,337	2,363,357	124,409	115,522	229,306	204,504	254,226	263,848	2,530,265	3,946,020

[a] Including bentonite, modeling clay, pipe clay, terra-cotta clay, and shale.
[b] Included in "Other States."
[c] Included in f (61,512 tons, valued at $192,701).
[d] Paper clay for Maryland is included in "Maryland miscellaneous."
[e] Includes all products made by less than 3 producers in 1 State.
[f] Made up of State totals of Florida, Idaho, Minnesota, North Dakota, Oregon, Utah, Vermont, and Wyoming.

Thirty-five States reported sales of clay in 1912, an increase of 1, Minnesota, over 1911. The leading clay-producing State in 1912 in both quantity and value was Pennsylvania. In 1911, and for several preceding years, New Jersey was the leading clay-mining State, but in 1912 it was second. For 1912 the production of Pennsylvania was 462,605 short tons, valued at $741,484. This was an increase in quantity of 133,408 tons, or 40.53 per cent, and in value of $173,862, or 30.63 per cent. Pennsylvania reported 18.28 per cent of all clay sold in 1912, and 18.79 per cent of the value. For 1911 New Jersey reported 18.60 per cent of the total quantity and 18.93 per cent of the value. Pennyslvania's production in 1912 was greater than that of New Jersey by 23,722 tons in quantity and $39,476 in value. Of Pennsylvania's total clay production in 1912, fire clay was 80.62 per cent of the quantity and 72.54 per cent of the value. New Jersey was the second State, reporting 438,883 tons of clay valued at $702,008, which was an increase over 1911 of 32,971 tons, or 8.12 per cent in quantity and of $43,133, or 6.55 per cent in value. New Jersey's production was 17.35 per cent of the total quantity of clay mined in 1912, and 17.79 per cent of the value. In this State fire clay was also the leading variety, 66.41 per cent of the quantity of clay mined in the State and 71.52 per cent of the value being of this variety.

Ohio, the leading clay-working State, was third in quantity of clay marketed and fourth in value, and Missouri was fourth in quantity and third in value. In 1911 Ohio was third in quantity and fifth in value and Missouri was fourth in quantity and third in value. Ohio showed an increase in quantity of clay mined of 70,713 short tons, or 24.75 per cent, and in value of $56,087, or 27.14 per cent. Missouri's output of clay increased 68,010 tons, or 29.87 per cent, and the value increased $50,218, or 9.81 per cent. These four States, Pennsylvania, New Jersey, Ohio, and Missouri, reported 1,553,637 tons, or 61.40 per cent of the total quantity for 1912; and the value of this clay was $2,268,553, or 57.49 per cent of the total.

Of the remaining 23 States for which totals are given, 15 showed increase in quantity of clay marketed, and 8 showed decrease; 14 showed increase in value and 9 showed decrease. Thirteen States showed increase in production and value and 7 showed decrease in both. Of the remaining three States, Illinois showed a decrease in the quantity of clay and an increase in value, and Massachusetts and Wisconsin showed increase in quantity and decrease in value. Indiana showed the largest increase in quantity, 20,043 tons, or 32.33 per cent. South Carolina showed the largest increase in value, $38,911, or 31.36 per cent. Kentucky which reported the largest increase in 1911, showed the largest decrease in 1912—40,711 tons, or 30.89 per cent, in quantity and $32,897, or 26.01 per cent, in value. In 1911 this State reported an increase of 51,388 tons and $40,802 over 1910. As in 1911 the principal increase in Kentucky was in fire clay, so in 1912 the chief decrease was in that variety of clay.

In 1912 Pennsylvania was the largest producer of fire clay, though second in value, reporting 372,944 tons, valued at $537,898. Missouri was first in value of fire clay, reporting $552,514, and third in quantity. In 1911 New Jersey was first in output and second in value. In 1912 it was second in quantity and third in value. Ohio was fourth in quantity and value, as in 1911. Kentucky, which was fifth in quantity and value in 1911, was sixth in 1912, and Illinois was fifth in both in 1912. The average price per ton of fire clay in these States in 1912 was: Illinois, $1.19; Kentucky, $0.98; Missouri, $1.92; New Jersey, $1.72; Ohio, $0.82; and Pennsylvania, $1.44. In 1911 these prices of fire clay were $1.28, $0.84, $2.31, $1.67, $.078, and $1.46, respectively. The first five States, namely, Illinois, Missouri, New Jersey, Ohio, and Pennsylvania, produced 1,279,906 tons, or 75.50 per cent of the total quantity, valued at $1,895,069, or 80.19 per cent of the total value of fire clay in 1912.

Kaolin was reported from five States for 1912. North Carolina was the leading State, reporting 14,950 tons, or 57.83 per cent of the total quantity, and $139,717, or 63.29 per cent of the total value.

IMPORTS.

The following table shows the imports of clay from 1907 to 1912:

Classified imports of clay for consumption, 1907–1912, in short tons.

Year.	Kaolin or china clay.			All other clays.						Total.	
				Unwrought.		Wrought.		Common blue.			
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1907	239,923	$1,582,893	$6.60	31,196	$145,698	2,520	$81,155	12,378	$110,686	286,017	$1,920,432
1908	176,895	1,129,847	6.39	27,730	129,411	1,372	22,990	4,872	37,053	219,869	1,319,301
1909	246,381	1,505,779	6.11	30,147	134,978	1,906	50,632	12,346	104,401	290,780	1,795,790
1910	257,902	1,593,472	6.18	27,890	113,352	1,496	26,205	21,176	181,334	308,464	1,914,363
1911	255,107	1,461,068	5.73	26,086	100,540	1,032	10,436	17,193	124,278	299,418	1,696,322
1912	278,276	1,629,105	5.85	32,473	127,004	794	12,109	23,112	184,018	334,655	1,952,236

The imports of clay, except for kaolin or china clay and the clay designated as common blue but which is high-grade fire clay, are unimportant. In 1912, of the clay imported, 83.15 per cent of the quantity and 83.45 per cent of the value was kaolin or china clay.

The quantity imported increased 35,237 tons, or 11.77 per cent, and the value increased $255,914, or 15.09 per cent, in 1912. This was an increase of 26,191 tons, or 8.49 per cent, and of $37,873, or 1.98 per cent, over 1910, the year of maximum quantity and value up to 1912. Every variety, except wrought clay, showed an increase in quantity, and every variety showed an increase in value. Kaolin showed the largest increase over 1911 both in quantity and value, the former being 23,169, or 9.08 per cent, and the latter $168,037, or 11.50 per cent. The average price per ton of kaolin imported in 1912 was $5.85 as compared with $5.73 in 1911 and with $6.18 in 1910.

BUILDING OPERATIONS.

The following tables show the building operations of some of the leading cities of the country. Efforts were made to obtain detailed information for all cities of 35,000 or more inhabitants—157 in number. For 105 cities sufficient detail was received to include these cities in a table; for 38 cities only the totals for permits and cost of buildings could be obtained; and for 14 cities no data were procured. In some cases the data furnished were apparently inconsistent and considerable editing of reports was necessary.

The first table shows a comparison between 1911 and 1912 in 48 cities, also the increase or decrease in the cost of building operations. Used as an index of prosperity, the figures here given show, on the whole, that the building industries were in a very progressive condition as compared with 1911 and 1910. Nearly every city that had an increase in cost of building operations in 1911 showed further gains in 1912. Chicago, Cincinnati, and Philadelphia were the only ones of the very large cities that showed increase in 1911 to show decrease in 1912. On the other hand, Boston, Brooklyn, and New York, which showed decrease in 1911, rallied and made large gains in 1912. Where an exact comparison can be made, there was an increase in 1912 of 7.49 per cent over 1911 and of 3.03 per cent over 1910.

Building operations in a number of the leading cities of the United States in 1911 and 1912.

City.	1911		1912		Increase (+) or decrease (—) in 1912.	Percentage of increase or decrease in 1912.	Rank of cities in cost of buildings in 1912.
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.			
Atlanta, Ga	3,993	$6,142,077	3,529	$9,806,836	+$3,664,759	+59.67	21
Boston, Mass	3,547	19,379,396	4,410	26,755,652	+7,376,256	+38.06	6
Brooklyn, N. Y	9,223	37,218,384	11,408	40,537,784	+3,319,400	+ 8.92	3
Buffalo, N. Y	3,402	10,364,000	4,090	12,992,000	+2,628,000	+25.36	15
Cambridge, Mass	567	2,905,525	580	2,946,490	+ 40,965	+ 1.41	54
Chicago, Ill	12,586	103,272,000	10,751	83,175,900	—20,096,100	—19.46	2
Cincinnati, Ohio	11,228	12,688,540	5,386	8,660,264	—4,028,276	—31.75	24
Cleveland, Ohio	7,860	16,994,677	8,790	18,180,078	+1,185,401	+ 6.98	10
Columbus, Ohio	2,694	4,668,277	2,656	4,675,303	+ 7,026	+ .15	41
Dayton, Ohio	993	2,339,390	1,214	3,552,120	+1,212,730	+51.84	49
Denver, Colo	2,410	6,084,260	2,254	5,332,675	— 751,585	—12.35	35
Detroit, Mich	6,667	19,012,670	7,991	25,588,470	+6,575,800	+34.59	7
Fall River, Mass	496	2,706.575	572	1,240,255	—1,466,320	—54.18	102
Grand Rapids, Mich	1,312	2,520,296	1,433	2,456,516	— 63,780	— 2.53	64
Hartford, Conn	1,305	5,896,244	1,277	7,379,525	+1,483,281	+25.16	28
Indianapolis, Ind	4,941	8,349,477	4,781	9,150,407	+ 800,930	+ 9.59	22
Jersey City, N. J	2,012	5,506,342	1,336	5,911,880	+ 405,538	+ 7.36	34
Kansas City, Kans	639	867,702	455	795,775	— 71,927	— 8.29	126
Kansas City, Mo	3,736	12,818.103	3,953	12,127,079	— 691,024	— 5.39	16
Los Angeles, Cal	12,498	23,004.185	16,455	31,367,995	+8,363,810	+36.36	5
Louisville, Ky	2,447	5,625,527	2,379	6,562,777	+ 937,250	+16.66	31
Lowell, Mass	564	1,500,269	572	1,291,649	— 208,620	—13.91	100
Memphis, Tenn	3,213	5,859,146	3,657	7,162,214	+1,303,068	+22.24	29
Milwaukee, Wis	4,360	12,299,375	4,361	15,257,162	+2,957,787	+24.05	12
Minneapolis, Minn	6,026	13,735,285	5,965	14,229,475	+ 494,190	+ 3.60	14
Nashville, Tenn	1,515	1,499,408	1,503	1,378,997	— 120,411	— 8.03	96
Newark, N. J	[a] 2,460	[a] 10,975,334	2,937	11,628,358	+ 653,024	+ 5.95	18
New Bedford, Mass	950	2,601,150	940	2,400,050	— 201,100	— 7.73	65
New Haven, Conn	1,196	5,868,519	1,330	4,762,341	—1,106,178	—18.85	40
New Orleans, La	[b] 2,282	[b] 3,155,150	1,794	3,309,620	+ 154,470	+ 4.90	51
New York, N. Y	6,496	135,703,715	8,283	163,519,362	+27,815,647	+20.50	1
Oakland, Cal	3,946	7,132,566	4,058	8,821,950	+1,689,384	+23.69	23
Omaha, Nebr	1,372	5,426,863	1,372	4,546.761	— 880,102	—16.22	42
Philadelphia, Pa	16,215	40,030,985	11,192	36,392,405	—3,638,580	— 9.09	4
Pittsburgh, Pa	4,392	11,963,257	3,890	11,530,531	— 432,726	— 3.62	19
Portland, Oreg	7,686	19,152,370	8,224	14,652,071	—4,500,299	—23.50	13
Providence, R. I	2,755	5,524,200	2,856	8,530,800	+3,006,600	+54.43	25
Richmond, Va	1,528	6,018,699	1,631	6,255,711	+ 237,012	+ 3.94	33
Rochester, N. Y	3,680	9,389,775	3,888	12,035,466	+2,645,691	+28.18	17
St. Joseph, Mo	648	995,473	850	1,119,797	+ 124,324	+12.49	109
St. Louis, Mo	8,152	18,607,556	8,760	20,675,804	+2,068,248	+11.12	9
St. Paul, Minn	2,033	6,909,240	3,491	8,051,417	+1,142,177	+16.53	27
San Francisco, Cal	6,079	20,915,474	6,316	23,338,563	+2,423,089	+11.59	8
Scranton, Pa	787	1,969,454	676	1,716,491	— 252,963	—12.84	86
Seattle, Wash	10,959	7,491,156	9,819	8,415,325	+ 924,169	+12.34	26
Syracuse, N. Y	1,698	5,238,184	1,546	4,487,861	— 750,323	—14.32	44
Washington, D. C	4,678	14,464,548	5,048	17,593,848	+3,129,300	+21.63	11
Worcester, Mass	1,545	4,716,163	1,698	6,689,900	+1,973,737	+41.85	30
Total	201,771	687,506,961	202,357	738,989,710	+51,482,749	+ 7.49	....

[a] Figures supplied by the Bureau of Statistics, Department of Commerce and Labor. The number of permits or buildings was estimated.
[b] Public buildings were not included.

Of the 48 cities included in this table, 31 showed increase in the cost of buildings and 17 showed decrease. The total increase was $90,743,063; the total decrease was $39,260,314, a net increase of $51,482,749. In 1911, 26 of these cities showed decrease and 22 showed increase; the net decrease was $29,721,614, or 4.14 per cent. Compared with 1910, there was an increase in 1912 of $21,761,135. The greatest increase in 1912 was in New York City, $27,815,647, or 20.5 per cent. The city to show the second largest increase was Los Angeles, $8,363,810, or 36.36 per cent. These two cities contributed 39.87 per cent of the total increase. The greatest proportionate increase in 1912 was in Atlanta, Ga., 59.67 per cent. The largest decrease was in Chicago, $20,096,100, or 19.46 per cent; the largest proportional decrease was in Fall River, Mass., 54.18 per cent. In 1911, Fall River showed the largest proportional increase, 75.28 per cent, so that the cost of building operations there in 1912 was less than those of 1910.

Of the 48 cities included in this table 15 showed increase in both 1911 and 1912, and 10 showed decrease in both years. Sixteen cities that showed decrease in 1911 showed increase in 1912, namely, Atlanta, Boston, Brooklyn, Columbus, Jersey City, Memphis, Minneapolis, Newark, New Orleans, New York, Rochester, St. Joseph, St. Louis, St. Paul, Seattle, and Washington. Seven cities that showed increase in 1911 showed decrease in 1912, namely, Chicago, Cincinnati, Fall River, Grand Rapids, New Haven, Philadelphia, and Syracuse.

New York City (boroughs of the Bronx and Manhattan) is the leading city in cost of building operations. In 1912 they cost $163,519,362, or 22.13 per cent of the total reported by the 48 cities. The maximum cost of building operations in New York was in 1909, when they cost $186,047,477. In 1908, the year of general business depression, they cost $117,819,382. From 1909 to 1911, inclusive, they declined in cost, but in 1912 rallied and reached the highest figure since 1909. In the cost of building operations Chicago, the second city, the maximum was attained in 1911, after a rapid rise from 1908. In 1912 there was a sharp decline and the cost of building operations was less than that of any year since 1908. The cost of building operations in Los Angeles rose steadily from $9,931,337 in 1908 to $31,367,995 in 1912, an increase of $21,436,618, or 215.85 per cent. This city rose in rank in cost of building operations from seventeenth in 1908 to fifth in 1910, which rank it has maintained since.

The total number of permits or buildings increased from 201,771 in 1911 to 202,357 in 1912, an increase of 586. The number ranged in 1912 from 455 in Kansas City, Kans., to 16,455 in Los Angeles. The average cost per operation in these 48 cities in 1912 was $3,652; in 1911 it was $3,407, and in 1910, $3,457. In New York the average cost was $19,742 in 1912, $20,890 in 1911, and $22,404 in 1910. In Chicago it was $7,737 in 1912, $8,205 in 1911, and $4,374 in 1910. In Brooklyn, the third city in cost of building operations, this city having passed Philadelphia in 1912, the average cost per permit or building was $3,553 in 1912, $4,035 in 1911, and $3,966 in 1910. In Philadelphia it was $3,252 in 1912, $2,469 in 1911, and $2,311 in 1910.

Building statistics of the leading cities of the United States, by character of operations, in 1912.

City.	Wooden buildings.						Fire-resisting buildings.							
							Brick.				Stone.			
	New.		Additions, alterations, and repairs.		Total.		New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.	
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.
Akron, Ohio	1,701	$2,679,962	471	$170,375	2,172	$2,850,337	232	$1,826,490	87	$123,200				
Allentown, Pa	81	54,150	23	10,165	104	64,315	209	2,319,750	77	200,500	1	$8,000		
Atlanta, Ga	1,390	3,325,815	2,039	1,055,686	3,429	4,381,501	88	1,196,335						
Augusta, Ga	259	496,210	1,006	39,048	1,265	535,258	42	483,079	99	46,385				
Bayonne, N. J	252	1,032,775	141	126,157	393	1,158,932	70	359,836						
Berkeley, Cal	480	1,622,000	440	232,000	920	1,854,000	11	60.000						
Binghamton, N. Y	430	629,128	a 410	a 213,558	840	842,686	a 56	a 502,192						
Birmingham, Ala	1,013	1,823,767	1,539	242,743	2,552	2,066,510	102	1,084,664	251	225,770				
Boston, Mass	1,295	6,248,516	1,211	973,660	2,506	7,222,176	399	8,757,850	1,337	3,958,766	1	25,000	23	$337,225
Brockton, Mass	317	821,963	192	212,277	509	1,034,240	16	258,000	14	46,000	1	100,000		
Buffalo, N. Y	2,520	5,170,201	1,182	825,846	3,702	5,996,047	278	5,525,428	93	374,525	7	462,000		
Butte, Mont	165	640,450			165	640,450	2	50,000						
Cambridge, Mass	258	1,276,150	228	176,525	486	1,452,675	b 53	b 1,400,525	b 41	b 93,290	(b)	(b)	(b)	(b)
Camden, N. J	67	134,000	123	36,900	190	170,900	615	1,617,000	109	64,700	1	35,000		
Canton, Ohio	412	692,500	175	65,290	587	757,790	37	498,778	1	10,000				
Charleston, S. C	187	248,973	284	82,092	471	331,065	29	147,950	77	62,723				
Chester, Pa	8	11,000			8	11,000	147	413,800	35	26,445	3	40,000		
Cincinnati, Ohio	1,021	1,551,655	a 3,605	a 1,464,328	4,626	3,015,983	a 760	a 5,644,281						
Cleveland, Ohio	2,051	5,409,825	c 6,001	c 2,867,716	8,052	8,277,541	c 738	c 9,902,537	(c)	(c)	(c)	(c)	(c)	(c)
Covington, Ky	71	108,475	74	34,944	145	143,419	125	772,891	55	74,623				
Dallas, Tex	1,373	2,280,044	317	435,171	1,690	2,715,215	136	2,254,223						
Dayton, Ohio	889	1,571,370	174	88,077	1,063	1,659,447	83	747,640	29	61,853				

a Additions, etc., to all classes of buildings for Binghamton, N. Y., and Cincinnati, Ohio, are included with additions to wooden buildings. New concrete buildings and all other new fire-resisting buildings for Binghamton and Cincinnati are included with new brick buildings.

b New stone and new concrete buildings for Cambridge, Mass., are included with new brick buildings and additions, etc., to all classes of fire-resisting buildings, are included with additions to brick buildings.

c All classes of new fire-resisting buildings for Cleveland, Ohio, are included with new brick buildings, and additions, etc., to all classes of buildings are included with additions to wooden buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1912—Continued.

City.	Wooden buildings.						Fire-resisting buildings.							
							Brick.				Stone.			
	New.		Additions, alterations, and repairs.		Total.		New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.	
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.
Des Moines, Iowa	400	$890,000	50	$13,492	450	$903,492	174	$475,000	62	$190,000				
Detroit, Mich	5,685	11,803,410	1,141	754,630	6,826	12,558,040	691	5,529,140	417	1,164,290				
Dubuque, Iowa	86	182,700	(a)	4,975	a 86	187,675	19	375,400						
Duluth, Minn	545	808,617	451	180,248	996	988,865	58	678,416	108	146,316				
Elizabeth, N. J	367	1,162,865	93	93,714	460	1,256,579	42	405,429	17	27,874				
Elmira, N. Y	132	298,500	46	37,400	178	335,900	17	322,900	24	36,300				
Evansville, Ind	538	603,498	431	70,722	969	674,220	61	382,115	133	133,241				
Fall River, Mass	401	700,000	140	200,000	541	900,000	20	200,000	6	50,000	2	$50,000		
Fitchburg, Mass	129	305,627	129	113,968	258	419,595	16	345,180	15	177,300	2	5,000		
Flint, Mich.[b]	95	97,400	46	18,800	141	116,200	18	59,100	11	8,600				
Fort Worth, Tex	254	444,798	68	84,285	322	529,083	64	1,037,900	19	53,700				
Galveston, Tex	168	230,882	404	74,772	572	305,654	16	317,400	38	11,884				
Grand Rapids, Mich	789	1,208,444	458	191,223	1,247	1,399,667	71	776,615	54	151,452				
Harrisburg, Pa	43	29,525	54	19,190	97	48,715	337	807,700	95	109,805	8	107,700		
Hartford, Conn	536	1,587,195	388	294,420	924	1,881,615	c 242	c 5,166,905	c 111	c 331,005	(c)	(c)	(c)	(c)
Haverhill, Mass	206	653,800	37	79,600	243	733,400	11	245,000	11	50,800				
Hoboken, N. J	13	17,257	93	47,486	106	64,743	15	133,200	88	82,109				
Holyoke, Mass	85	361,830	51	35,590	136	397,420	46	1,262,000	40	100,511				
Houston, Tex	822	1,536,950	1,658	232,881	2,480	1,769,831	54	1,288,305	267	189,371				
Indianapolis, Ind	1,979	3,821,585	d 2,343	d 829,162	4,322	4,650,747	362	2,059,620	(d)	(d)				
Jacksonville, Fla	e 977	e 1,629,350	(e)	(e)	977	1,629,350	171	2,178,607	(e)	(e)	(e)	(e)	(e)	(e)
Kalamazoo, Mich	300	600,000	50	30,000	350	630,000	25	500,000	20	150,000				
Kansas City, Kans	413	495,925			413	495,925	42	299,850						
Kansas City, Mo	2,254	4,522,087	760	381,558	3,014	4,903,645	378	4,678,464	483	619,125	20	275,060	15	$28,900
Knoxville, Tenn	69	113,479	f 895	f 198,593	964	312,072	29	633,611						
Lawrence, Mass	101	421,350	61	85,745	162	507,095	10	128,000	7	16,000				
Lincoln, Nebr	305	705,555	103	51,915	408	757,470	46	399,910	19	8,365	2	1,515		
Little Rock, Ark	332	673,149	392	154,975	724	828,124	21	368,700	153	175,612				
Los Angeles, Cal	10,672	16,442,162	4,295	1,307,907	14,967	17,750,069	g 464	g 12,669,941	g 1,024	g 947,985	(g)	(g)	(g)	(g)
Louisville, Ky	1,224	1,740,910	649	166,860	1,873	1,907,770	127	1,798,657	340	530,770				

Lowell, Mass.	245	471,940	309	227,909	554	699,849	16	421,800	...	...	...	...	...	...
Lynn, Mass.	435	1,505,375	266	167,300	701	1,672,675	30	1,086,800	18	69,800	...	...	...	...
McKeesport, Pa.	54	70,933	52	30,840	106	101,773	8	28,670	...	...	...	...	...	...
Manchester, N. H.	464	989,845	624	223,535	1,088	1,213,380	14	706,873	60	143,296	1	275,000	2	23,800
Milwaukee, Wis.	1,975	5,531,710	1,932	1,621,329	3,907	7,153,039	216	1,808,360	10	25,590	1	60,000	...	...
Minneapolis, Minn.	3,064	5,133,695	2,174	892,715	5,238	6,026,410	150	1,791,370	333	529,430	1	250	19	32,045
Montgomery, Ala.	124	170,309	142	58,788	266	229,097	35	250,732	48	48,735	...	...	...	...
Nashville, Tenn.	461	377,447	811	48,528	1,272	425,975	114	861,800	117	91,222	...	...	...	...
New Bedford, Mass.	389	1,545,000	441	307,062	830	1,852,062	8	373,000	20	120,682	...	...	...	...
New Britain, Conn.	89	388,800	81	69,235	170	458,035	60	659,700	25	10,000	...	...	...	...
Newton, Mass.	276	1,113,788	181	172,039	457	1,285,827	h 44	h 415,850	...	...	...	...	...	...
New York, N. Y.	264	979,549	1,318	345,920	1,582	1,325,469	1,789	149,124,036	4,898	12,203,907	...	...	...	...
Norfolk, Va.	295	624,715	90	30,541	385	655,256	249	1,775,538	54	144,393	...	...	...	...
Oakland, Cal.	2,313	4,731,888	f 1,670	f 1,063,907	3,983	5,795,795	57	2,470,286	...	...	...	...	...	...
Oklahoma, Okla.	181	399,168	26	15,174	207	414,342	g 49	g 456,314	g 34	g 14,590	...	...	...	...
Omaha, Nebr.	902	1,960,943	194	187,643	1,096	2,148,586	196	1,939,995	76	143,180	...	...	...	...
Passaic, N. J.	154	447,235	106	73,160	260	520,395	63	562,160	36	94,121	...	...	...	...
Paterson, N. J.	357	973,978	372	117,994	729	1,091,972	96	711,884	46	226,707	...	...	...	...
Pawtucket, R. I.	177	623,325	162	64,670	339	687,995	i 18	i 466,993	(i)	(i)	...	...	...	...
Philadelphia, Pa.	121	243,265	172	85,450	293	328,715	5,872	24,287,285	4,841	8,742,705	40	120,500	70	72,800
Pittsburgh, Pa.	1,187	2,135,000	670	530,000	1,857	2,665,000	751	1,375,000	590	250,000	12	590,000	...	...
Portland, Me.	207	607,335	128	148,750	335	756,085	13	452,500	29	148,515	...	...	...	...
Pueblo, Colo.	123	122,564	82	27,465	205	150,029	110	387,130	26	299,668	...	...	...	...
Quincy, Ill.	19	31,870	4	3,100	23	34,970	21	124,300	9	14,375	2	7,000	...	...
Richmond, Va.	204	221,205	273	88,542	477	309,747	455	2,044,995	185	110,209	...	...	...	...
Rochester, N. Y.	2,242	6,783,648	875	513,343	3,117	7,296,991	189	3,312,843	257	606,712	5	188,653	...	...
Sacramento, Cal.	578	1,519,735	181	165,045	759	1,684,780	31	563,339	108	231,413	...	...	...	...
Saginaw, Mich.	213	191,248	59	24,736	272	215,984	34	185,989	11	9,550	...	...	...	...
St. Louis, Mo.	2,645	735,346	1,618	362,016	4,263	1,097,362	c 2,598	c 18,047,373	c 1,899	c 1,531,069	(c)	(c)	(c)	(c)
Salem, Mass.	185	475,258	114	108,651	299	583,909	7	257,751	3	17,250	...	...	1	33,000
Salt Lake City, Utah.	115	53,350	65	26,270	180	79,620	g 399	g 4,811,167	g 152	g 371,611	(g)	(g)	(g)	(g)
San Antonio, Tex.	1,725	1,439,448	1,033	180,888	2,758	1,620,336	75	674,428	134	100,188	...	...	...	...
San Francisco, Cal.	2,523	8,561,669	3,176	899,429	5,699	9,461,098	180	6,297,702	275	1,000,000	14	2,296,304	15	75,000

a The number of permits for additions, etc., to wooden buildings for Dubuque, Iowa, was not given.

b The statistics for Flint, Mich., are for one-half year only, beginning July 1, 1912, as none were collected prior to that date.

c New stone and new concrete buildings for Hartford, Conn., and St. Louis, Mo., are included with new brick buildings, and additions, etc., to stone and concrete buildings are included with additions to brick buildings.

d Additions, etc., to brick buildings for Indianapolis, Ind., are included with additions to wooden buildings.

e New stone and new concrete buildings for Jacksonville, Fla., as well as additions, etc., to brick and stone buildings, are included with new brick buildings, and additions, etc., to wooden buildings are included with new wooden buildings.

f Additions, etc., to all classes of buildings for Knoxville, Tenn., and Oakland, Cal., are included with additions to wooden buildings.

g All classes of new fire-resisting buildings for Los Angeles, Cal., Oklahoma, Okla., and Salt Lake City, Utah, are included with new brick buildings, and additions, etc., to all classes of fire-resisting buildings are included with additions to brick buildings.

h All fire-resisting buildings for Newton, Mass., are included with brick buildings.

i Additions, etc., to brick buildings for Pawtucket, R. I., are included with new brick buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1912—Continued.

City.	Wooden buildings.						Fire-resisting buildings.							
							Brick.				Stone.			
	New.		Additions, alterations, and repairs.		Total.		New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.	
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.
Scranton, Pa.	231	$631,873	238	$132,654	469	$764,527	51	$448,239	47	$413,166	8	$48,650		
Seattle, Wash.	3,858	4,329,445	5,626	1,123,925	9,484	5,453,370	21	1,052,000	260	284,360				
Sioux City, Iowa	616	1,375,000	(a)	(a)	616	1,375,000	7	200,000	(a)	(a)	3	25,000	(a)	(a)
Somerville, Mass.	(b)	(b)	(b)	(b)	355	1,427,549	26	315,810	(b)	(b)				
South Bend, Ind.	325	425,840			325	425,840	95	400,550						
Spokane, Wash.	708	1,045,107	210	87,835	918	1,132,942	62	767,625	132	219,000				
Springfield, Ill.	187	424,330	176	108,330	363	532,660	46	767,320	50	110,572				
Springfield, Mass.	726	2,265,000	485	523,505	1,211	2,788,505	144	3,242,434	134	261,555				
Springfield, Ohio	200	400,000	100	100,000	300	500,000	50	100,000	50	50,000				
Syracuse, N. Y.	890	2,840,431	426	310,745	1,316	3,151,176	59	773,630	82	284,760				
Tampa, Fla.	308	626,300	706	89,620	1,014	715,920	32	924,200	95	29,337	8	53,000	5	$1,863
Topeka, Kans.	400	592,629	157	55,553	557	648,182	41	115,830			17	126,667		
Troy, N. Y.	116	242,580	142	92,081	258	334,661	37	920,642	125	117,628				
Washington, D. C.	368	1,049,064	664	124,790	1,032	1,173,854	2,164	13,472,468	1,618	1,623,347				
Wheeling, W. Va.	65	62,512	257	50,304	322	112,816	26	1,041,343	224	132,482				
Wichita, Kans.	129	268,270	19	15,095	148	283,365	16	66,475	14	21,300	5	401,175		
Wilkes-Barre, Pa.	288	453,994	142	132,764	430	586,758	83	740,721	30	192,713	1	35,000		
Wilmington, Del.							428	1,086,479	439	286,655	8	79,000		
Yonkers, N. Y.	309	1,176,850	(a)	(a)	309	1,176,850	172	1,877,300	(a)	(a)	10	499,000	(a)	(a)
York, Pa.	75	97,500	167	33,400	242	130,900	208	257,768	215	107,500				
Total	80,265	161,385,088	63,837	26,969,244	144,457	189,781,881	25,590	348,651,111	23,676	42,264,488	184	5,914,474	150	604,633
Percentage of total		24.43		4.08		l 28.73		52.79		6.40		.90		.09

a Additions, etc., for each class of buildings reported for Sioux City, Iowa, and Yonkers, N. Y., are included with the new buildings of those classes.

b Additions, etc., to brick buildings for Somerville, Mass., are included with new brick buildings. The total only was given for wooden buildings for Somerville, Mass.—i. e., 355 permits or buildings, costing $1,427,549. The percentage for this value, equivalent to $\frac{22}{100}$ of 1 per cent, is included in the percentage for total wooden buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1912—Continued.

City.	Fire-resisting buildings.										Grand total.		Rank of cities in cost of buildings erected in 1912.
	Concrete.				All other.				Total.				
	New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.						
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	
Akron, Ohio									319	$1,949,690	2,491	$4,800,027	39
Allentown, Pa	9	$34,500							296	2,562,750	400	2,627,065	60
Atlanta, Ga	7	1,864,000			5	$2,365,000			100	5,425,335	3,529	9,806,836	21
Augusta, Ga									141	529,464	1,406	1,064,722	112
Bayonne, N. J									70	359,836	463	1,518,768	91
Berkeley, Cal	1	5,000							12	65,000	932	1,919,000	78
Binghamton, N. Y	(a)	(a)			(a)	(a)			a 56	502,192	896	1,344,878	98
Birmingham, Ala					6	373,120	6	$63,015	365	1,746,569	2,917	3,813,079	46
Boston, Mass	18	559,350	15	$28,670	51	5,570,625	60	295,990	1,904	19,533,476	4,410	26,755,652	6
Brockton, Mass									31	404,000	540	1,438,240	93
Buffalo, N. Y	10	634,000							388	6,995,953	4,090	12,992,000	15
Butte, Mont	2	45,000							4	95,000	169	735,450	128
Cambridge, Mass	(b)	(b)	(b)	(b)			(b)	(b)	94	1,493,815	580	2,946,490	54
Camden, N. J	7	194,000			39	22,700			771	1,933,400	961	2,104,300	75
Canton, Ohio	4	35,000			8	224,500			50	768,278	637	1,526,068	90
Charleston, S. C									106	210,673	577	541,738	133
Chester, Pa	9	10,000					1	25,000	195	515,245	203	526,245	135
Cincinnati, Ohio	(a)	(a)			(a)	(a)			a 760	a 5,644,281	5,386	8,660,264	24
Cleveland, Ohio	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	c 738	c 9,902,537	8,790	18,180,078	10
Covington, Ky									180	847,514	325	990,933	115
Dallas, Tex									136	2,254,223	1,826	4,969,438	38
Dayton, Ohio	30	1,072,230			9	10,950			151	1,892,673	1,214	3,552,120	49
Des Moines, Iowa	6	250,000	15	12,000	12	20,000	40	33,000	309	980,000	759	1,883,492	80

[a] Additions, etc., to all classes of buildings for Binghamton, N. Y., Cincinnati, Ohio, are included with additions to wooden buildings. New concrete buildings and all other new fire-resisting buildings for Binghamton and Cincinnati are included with new brick buildings.

[b] New stone and new concrete buildings for Cambridge, Mass., are included with new brick buildings and additions, etc., to all classes of fire-resisting buildings, are included with additions to brick buildings.

[c] All classes of new fire-resisting buildings for Cleveland, Ohio, are included with new brick buildings, and additions, etc., to all classes of buildings are included with additions to wooden buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1912—Continued.

City.	Fire-resisting buildings.										Grand total.		Rank of cities in cost of buildings erected in 1912.
	Concrete.				All other.				Total.				
	New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.						
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	
Detroit, Mich	39	$2,056,900	4	$121,000	11	$4,118,600	3	$40,500	1,165	$13,030,430	7,991	$25,588,470	7
Dubuque, Iowa	11	30,950							30	406,350	116	594,025	131
Duluth, Minn	a 21	a 866,946	(a)	(a)	(a)	(a)	(a)	(a)	187	1,691,678	1,183	2,680,543	59
Elizabeth, N. J	6	7,900			25	122,271			90	563,474	550	1,820,053	83
Elmira, N. Y	14	56,500							55	415,700	233	751,600	127
Evansville, Ind	4	268,000	1	70,000					199	853,356	1,168	1,527,576	89
Fall River, Mass	3	40,255							31	340,255	572	1,240,255	102
Fitchburg, Mass	1	7,500							34	534,980	292	954,575	116
Flint, Mich. b	2	5,100			6	6,000	3	2,800	40	81,600	181	197,800	142
Fort Worth, Tex	7	1,757,350	3	8,500	1	1,000	1	1,800	95	2,860,250	417	3,389,333	50
Galveston, Tex	3	555,000			14	8,709			71	892,993	643	1,198,647	103
Grand Rapids, Mich	61	128,782							186	1,056,849	1,433	2,456,516	64
Harrisburg, Pa	1	70,000			14	23,205			455	1,118,410	552	1,167,125	106
Hartford, Conn	(c)	(c)	(c)	(c)					353	5,497,910	1,277	7,379,525	28
Haverhill, Mass	2	10,000					12	36,700	36	342,500	279	1,075,900	111
Hoboken, N. J	2	210,000			4	10,550			109	435,859	215	500,602	136
Holyoke, Mass					3	400,000			89	1,762,511	225	2,159,931	72
Houston, Tex	19	590,500	2	800	10	1,228,760	5	23,645	357	3,321,381	2,837	5,091,212	37
Indianapolis, Ind	97	2,440,040							459	4,499,660	4,781	9,150,407	22
Jacksonville, Fla	(d)	(d)							171	2,178,607	1,148	3,807,957	47
Kalamazoo, Mich							3	25,000	48	675,000	398	1,305,000	99
Kansas City, Kans									42	299,850	455	795,775	126
Kansas City, Mo	32	1,488,500	3	67,000	8	66,385			939	7,223,434	3,953	12,127,079	16
Knoxville, Tenn									e 29	e 633,611	993	945,683	117
Lawrence, Mass	4	42,000	2	16,500					23	202,500	185	709,595	129
Lincoln, Nebr	9	13,675					11	4,200	87	427,665	495	1,185,135	104
Little Rock, Ark					2	226,000			176	770,312	900	1,598,436	88
Los Angeles, Cal	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	1,488	13,617,926	16,455	31,367,995	5
Louisville, Ky	17	442,980			22	1,882,600			506	4,655,007	2,379	6,562,777	31
Lowell, Mass	2	170,000							18	591,800	572	1,291,649	100
Lynn, Mass	3	38,000			2	6,200			53	1,200,800	754	2,873,475	56

McKeesport, Pa.									8	28,670	114	130,443	143
Manchester, N. H.	1	250,000			3	125			81	1,399,094	1,169	2,612,474	61
Milwaukee, Wis.	125	6,168,873					102	41,300	454	8,104,123	4,361	15,257,162	12
Minneapolis, Minn.	30	33,805	7	12,200	108	5,031,935	79	772,030	727	8,203,065	5,965	14,229,475	14
Montgomery, Ala.									83	299,467	349	528,564	134
Nashville, Tenn.									231	953,022	1,503	1,378,997	96
New Bedford, Mass.					82	54,306			110	547,988	940	2,400,050	65
New Britain, Conn.									85	669,700	255	1,127,735	108
Newton, Mass.									44	415,850	501	1,701,677	87
New York, N. Y.	10	864,500			4	1,450			6,701	162,193,893	8,283	163,519,362	1
Norfolk, Va.	11	290,200			44	23,758			358	2,233,889	743	2,889,145	55
Oakland, Cal.	13	542,269			5	13,600			e 75	e 3,026,155	4,058	8,821,950	23
Oklahoma, Okla f									83	470,904	290	885,246	122
Omaha, Nebr.	4	315,000							276	2,398,175	1,372	4,546,761	42
Passaic, N. J.									99	656,281	359	1,176,676	105
Paterson, N. J.	31	89,950	5	2,175			2	1,715	180	1,032,431	909	2,124,403	74
Pawtucket, R. I.									18	466,993	357	1,154,988	107
Philadelphia, Pa.	30	2,500,200	21	325,000	15	12,000	10	3,200	10,899	36,063,690	11,192	36,392,405	4
Pittsburgh, Pa.	30	750,000	80	275,531	400	4,000,000	170	1,625,000	2,033	8,865,531	3,890	11,530,531	19
Portland, Me.	2	6,950							44	607,965	379	1,364,050	97
Pueblo, Colo.	3	215,200							139	901,998	344	1,052,027	113
Quincy, Ill.	2	18,000							34	163,675	57	198,645	141
Richmond, Va.					253	3,481,998	261	308,762	1,154	5,945,964	1,631	6,255,711	33
Rochester, N. Y.	122	482,870	87	68,848			111	78,549	771	4,738,475	3,888	12,035,466	17
Sacramento, Cal.	11	288,400	1	700	g 19	g 24,912	(g)	(g)	170	1,108,764	929	2,793,544	58
Saginaw, Mich.	1	40,000							46	235,539	318	451,523	138
St. Louis, Mo.	(c)	(c)	(c)	(c)					4,497	19,578,442	8,760	20,675,804	9
Salem, Mass.	4	15,000							15	323,001	314	906,910	120
Salt Lake City, Utah	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	551	5,182,778	731	5,262,398	36
San Antonio, Tex.	13	371,270			53	40,600	6	1,170	281	1,187,656	3,039	2,807,992	57
San Francisco, Cal.	123	4,183,459	10	25,000					617	13,877,465	6,316	23,338,563	8
Scranton, Pa.							101	41,909	207	951,964	676	1,716,491	86
Seattle, Wash.					10	1,570,000	44	55,595	335	2,961,955	9,819	8,415,325	26
Sioux City, Iowa	2	600,000	(h)	(h)					12	825,000	628	2,200,000	71
Somerville, Mass.	5	9,300	1	300	14	24,760			46	350,170	401	1,777,719	85
South Bend, Ind.	15	116,550							110	517,100	435	942,940	118
Spokane, Wash.	14	126,340			3	385	1	5,000	212	1,118,350	1,130	2,251,292	68

a All other new fire-resisting buildings for Duluth, Minn., are included with new concrete buildings, and additions, etc., to all other fire-resisting buildings, and to concrete buildings are included with new concrete buildings.

b The statistics for Flint, Mich., are for one-half year only, beginning July 1, 1912, as none were collected prior to that date.

c New stone and new concrete buildings for Hartford, Conn., and St. Louis, Mo., are included with new brick buildings, and additions, etc., to stone and concrete buildings are included with additions to brick buildings.

d New stone and new concrete buildings for Jacksonville, Fla., as well as additions, etc., to brick and stone buildings, are included with new brick buildings, and buildings, etc., to wooden buildings are included with new wooden buildings.

e Additions, etc., to all classes of buildings for Knoxville, Tenn., and Oakland, Cal., are included with additions to wooden buildings.

f All classes of new fire-resisting buildings for Los Angeles, Cal., Oklahoma, Okla., and Salt Lake City, Utah, are included with new brick buildings, and additions, etc., to all classes of fire-resisting buildings are included with additions to brick buildings.

g Additions, etc., to all other fire-resisting buildings for Sacramento, Cal., are included with all other new fire-resisting buildings.

h Additions, etc., for each class of buildings reported for Sioux City, Iowa, and Yonkers, N. Y., are included with the new buildings of those classes.

Building statistics of the leading cities of the United States, by character of operations, in 1912—Continued.

City.	Fire-resisting buildings.										Grand total.		Rank of cities in cost of buildings erected in 1912.
	Concrete.				All other.				Total.				
	New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.						
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	
Springfield, Ill.									96	$877,892	459	$1,410,552	95
Springfield, Mass.									278	3,503,989	1,489	6,292,494	32
Springfield, Ohio	50	$100,000					25	$50,000	175	300,000	475	800,000	125
Syracuse, N. Y.	45	197,570	44	$80,725					230	1,336,685	1,546	4,487,861	44
Tampa, Fla.	18	155,292	7	2,638	4	$20,152	81	1,362	250	1,187,844	1,264	1,903,764	79
Topeka, Kans.					28	38,550			86	281,047	643	929,229	119
Troy, N. Y.	9	52,941							171	1,091,211	429	1,425,872	94
Washington, D. C.	6	78,989			18	824,262	210	420,928	4,016	16,419,994	5,048	17,593,848	11
Wheeling, W. Va.									250	1,173,825	572	1,286,641	101
Wichita, Kans.	4	66,000							39	554,950	187	838,315	123
Wilkes-Barre, Pa.	7	22,925			2	750,000			123	1,741,359	553	2,328,117	67
Wilmington, Del.	3	176,000			2	216,000			880	1,844,134	880	1,844,134	82
Yonkers, N. Y.	14	134,800			19	69,650			215	2,580,750	524	3,757,600	48
York, Pa.									423	365,268	665	496,168	137
Total	1,221	35,262,611	308	1,117,587	1,338	32,885,618	1,348	3,958,170	53,815	470,658,692	198,272	660,440,573	
Percentage of total		5.34		.17		4.98		.60		71.27		100.00	
Albany, N. Y.											2,725	4,510,304	43
Altoona, Pa.											711	828,506	124
Atlantic City, N. J.											1,174	3,895,367	45
Bay City, Mich.											324	571,020	132
Bridgeport, Conn.											1,016	3,301,904	52
Brooklyn, N. Y.											11,408	40,537,784	3
Chattanooga, Tenn.											2,308	1,440,000	92
Chicago, Ill.											10,751	83,175,900	2
Columbus, Ohio											2,656	4,675,303	41
Davenport, Iowa											294	1,031,620	114
Denver, Colo.											2,254	5,332,675	35
El Paso, Tex.											849	2,228,405	69

Erie, Pa												1,399	2,345,833	66
Jersey City, N. J												1,336	5,911,880	34
Lancaster, Pa												538	904,042	121
Macon, Ga												507	1,085,777	110
Malden, Mass												294	707,035	130
Memphis, Tenn												3,657	7,162,214	29
Newark, N. J												2,937	11,628,358	18
New Haven, Conn												1,330	4,762,341	40
New Orleans, La												1,794	3,309,620	51
Peoria, Ill												622	2,475,725	63
Portland, Oreg												8,224	14,652,071	13
Providence, R. I												2,856	8,530,800	25
Racine, Wis													a 2,000,000	76
St. Joseph, Mo												850	1,119,797	109
St. Paul, Minn												3,491	8,051,417	27
San Diego, Cal												4,559	10,001,415	20
Savannah, Ga												1,038	1,995,368	77
Schenectady, N. Y												728	2,511,947	62
Superior, Wis												139	277,638	140
Tacoma, Wash												1,740	1,876,487	81
Trenton, N. J												840	2,216,036	70
Utica, N. Y												857	2,153,118	73
Waterbury, Conn												577	1,800,000	84
West Hoboken, N. J												178	447,348	139
Worcester, Mass												1,698	6,689,900	30
Youngstown, Ohio												1,198	3,223,526	53
Grand total												278,129	919,809,054	

a Estimated by chief of fire department. No permits given.

This table shows that the 143 cities included reported building operations costing $919,809,054 in 1912. Of these, 105 cities reported sufficient detail to permit the publication of statistics of building operations by classes of structures. These 105 cities reported 198,272 permits or buildings, work on which cost $660,440,573. Of this, new buildings of every variety cost approximately $584,098,902, or 88.44 per cent of the total, and additions, alterations, and repairs $74,914,122 or 11.34 per cent of the total, $1,427,549, or 0.22 per cent having been reported as wooden buildings unclassified.

Taken by classes, the new wooden buildings constituted 24.43 per cent of the total cost and new brick buildings 52.79 per cent of the total, all other new buildings constituting 11.22 per cent, approximately. Of the cost of new buildings, 72.37 per cent was for all fire-resisting buildings and 27.63 per cent for wooden buildings. Of the cost of all new fire-resisting buildings, 82.48 per cent was for brick buildings, 1.40 per cent for stone buildings, 8.34 per cent for concrete buildings, and 7.78 per cent for all other fire-resisting buildings. Of the cost of additions, alterations, and repairs, 36 per cent was for wooden buildings and 64 per cent for all fire-resisting buildings. Of the fire-resisting buildings, 88.15 per cent was for brick buildings, 1.26 per cent for stone buildings, 2.33 per cent for concrete buildings, and 8.26 per cent for all other fire-resisting buildings.

Operations on brick buildings (new buildings, additions, alterations, and repairs) cost $390,915,599, or 59.19 per cent of the entire cost of all operations in these 105 cities, all other fire-resisting buildings contributing $79,743,093, or 12.08 per cent. In addition to the brick used in the construction of brick buildings, large quantities are used in foundations, chimneys, etc., to wooden buildings and in the construction of all fire-resisting buildings.

The average cost of new wooden buildings in the 105 cities shown in this table in 1912 was $2,011; of new brick buildings, $13,625; of new stone buildings, $32,144; of new concrete buildings, $28,880, and of miscellaneous fire-resisting buildings, $24,578.

Wooden buildings.—Los Angeles reported, as for several years, the largest number of new wooden buildings, 10,672, with an average cost of $1,541. This is an increase of 2,578 buildings over 1911 and practically the same average cost per building as for 1911, there being a decrease in 1912 of but $74. Detroit was second in 1912, as in 1911, reporting for 1912, 5,685 new wooden buildings, at an average cost of $2,076. Seattle was third in both 1911 and 1912 in the number of new wooden buildings reported.

Los Angeles in 1912, as in 1911 and 1910, was the leading city in the cost of new wooden buildings, reporting for 1912 a total cost of $16,442,162. This was an increase of $3,371,200 over 1911. Detroit was second in 1912, as in 1911, reporting new wooden buildings costing $11,803,410 in 1912, an increase of $2,274,850 over 1911. San Francisco, which was sixth in the number of permits or buildings of this class of buildings in 1912 was third in cost.

The leading cities in the cost of all operations on wooden buildings showed increase in 1912 over 1911, as follows: Boston, $1,608,429, or 28.65 per cent; Cleveland, $1,756,564, or 26.94 per cent; Detroit, $2,490,545, or 24.74 per cent; Los Angeles, $3,542,299, or 24.93 per cent; Milwaukee, $679,325, or 10.49 per cent; Rochester, $916,001, or 14.36 per cent; and San Francisco, $416,317, or 4.6 per cent. The wooden buildings reported from New York City were erected principally in the Borough of the Bronx.

Fire-resisting buildings.—New York City reported the greatest cost of fire-resisting buildings, including additions, alterations, etc., for 1912—$162,193,893, or 34.46 per cent, of the total cost of this class of buildings in these 105 cities. This was an increase of $27,532,844, or 20.45 per cent, over 1911. Of the other larger cities but two, Cleveland and Kansas City, Mo., showed decrease in this class of buildings. The following of these cities showed increase in this class of structures in 1912 over 1911: Atlanta, $3,368,908, or 163.82 per cent; Boston, $5,767,827, or 41.90 per cent; Buffalo, $1,904,463, or 37.4 per cent; Detroit, $4,085,255, or 45.67 per cent; Indianapolis, $564,322, or 14.34 per cent; Los Angeles, $4,821,511, or 54.81 per cent; Milwaukee, $2,278,462, or 39.11 per cent; Minneapolis, $610,305, or 8.04 per cent; Oakland, $939,267, or 45.01 per cent; Rochester, $1,729,690, or 57.49 per cent; San Francisco, $2,006,772, or 16.91 per cent; Seattle, $821,450, or 38.38 per cent; and Washington, $3,442,031, or 26.52 per cent.

NOTES ON THE OCCURRENCE OF DIFFERENT VARIETIES OF CLAY.

By J. H. HANCE.

INTRODUCTION.

The present chapter is intended to set forth a brief, general sketch of the clay-working industry of the United States. Lack of space prevents detailed descriptions of the various important producing localities, but an attempt is made to suggest undeveloped clay resources in connection with known deposits now being worked.

Most of the literature on the subject is widely scattered, and a collation of all this material would require more time than the writer has at his disposal, so that a few texts, notably "History of the clay-working industry in the United States," by Ries and Leighton, and "Clays, occurrences, properties, and uses," by Reis, both published by Wiley & Sons, and United States Geological Survey Professional Paper 11, "Clays of the United States east of the Mississippi River," by Ries, have supplied most of the matter. This article is rather a digest of information collected by other writers.

According to recent discoveries of archeologists in western Asia, clay working was an art with the ancients whose records seem to date back 6,000 years B. C., and clay products such as pottery and brick have the comprehensive distribution that such an age might suggest. It is one of the oldest of established industries in the United States and in primitive form preceded the coming of the Anglo-Saxon to this hemisphere.

The discovery and development of clay deposits have followed settlement rather than caused it, as the value of the material, raw or manufactured, is not such as to encourage pioneering. In fact the discovery of deposits of fuel and metals generally bears to the development of clay resources the relation of cause and effect. The value of clay products in the United States, however, is exceeded only by that of coal, iron, and copper.

The manufacture and use of structural materials of clay have made phenomenal progress of late years, and are so closely allied with our urban development that the modern city would be impossible without these products. Fireproofing materials alone have contributed largely to this advance by practically eliminating the risk of life and property in large office buildings. New and improved methods have greatly enlarged the lists of building materials available and have cheapened the costs of production, at the same time improving the quality of the product. Much of the raw material can bear but little transportation. Cheap fuel, such as is available in Ohio, Pennsylvania, and Illinois, by reason of coal, oil, or natural gas resources, and in New York and New Jersey where water transportation results in low freight rates, good shipping facilities and nearness to market are controlling factors in determining the centers of production. Ohio ranks first in value of clay products, with a long lead over its nearest competitors, which are Pennsylvania, New Jersey, Illinois, and New York.

In the following portion of this article the old geographic grouping of the States is used, as it seems fairly well adapted to this method of presentation. Many interesting details are omitted and possibly some of the more important ones.

The classification of clays adapted from Orton and Wheeler has been used as a framework, and a discussion of the industry and resources has been expanded on that. For the benefit of those less familiar with the industry, the various clays are briefly defined, but it should be borne in mind that complete definitions are not attempted, merely distinguishing characteristics, which serve to differentiate the various kinds.

CLASSIFICATION OF CLAYS.

The following classification of clays is used in this discussion:

High-grade clays:
- White-ware clays—
  - Kaolin.
  - China clay.
  - Ball clay.
- Refractory clays—
  - Plastic fire clay.
  - Flint clay.
  - Refractory shale.
- Pottery clays.

Low-grade clays:
- Vitrifying clays—
  - Stoneware clays and shales.
  - Paving-brick clays and shales.
  - Sewer-pipe clays and shales.
  - Roofing-tile clays and shales.
- Brick clays—
  - Terra-cotta clays and shales.
  - Common-brick clays and shales.
  - Drain-tile clays and shales.
- Gumbo clays.
- Loess and adobe clays
- Slip clays.
- Fuller's earth.

WHITE-WARE CLAYS.

White-ware clays consist of kaolin, china clay, and ball clay. Kaolin, as usually defined, is limited to those residual, white-burning clays consisting chiefly of kaolinite and other hydrous aluminum silicates, but possessing little plasticity. It is formed by the decomposition of pegmatites, granites, quartz-porphyries, acidic feldspathic rocks, gneisses, schists, and argillaceous limestones. China clay and ball clay are sometimes spoken of as plastic kaolins. They possess more plasticity than the latter and ordinarily more fluxing impurities and iron. Kaolin forms the basis of much of the white ware made, and the required plasticity is secured by adding china or ball clays, flint, or spar.

Most of the known workable kaolin deposits are east of Mississippi River, although some valuable deposits are developed in Missouri, Utah, and Texas. Little clay of this kind is found north of the terminal moraine of the continental ice sheet, although some deposits are undoubtedly buried beneath the glacial débris.

Maine, New Hampshire, and Vermont are underlain by old crystalline or metamorphic rocks, over which is spread a mantle of glacial drift. Little raw material of value is produced, and consequently the industry there is confined to the production of low grades. A few white-burning residual clays are found along the western edge of Vermont and near West Cornwall, Conn.

In the Middle Atlantic States kaolin or other white ware clay deposits have been worked at the following localities: Blair, Cumberland, Berks, Chester, and Delaware counties in Pennsylvania; northwestern Delaware and northeastern Maryland near the Pennsylvania line; Patrick and Henry counties in the southwestern part of Virginia, and Buckingham County west of Richmond.

In the Southern States: Henry County, Tenn.; Jackson, Swain, Haywood, Richmond, Montgomery, Mecklenburg, and Guilford counties, N. C.; Aikin, Richland, Kershaw, and Spartanburg counties, S. C.; a narrow strip extending from Augusta, Ga., southwest across the State, and including Dry Branch, Perry, and Butler; Randolph, Cleburne, Etowah, Talladega, Calhoun, Blount, and Dekalb counties, Ala.; Marshall, Tippah, Tishomingo, and Lafayette counties, Miss.; Putnam, Lake, and Polk counties, Fla.; Pike, Pulaski, Saline, Ouachita, and Benton counties, Ark.; the Wichita Mountains in western Oklahoma; Edwards, Washington, Lee, Fayette, and Gonzales counties, Tex.

In the Central States: On the eastern edge of the western coal field in the extreme western part of Kentucky; Lawrence, Martin, Owen, and Greene counties, Ind.; the southeastern, central, and southwestern parts of Missouri; and a possible deposit near Custer, S. Dak.

In the northwestern group of States no kaolins are reported, although there are probably some white ware clays in the areas of crystalline rocks. In the Southwestern States, white ware clay is obtained from Millard and Salt Lake counties, Utah.

Many other deposits of kaolins and ball clays are undoubtedly known and worked in a small way, of which the writer has no record. Further development in the drift-covered Eastern States and those farther south, will probably furnish new supplies of these valuable clays, and the extension of railroad facilities will also make available deposits now lying idle. The production of this kind of clay in the United States is exceeded by the demand and considerable is annually imported from England, the value of the imports in 1912 reaching $1,629,105.

The conversion of white ware clays into the finer grades of porcelain and china is confined chiefly to Trenton, N. J., Syracuse and Green Point, N. Y., and the vicinity of East Liverpool, Ohio. The growth of the industry at these places has been due to causes previously stated. Originally introduced as an auxiliary feature, the manufacture of high-grade pottery has grown to huge proportions and now represents the combinations of many scattered small plants. As the ware is expensive, the best raw material is eagerly sought for and will bear refining and shipment.

A considerable quantity of this white clay is used for paper manufacture and for this purpose purity of color and freedom from grit are essential. For this use plasticity and color after burning are unimportant. This branch of the American industry is supplied with material from South Carolina, Georgia, Maryland, Delaware, southeastern Pennsylvania, and England.

REFRACTORY CLAYS.

This term is applied to clays capable of enduring high temperatures without change, but usage of the term is, unfortunately, far more general. In Germany such a clay must have a fusion point above cone 27 (1,670° C.) and this same requirement might well be incorporated in practice here. The American custom of grading fire clays as Nos. 1, 2, and 3 is also misleading, as there is no uniformity of the standards, and the result is an overlapping of the grades. Most of the best fire clays are nonplastic, and the necessary plasticity is obtained by the addition of a small quantity of less refractory material. Freedom from fluxes, such as iron, lime, the alkalies, and excessive silica, is essential.

The important occurrences are in Howard, Garrett, and Harford counties, Md.; Mineral and Hancock counties, W. Va.; Elk, Butler, Huntingdon, Cameron, Armstrong, Clearfield, Clinton, Indiana, Fayette, Beaver, McKean, and Westmoreland counties, Pa.; Scioto, Hocking, Muskingum, Coshocton, Tuscarawas, Stark, Vinton, Perry, Carroll, Jackson, and Moxahala counties, Ohio; the extreme western and northeastern parts of Kentucky; a strip extending from La Fayette, Ind., to the southern end of the State where it is about 80 miles wide; a large area extending over the central, eastern, and southern portions of Illinios; and in nearly every county in Missouri. Other deposits are known at Rutland, Vt.; in Middlesex, Sussex, Mercer, Burlington, and Warren counties, N. J.; Suffolk County, N. Y.; Newcastle County, Del.; Bradley, Stewart, Franklin, Marion, and Madison counties, Tenn.; Cleveland and Guilford counties, N. C.; Cherokee, Colbert, Calhoun, Dekalb, Bibb, Tuscaloosa, Marion, Choctaw, Clarke, and Conecuh counties, Ala.; in the northeastern and southern parts of Mississippi; Bowie, Hopkins, Henderson, Limestone, Comal, Robertson, and Bastrop counties, Tex.; in the south-central part and along the southern border of Iowa; Stark and Morton counties, N. Dak.; Pennington County, S. Dak.; Cascade County, Mont.; King and Lewis counties, Wash.; Jefferson, Boulder, Douglas, El Paso, Fremont, La Plata, Montezuma, and Pueblo counties, Colo.; and in Salt Lake County, Utah.

A special grade of fire clay is the glass-pot clay. Besides possessing refractory qualities, it must burn dense at a low temperature, without warping, and have good bonding power. Some clay of this kind is obtained in Fayette County, Pa.; Mineral City, Ohio; and the St. Louis area in Missouri; but considerable is imported from Germany.

The manufacture of refractory material in the United States is 100 years old and seems to have been begun in New Jersey. The following States lead in this phase of the clay industry: Pennsylvania, New Jersey, Missouri, Ohio, Kentucky, and California. New York and Illinois also contribute largely to the annual output.

POTTERY CLAYS.

This term is rather indefinite, as it includes articles manufactured from both white ware and refrectory clays and also some vitrified clay products. Some of the items in this group are as follows: Brown and other earthen and common stoneware, china and porcelain, both plain and decorated, crockery, and glazed ware.

Clays suitable for this product are usually semirefractory and dense burning. They should hold their form well in burning and may have high plasticity and tensile strength. Enough iron or manganese may be present to produce a buff color in the burned ware. Ordinarily, a mixture of clays is used, these being carefully washed, mixed wet, and screened.

The first pottery to be established by the white settlers seems to have operated in Long Island in 1661, although this may have been preceded by others in the present Middle Atlantic States.

Clay for this group is found in the following localities: Dekalb, Hardeman, Carroll, and Madison counties, Tenn.; Wilkinson County, Ga.; Dekalb, Blount, Cherokee, Elmore, Fayette, Colbert, Saint Clair, Tuscaloosa, Marshall, Marion, Franklin, Lamar, and Pickens counties, Ala.; in the north and east central and extreme southwestern portions of Mississippi; Garland, Saline, Miller, and Johnson counties, Ark.; Stark and Hocking counties, Ohio; Ontonagon County, Mich.; Madison, Fulton, and Hickman counties, Ky.; Clay, Dubois, Perry, and Miami counties, Ind.; Massac, Daviess, Boone, Adams, Brown, Greene, Pulaski, Alexander, and Jersey counties, Ill.; Allamakee County, Iowa; east central part of Nebraska; Placer, Amador, Calaveras, and Riverside counties, Cal. In many other localities the production of pottery clay is secondary to that of other forms, and the record of its output is thereby partly obscured.

The manufacture of pottery has concentrated at the larger distributing centers, although many unique forms of art pottery are still produced at small plants. Cheap labor, considering the skill required, an abundance of fuel, and cheap transportation facilities, have resulted in nearly all of this work being carried on east of the Mississippi, and in fact east of the 85th meridian. Pottery is generally made from a mixture of clays, some of which may be imported and others shipped from the various producing States. For much of the ware the requirements are not so severe as for white burning or refractory material. Much depends upon the glazes and workmanship, and this phase of ceramics has been brought to a high degree of art. Although a protective duty was considered necessary to the establishment of this work, the United States is now exporting a large quantity each year. The value of the imports is far in excess of the exports, however, and is about equal to one-fifth of the annual production.

VITRIFYING CLAYS.

This grouping somewhat overlaps the pottery clays, but is intended to apply to a lower grade of material. It may be semirefractory in character, should burn dense, and may contain considerable iron as a color and flux. A fair tensile strength is frequently desirable, as is also low fire shrinkage and low vitrification temperature. The latter is important as it affects the fuel consumption and since the products are low priced, a minimum manufacturing cost is required. The color to which the clay burns is not important as that may be controlled artifically.

For terra cotta products, a fairly good grade of clay and one of semirefractory nature is preferred. Freedom from soluble salts is important, and buff burning clay is considered suitable as it vitrifies at the proper temperature. Low shrinkage and freedom from warping are essential.

In the so-called pipe clays a high percentage of iron is considered favorable to the formation of the necessary glaze.

Pressed brick requires a fair grade of clay or shale, semirefractory in character, and one which vitrifies at a moderate temperature, with low shrinkage.

Paving brick material has a broad range and includes many of the impure shales which have a wide distribution.

Fireproofing and hollow structural work calls for low-grade fire clays or refractory shales, which should have fair plasticity and tensile strength and burn hard at a low temperature without vitrification.

Clays and shales suitable for these products have a wide distribution. Besides low-grade stoneware and fire clays already referred to, the following localities contain available supplies of this material: Greene and Warren counties and the northwestern part of New York; Union, Berks, Clarion, Beaver, and Alleghany counties, Pa.; Middlesex County, N. J.; Newcastle County, Del.; the Coastal Plain area in Maryland, and a northeast-southwest strip across the State, including Baltimore; Preston, Tucker, Randolph, Pocahontas, Greenbrier, Monroe, Summers, Hancock, Mingo, Wyoming, Raleigh, Upshur, and Monongalia counties in West Virginia; Pomona County and elsewhere in North Carolina; Jones, Bibb, and Sumter counties, Ga.; Jefferson, Fayette, Marion, Franklin, and Colbert counties, Ala.; the southern, southwestern, and northeastern portions of Louisiana; Arbuckle Mountains in Oklahoma; Falls, Wood, Smith, Rusk, Bexar, Wilson, Parker, Young, Eastland, Wise, Denton, Delta, Hunt, Navarro, Taylor, Ellis, Webb, and Milam counties, Tex.; Delaware, Cuyahoga, Summit, Belmont, and Jefferson counties, Ohio; the Blue Grass region of Kentucky; a strip about 20 miles wide extending from La Fayette to New Albany, and in Pulaski, Newton, Lake, and Porter counties, Ind.; Jo Daviess, Boone, and Knox counties, Ill.; the central and west central part of Wisconsin; Carlton, Dakota, Anoka, and Wabasha counties, Minn; northeastern part of Iowa, and to some extent in nearly every county of the State; eastern part of Missouri; in southeastern Nebraska; eastern Kansas; King and Whitman counties, Wash.; Otero, Jefferson, and Boulder counties, Colo.; San Miguel County, N. Mex. Most of the clay for wall and floor tile is produced in Ohio, Florida, Georgia, Pennsylvania, Kentucky, Tennessee, and North Carolina, and some is imported from England.

The production of this material is enormous and its value runs well up into the millions. The principal centers of manufacture are located as follows: Sewer pipe in Ohio, Missouri, New Jersey, Illinois, Pennsylvania, and Indiana; paving brick in Ohio, Illinois, Pennsylvania, Kansas, West Virginia, Missouri, and Indiana; pressed and enameled brick in Ohio, Pennsylvania, Illinois, New Jersey, Indiana, and Missouri; terra cotta in New Jersey, New York, Pennsylvania, Illinois, and Missouri; fire proofing material in New Jersey, Ohio, Indiana, Illinois, and Pennsylvania; hollow blocks and hollow tiles in Ohio, New Jersey, Indiana, and Iowa; roofing tile in Ohio, Illinois, Maryland, Pennsylvania, West Virginia, and California; conduits in Ohio, Indiana, and New Jersey.

BRICK CLAYS.

This is by far the largest class, as the requirements are less exacting than those of the preceding groups. Almost any kind of clay can be used for brick if it possesses plasticity. If too fat, sand can easily be added to remedy the trouble. Red burning clays are preferable, as they harden at a low temperature and thus save fuel.

Since the manufactured product is low priced, the raw material will bear scarcely any transportation, and as a consequence labor, fuel, and nearness to market are the deciding factors. This results in many extremely poor clays being used.

In the Northern States an abundant supply of fairly good material is usually obtained from the glacial drift. Along the coasts marine clays are generally available. In fact, each State probably has within its borders a plentiful supply of this material to meet most of its needs for the purpose.

In the New England States glacial, fluviatile, and marine clays are abundant. In New York and Pennsylvania drift clay and Paleozoic shales are used. In the Southern States Mesozoic and Pleistocene material furnishes the required supply. In the Central States drift and some older material is utilized.

The leading common-brick region is that of the Hudson Valley of New York, and Hackensack of New Jersey. This is but the natural result of the New York market. Cook County, Ill., is second, and this, too, is what might be expected, due to the Chicago market. Philadelphia County is third, followed by the District of Columbia and vicinity, Baltimore, St. Louis, Kansas City, Richmond, Detroit, Milwaukee, and Cleveland.

GUMBO CLAYS.

This term is applied to fine-grained, plastic, tenacious surface clays of recent formation, which are found principally in the western Central States along stream channels. They are burned and used for railroad ballast almost entirely.

ADOBE AND LOESS.

Adobe is a surface clay, generally high in lime and of limited use. In the Southwest the principal article made from this is the sun-dried adobe brick.

The term loess is applied to extensive Pleistocene deposits, which may be subaqueous or eolian in origin. They are high in silica and low in alumina, with a considerable amount of the alkalies present. In Nebraska, Iowa, and other western Central States they are extensively used in making brick and other cheap products.

MINERAL PAINT.

Cheap paints are made by roasting and grinding certain clays and shales, and mixing with oil. The color is usually due to the iron or manganese content.

SLIP CLAYS.

Slip clays are used for glazing and should possess the following properties: Fineness of grain, high percentage of fluxing impurities, low air shrinkage, low melting temperature, and early maturity in burning. They should conform readily to the clay with which used and consequently should have a wide range. In using the glaze the slip clay is mixed with water to a creamy consistency and then applied to the ware either by dipping or spraying. Artificial white glazes are now gaining in precedence. Albany, N. Y., furnishes most of the best clay of this kind, but Bexar, Wise, Polk, and Grimes counties, Tex., and Ontonagon County, Mich., also supply material for this purpose.

FULLER'S EARTH.

This material seems to consist mainly of hydrous aluminum silicates, possessing amorphous colloidal structure. Its peculiar value lies in its absorptive power for many substances, and it is used for decolorizing oils and other liquids. The better grades of earth are porous enough to filter easily, and do not give a permanent taste or odor to the oil.

A considerable quantity is imported from England, a little less than half the annual consumption, but the following States also supply the trade: Florida, Georgia, Alabama, Arkansas, Colorado, New York, South Dakota, California, South Carolina, and Massachusetts.

GEOLOGIC AND GEOGRAPHIC DISTRIBUTION OF CLAY RESOURCES.

GENERAL STATEMENT.

In this section a résumé of the occurrences of the raw materials is given, grouping the clays according to the age of the rocks, as the properties of a clay are, in many cases at least, functions of its age.

With the exception of indianaite, kaolin and ball clays are usually formed by the decay of crystalline and metamorphic rocks, and hence are associated with the older rocks. Conditions favorable for the formation of refractory clays seem to have been similar in many places to those necessary for coal accumulation, and these two useful materials are often, though not necessarily, found occurring together, the clay generally underlying the coal.

Vitrifying clays and shales may be unindurated sediments or weathered shales. Iron and other fluxes which detract from the higher grades of clay are essential constituents here. As a consequence more clays satisfy these conditions and the distribution is correspondingly greater.

Pottery clays lie between these last two named varieties in general characteristics, depending largely upon the kind of ware desired. Their distribution is somewhat similar to that of refractory clay.

As was previously stated, brick clays meet less exacting conditions than any of these four classes and consequently can be still more easily found. Recent material which has undergone but little refining by nature can be utilized.

The following accepted geologic scale is used as a basis:

Cenozoic era:
- Quaternary.
- Tertiary.

Mesozoic era:
- Cretaceous.
- Jurassic.
- Triassic.

Paleozoic era:
- Carboniferous.
- Devonian.
- Silurian.
- Ordovician.
- Cambrian.

Proterozoic era:
- Algonkian } Pre-Cambrian.
- Archean. }

PROTEROZOIC ERA.

Rocks deposited in Proterozoic time are differentiated into Archean and Algonkian but in many cases are termed merely pre-Cambrian. Clay derived from these rocks occurs as follows: White ware in Massachusetts, Connecticut, and Delaware; white ware and refractory material in Maryland; white ware in Virginia, Tennessee, North Carolina, and South Carolina; refractory material in Georgia; white ware and refractory material in Alabama; white ware, refractory and vitrifying material in Wisconsin; and vitrifying material in Minnesota.

PALEOZOIC ERA.

Clay residual from Cambrian rocks is used for white ware in Vermont; Cambrian and post-Cambrian material for white ware in Massachusetts; in New York, Ordovician rocks furnish kaolin, and rocks from the several Paleozoic systems are used for refractory, vitrified, and brick products; in Pennsylvania, white ware clays from the Cambrian, Ordovician, and Silurian, refractory material from the Cambrian, Ordovician, Silurian, and Carboniferous, pottery material from the Carboniferous, vitrifying clays from the Silurian and Devonian, and material for brick from the Silurian, Devonian, and Carboniferous; in New Jersey the Paleozoic rocks supply refractory material from the Cambrian and Ordovician, and brick clays from the Ordovician; in Maryland refractory clays are obtained from the Carboniferous, and vitrifying materials from the Devonian; in West Virginia refractory and vitrifying clays are interbedded with the Carboniferous rocks, and the Silurian and Devonian both furnish clays for brick purposes; in Virginia, Cambrian rocks supply white ware clays, and Carboniferous material is used for refractory and vitrified products; in Tennessee white ware clays are found in the Silurian rocks, refractory clays in the Silurian and Carboniferous, pottery clays in the Cambrian and Carboniferous, vitrifying clays in the Carboniferous and possibly other of the Paleozoic systems, and brick clays throughout the Paleozoic; in North Carolina and South Carolina white ware clays are obtained from various Paleozoic rock systems; in Georgia white ware clays occur in the Silurian rocks, refractory clays in the Ordovician and Silurian, and brick clays in the Cambrian, Silurian, and Carboniferous; in Alabama white ware, refractory, pottery, and brick clays are mined from the Cambrian, Silurian, and Carboniferous; in Arkansas several members of the Carboniferous supply material for pottery; in Oklahoma the Silurian furnishes clays for vitrified products, and the Silurian and Carboniferous systems furnish clays for brick and tile; in Texas the Carboniferous supplies clays for pottery and vitrified products; in Ohio refractory material occurs in the Devonian and Carboniferous, pottery clays in the Carboniferous, vitrifying clays in the Devonian, Silurian, and Carboniferous, and brick material in the Ordovician, Silurian, and Devonian; in Michigan the Carboniferous contains clays suitable for refractory and vitrified products, and with the Devonian supplies brick clays; in Kentucky white ware and refractory clays are obtained from the Carboniferous, pottery clays from the Cambrian, Ordovician, Silurian, and Carboniferous, and vitrifying clays from the Ordovician, Silurian, and Carboniferous; in Indiana the Carboniferous contains clays for white ware, refractory ware, pottery, and vitrified products; in Illinois the Carboniferous clays are used for vitrified and refractory products, and with those of the Ordovician supply material for pottery and brick; in Minnesota vitrifying clays are obtained from the Ordovician; in Iowa pottery clays are found in the Ordovician, vitrifying clays from the Ordovician and Carboniferous, and brick material from the Devonian and Carboniferous; in Missouri white ware clays are found in the Cambrian, Ordovician, and Carboniferous, and refractory and vitrifying clays in the Ordovician and Carboniferous; in Nebraska and Kansas clay suitable for vitrified products is obtained from the Carboniferous; in Arizona a little refractory material is obtained from Cambrian limestone; in Utah the Carboniferous contains some white ware clays, and with the Cambrian furnishes refractory material.

MESOZOIC ERA.

In Massachusetts the Cretaceous rocks contain material suitable for pottery and brick; in New York the Cretaceous rocks supply clays for refractory, vitrified, and brick material; in New Jersey refractory pottery and vitrifying clays occur in the Cretaceous, and brick clays are obtained from both the Triassic and the Cretaceous; in Delaware the Cretaceous rocks supply material suitable for white ware, refractory, and vitrified products; in Maryland refractory and pottery clays are mined from the Triassic, and vitrifying clays are found both in the Triassic and the Cretaceous; in Virginia the Cretaceous rocks furnish clay suitable for brick; in South Carolina and in Georgia Cretaceous clays are used for white ware, refractory, and pottery products, and in Georgia the Cretaceous also contains clays used for vitrifying purposes; in Alabama refractory pottery and vitrifying clays are obtained from the Cretaceous; in Mississippi the Cretaceous contains refractory and vitrifying clays; in Arkansas, some of the rocks of this period furnish kaolin; in Texas white ware and refractory clays occur in the Cretaceous; in Kentucky the Cretaceous rocks contain refractory and vitrifying clays; in Minnesota vitrifying clays occur in the Cretaceous; in Iowa the Cretaceous contains clays suitable for pottery and vitrified products; in South Dakota refractory pottery and vitrifying clays occur in the Cretaceous; in Nebraska clays from the Cretaceous are used in making pottery and brick; in Montana Cretaceous rocks carry refractory clays; in Colorado the upper part of the Cretaceous carries refractory and vitrifying clays; and the Cretaceous of New Mexico contains refractory clays.

CENOZOIC ERA.

Under this heading is included recent débris from older rocks so that the area overlain by Cenozoic material is larger than that of any other time division. It includes the glacial débris throughout the northern States, and broad stretches of alluvium south of the terminal moraine. Ordinarily the clays are of low grade and suitable for the cheaper products only, but in some places they are white burning, refractory, or suitable for pottery.

In Massachusetts the Quaternary sediments are suitable for vitrified, refractory, and brick products, and with the Tertiary sediments are also used for pottery; in Rhode Island the Quaternary deposits are used for brick; in New York the Tertiary rocks furnish refractory material, and with the Quaternary contain vitrifying clays, and the Quaternary carries brick and the well-known "Albany slip clays;" in Pennsylvania the Quaternary supplies refractory and pottery material; in New Jersey vitrifying clays occurs in the Tertiary and Quaternary and brick clay in the Tertiary; in Maryland some refractory clay is found in the Quaternary and vitrifying clay in both the Tertiary and Quaternary; in Virginia refractory clays are obtained from the Tertiary and Quaternary, and pottery, vitrifying, and brick clays are mined from the Tertiary; in Tennessee the Tertiary rocks supply material for white ware, refractory, pottery, and vitrified products; in North Carolina the Quaternary deposits are used for pottery, stoneware, and bricks; in South Carolina the Quaternary deposits supply material for pottery; in Georgia some Tertiary material is available for white ware, both Tertiary and Quaternary for vitrified products, and brick clay is obtained from the Quaternary; in Alabama refractory material is found in the Tertiary; in Mississippi Tertiary clays are used for refractory, vitrified, and pottery products; in Florida the white-ware clays are from the Tertiary; in Arkansas the Tertiary is used for pottery; in Louisiana the vitrifying clays occur in the early Quaternary (Pleistocene) deposits; in Texas white-ware clay is obtained from the Tertiary vitrifying clay from the Tertiary and Quaternary, and some slip clay from the Pleistocene; in Ohio refractory and vitrifying clays are obtained from the Quaternary; in Michigan vitrifying, pottery, and slip clays are mined from the Quaternary; in Kentucky the Tertiary rocks supply clay for white ware, refractory, vitrified, and pottery products; in Indiana vitrifying clay occurs in the Quaternary; in Illinois refractory and pottery material is obtained from the Tertiary, and the Quaternary supplies clay for pottery, vitrified and brick products; in Wisconsin clays for white ware and vitrified products are mined from the Quaternary; in Missouri the Quaternary supplies material for vitrified products; in South Dakota refractory and pottery clays are obtained from the Tertiary and vitrifying clay from the Quaternary; in Washington and Colorado refractory and vitrifying clay is obtained from the Tertiary; in California pottery clay is mined from the Tertiary. In addition it should be stated here that enough Quaternary clay is present in nearly every State to supply the demand for brick and other cheap clay products, and in most instances, this material is obtainable near the larger markets.

SURVEY PUBLICATIONS ON CLAYS, FULLER'S EARTH, ETC.

In addition to the papers named below, certain of the geologic folios also contain references to clays, fuller's earth, etc.

These publications, except those to which a price is affixed or which are out of print, can be obtained free by applying to the Director, United States Geological Survey, Washington, D. C. The priced publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.

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SAND AND GRAVEL.

By Ralph W. Stone.

PRODUCTION.

The total production of sand and gravel in the United States in 1912 reported to the United States Geological Survey by producers was 68,354,561 short tons, valued at $23,113,208, as compared with 66,846,959 short tons, valued at $21,158,583, in 1911, a net increase in quantity of 1,507,602 short tons and in value of $1,954,625 over the production of 1911. Sand for building purposes constitutes about one-third of the total production. In 1912 the production of building sand was 23,776,013 short tons, valued at $7,968,127, as compared with 24,614,342 short tons, valued at $7,719,286, in 1911, a decrease in production of 838,329 short tons, but an increase in value of $248,841 over the production of 1911. The average value of building sand per ton increased from 31 cents in 1911 to 33½ cents in 1912. As there can be no appreciable diminution of the supply of building sand in this country in many years, the most plausible explanation of this increase in value must be higher wages paid to laborers. As 1912 was a year of prosperity and building was brisk, the writer is at a loss to account for the falling off in production of building sand of more than 1,000,000 tons.

The tonnage of gravel produced exceeds that of sand. The total production of gravel used for concrete, paving, filter beds, roofing, road-making, railroad ballast, and other purposes in 1912 was 29,771,585 short tons, valued at $7,741,017, in comparison with 26,592,982 short tons, valued at $6,720,083, produced in 1911, an increase in quantity of 3,178,603 short tons and in value of $1,020,934. These figures show an increase in average cost per ton of gravel from approximately 25 cents to 26 cents. Although in all probability wages paid to laborers have increased and tended to raise the cost of gravel, it is believed that the introduction of machinery during the year 1912 tended to reduce the average cost per ton, and hence the average value has changed but little.

Molding sand, which ranks second in quantity and value of production, broke all records in 1912, having for the first time exceeded 4,000,000 tons and passed the two and one-half million dollar mark. The production in 1912 was 4,485,380 short tons, valued at $2,718,726, as compared with 3,376,717 short tons, valued at $2,132,469, in 1911, an increase in quantity of 1,108,663 short tons and in value of $586,257.

The quantity and value of glass sand produced in 1912 was lower than in the two preceding years. The production amounted to 1,465,386 short tons, valued at $1,430,471, as compared with 1,538,666 short tons, valued at $1,543,733, in 1911, a net decrease in quantity of 73,280 short tons and in value of $113,262. The glass industry was progressive in 1912, for building operations throughout the country made a steady demand for window and plate glass. Many glass factories, however, were hindered in operation by a shortage of small help, and some plants had to lay off blowers because enough boys could not be procured. This labor difficulty made the output of glass less than it would have been under more favorable circumstances and may account in part at least for the decreased production of glass sand. The average value of glass sand per ton was a fraction of a cent over $0.96 in 1912 and slightly over $1.01 in 1911. It was slightly less than $1.04 in 1910 and than $1.05 in 1909.

Grinding and polishing sand had a good market in 1912. The production was 1,285,863 short tons, valued at $632,136, as compared with 938,628 short tons, valued at $521,761, in 1911, an increase in quantity of 347,235 short tons and in value of $110,375. Engine sand likewise showed an increase for the year, as it is likely to do annually so long as rail transportation continues to expand. The figures for 1912 are 1,288,616 short tons, valued at $428,986, an increase of 158,623 short tons and in value of $17,678 over 1911, when 1,129,993 short tons, valued at $411,308, were produced.

In 1911 the production of fire sand and furnace sand amounted to 672,140 short tons, valued at $347,733, and in 1912 to 506,900 short tons, valued at $346,000. This represents a decrease in quantity of 165,240 short tons and in value of $1,733 in 1912. Paving sand also was used in smaller quantity in 1912 by 156,042 short tons, but the value nevertheless was greater by $19,071 than in 1911. The figures are 1,788,530 short tons, valued at $670,680, in 1912, and 1,944,572 short tons, valued at $651,609, in 1911.

The gravel figures for 1912 do not include, as they did in 1910, a considerable quantity of chats or tailings from the Missouri zinc mines and of chert used for road building in Alabama and Tennessee. The productions of chats in Missouri in 1912, as reported by the Missouri Bureau of Geology and Mines, was 2,723,403 tons.

The unit of measurement given in the following tables of production is the short ton. Much of the sand is reported as sold by the cubic yard, a cubic yard varying in weight from 2,300 to 3,000 pounds according to the condition of the sand, according to the material of which the gravel is composed, and according to the custom of the locality. All of the glass sand is sold by the short ton, and also a considerable quantity of the molding, building, and other sand; hence the quantities reported were all reduced to this unit.

The following table gives the total production of sand and gravel in the United States in each of the last 10 years:

Quantity and value of sand and gravel produced in the United States, 1903–1912, in short tons.

Years.	Sand and gravel.	
	Quantity.	Value.
1903	2,110,660	[a] $1,831,210
1904	10,679,728	[a] 5,748,099
1905	23,204,967	11,223,645
1906	32,932,002	12,698,208
1907	41,851,918	14,492,069
1908	37,216,044	13,270,032
1909	59,565,551	18,336,990
1910	69,410,436	21,037,630
1911	66,846,959	21,158,583
1912	68,354,561	23,113,208

[a] Includes a very small quantity of gravel.

The following table gives the total production of glass sand in the United States in each of the last 10 years:

Quantity and value of glass sand produced in the United States, 1903–1912, in short tons.

Years.	Glass sand.	
	Quantity.	Value.
1903	823,044	$855,828
1904	858,719	796,492
1905	1,060,334	1,107,730
1906	1,089,430	1,208,788
1907	1,187,296	1,250,067
1908	1,093,553	1,134,599
1909	1,104,000	1,163,375
1910	1,461,089	1,516,711
1911	1,538,666	1,543,733
1912	1,465,386	1,430,471

The following table gives the production of molding sand in the United States in each of the last nine years, or since 1904, when the first statistics of molding sand were collected:

Quantity and value of molding sand produced in the United States, 1904–1912, in short tons.

Year.	Molding sand.	
	Quantity.	Value.
1904	3,439,214	$2,125,370
1905	3,084,098	2,102,423
1906	3,371,103	2,063,151
1907	3,682,494	2,460,754
1908	1,980,677	1,342,802
1909	3,122,806	2,146,220
1910	3,636,167	2,431,254
1911	3,376,717	2,132,469
1912	4,485,380	2,718,726

The tables following give the production of the various kinds of sand and the production of gravel by States in 1911 and 1912.

Production of sand and gravel in the United States in 1911 and 1912, by States and uses, in short tons.

1911.

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire sand.		Engine sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			52,766	$19,432	201,214	$70,284	(a)	(a)			(a)	(a)
Arizona					(a)	(a)			(a)	(a)		
Arkansas			197	170	129,271	42,813					32,865	$7,277
California	(a)	(a)	14,153	14,757	371,681	123,565	(a)	(a)	(a)	(a)	19,695	9,556
Colorado			7,195	2,492	45,379	23,404					46,171	2,780
Connecticut			1,335	2,465	18,825	7,990						
Delaware					66,904	33,672	(a)	(a)	(a)	(a)	(a)	(a)
Florida	(a)	(a)	69,745	7,978	41,482	22,704	(a)	(a)				
Georgia	(a)	(a)	14,684	6,879	283,456	105,231					16,540	3,828
Idaho					(a)	(a)						
Illinois	251,907	$171,978	237,359	120,690	1,875,814	691,846	59,880	$41,765	36,090	$15,141	46,897	6,158
Indiana	(a)	(a)	156,993	56,777	2,002,159	409,586	53,047	5,335	(a)	(a)	174,407	58,676
Iowa	(a)	(a)	5,271	4,582	718,078	226,675			(a)	(a)	19,713	5,527
Kansas	(a)	(a)	(a)	(a)	244,376	61,727					143,135	25,947
Kentucky	(a)	(a)	24,222	24,426	463,430	210,551	(a)	(a)	(a)	(a)	(a)	(a)
Louisiana					145,079	78,305					(a)	(a)
Maine					26,432	23,302						
Maryland	(a)	(a)	1,422	3,307	311,079	134,134	(a)	(a)			22,445	18,187
Massachusetts	(a)	(a)	9,629	7,899	217,837	135,930			(a)	(a)		
Michigan	(a)	(a)	68,878	17,901	833,729	247,997	(a)	(a)	(a)	(a)	(a)	(a)
Minnesota			27,007	23,731	367,648	78,255					7,734	1,451
Mississippi	(a)	(a)	8,264	3,416	151,650	62,230	(a)	(a)			(a)	(a)
Missouri	117,756	82,705	92,679	49,522	1,983,751	533,722	101,239	55,884	6,689	2,371	33,850	14,000
Montana					(a)	(a)						
Nebraska					629,173	107,955					(a)	(a)
Nevada					(a)	(a)					(a)	(a)
New Jersey	91,530	68,549	715,654	392,840	1,501,951	242,659	(a)	(a)	64,977	67,503	45,743	12,310
New Mexico					5,475	2,165	(a)	(a)			(a)	(a)
New York			505,256	421,503	4,750,927	1,105,618	5,770	2,693	21,105	9,855	18,953	8,264
North Carolina			784	685	5,957	2,678					(a)	(a)
North Dakota					8,136	5,680						
Ohio	119,991	125,576	533,163	394,145	2,235,333	786,360	9,633	12,220	15,211	12,612	47,621	16,523
Oklahoma			(a)	(a)	104,353	37,481					(a)	(a)
Oregon					397,614	222,116						
Pennsylvania	478,089	668,247	657,197	451,779	2,072,830	882,516	500,604	326,490	37,638	33,238	167,203	110,017
South Carolina	(a)	(a)	(a)	(a)	1,484	997	(a)	(a)			(a)	(a)
South Dakota			(a)	(a)	24,402	11,030	1,324	555			(a)	(a)
Tennessee	(a)	(a)	17,156	10,703	429,793	212,979	12,320	5,800			34,656	10,556
Texas	(a)	(a)	3,406	2,857	381,564	217,614	(a)	(a)	(a)	(a)	18,410	2,858

Utah			405	100	9,463	3,375	900	465	(a)	(a)	(a)	(a)
Vermont			(a)	(a)	(a)	(a)	(a)	(a)				
Virginia	(a)	(a)	41,533	18,303	216,756	98,675			(a)	(a)	7,843	3,220
Washington			(a)	(a)	293,029	84,438					(a)	(a)
West Virginia	268,368	313,758	2,267	1,620	205,194	93,037			(a)	(a)	29,949	20,606
Wisconsin	(a)	(a)	90,723	59,009	774,045	245,879	(a)	(a)	(a)	(a)	25,650	3,668
Wyoming					(a)	(a)					(a)	(a)
Concealed totals	211,025	112,920	17,374	12,501	67,589	32,111	193,911	70,554	31,813	17,304	170,513	69;899
Total	1,538,666	1,543,733	3,376,717	2,132,469	24,614,342	7,719,286	938,628	521,761	213,523	158,024	1,129,993	411,308

State.	Furnace sand.		Paving sand.		Other sands.		Total production of sand.		Gravel.		Grand total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	36,540	$7,738	10,975	$3,635	14,988	$7,391	356,293	$119,758	321,601	$95,655	677,894	$215,413
Arizona							30,387	b 22,215			30,387	22,215
Arkansas			48,830	12,900	(a)	(a)	279,303	73,508	728,286	110,389	1,007,589	183,897
California			35,412	12,601	48,216	16,730	501,473	187,462	1,410,179	229,518	1,911,652	416,980
Colorado	(a)	(a)	31,249	2,032	9,132	2,781	148,360	37,196	99,306	28,170	247,666	65,366
Connecticut					(a)	(a)	20,270	10,559			20,270	10,559
Delaware	58,553	25,911					137,205	65,813			137,205	65,813
Florida					(a)	(a)	112,776	33,339			112,776	33,339
Georgia			5,083	1,156	108,245	22,159	434,608	145,193	84,277	30,541	518,885	175,734
Idaho											(c)	(c)
Illinois	26,017	10,502	318,671	125,624	1,862,000	164,292	4,714,635	1,347,996	3,774,048	642,926	8,488,683	1,990,922
Indiana	142,163	14,390	54,361	23,578	1,713,078	153,584	4,430,060	751,090	1,603,099	382,739	6,033,159	1,133,829
Iowa	(a)	(a)	47,819	13,579	80,191	12,143	883,117	268,626	465,887	125,023	1,349,004	393,649
Kansas			(a)	(a)	189,401	38,148	(a)	(a)	(a)	(a)	734,507	164,058
Kentucky	9,927	4,410	4,975	2,875	28,279	15,603	546,631	268,350	360,274	121,218	906,905	389,568
Louisiana			(a)	(a)	261,570	42,413	421,114	123,326	548,145	220,955	969,259	344,281
Maine					(a)	(a)	(a)	(a)	(a)	(a)	33,308	30,088
Maryland			4,188	1,333	(a)	(a)	364,132	176,416	118,020	70,070	482,152	246,486
Massachusetts	(a)	(a)	14,485	11,455	33,547	6,418	281,603	167,433	92,723	55,389	374,326	222,822
Michigan	(a)	(a)	152,144	29,650	55,149	10,751	1,250,093	362,751	935,072	203,218	2,185,165	565,969
Minnesota			39,350	6,730	97,087	20,281	538,826	130,448	983,469	269,532	1,522,295	399,980
Mississippi			(a)	(a)	58,463	31,383	275,933	141,910	355,151	144,296	631,084	286,206
Missouri	(a)	(a)	41,610	15,364	79,770	27,293	2,460,212	783,411	1,145,701	259,263	3,605,913	1,042,674
Montana							(a)	(a)	(a)	(a)	5,143	2,461
Nebraska			122,246	20,044	33,219	3,879	789,349	132,149	68,939	24,628	858,288	156,777
Nevada							(a)	(a)	(a)	(a)	223,510	33,591
New Jersey	6,895	6,991	157,861	40,912	49,699	27,668	2,635,710	860,732	717,055	198,194	3,352,765	1,058,926
New Mexico							7,770	3,555	259,845	15,219	267,615	18,774
New York	(a)	(a)	82,720	46,818	172,580	95,282	5,561,410	1,691,328	1,976,168	723,124	7,537,578	2,414,452

a Production of States having less than three producers is included under "Concealed totals."

b Includes building sand from Idaho.

c Included in Arizona.

Production of sand and gravel in the United States in 1911 and 1912, by States and uses, in short tons—Continued.

1911.

State.	Furnace sand.		Paving sand.		Other sands.		Total production of sand.		Gravel.		Grand total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
North Carolina			(a)	(a)	74,320	$40,475	(a)	(a)	(a)	(a)	251,977	$93,336
North Dakota					(a)	(a)	8,406	$5,710	14,754	$10,085	23,160	15,795
Ohio	66,760	$59,790	105,073	$38,901	147,347	59,929	3,280,132	1,506,056	2,001,505	598,720	5,281,637	2,104,776
Oklahoma			15,989	5,382	(a)	(a)	128,124	45,855	163,300	51,684	291,424	97,539
Oregon					498,921	136,191	896,535	358,307	541,969	301,110	1,438,504	659,417
Pennsylvania	53,015	28,884	259,121	88,992	85,968	84,861	4,311,665	2,675,024	1,377,394	350,243	5,689,059	3,025,267
South Carolina							(a)	(a)	(a)	(a)	227,612	30,303
South Dakota					6,589	2,660	33,268	14,395	59,489	26,891	92,757	41,286
Tennessee	8,661	2,325	16,688	8,876	8,925	2,725	529,649	255,014	587,660	263,528	1,117,309	518,542
Texas			46,130	28,000	20,530	5,772	470,873	257,897	577,479	285,969	1,048,352	543,866
Utah			13,480	8,060	5,263	1,375	40,736	16,185	104,121	9,704	144,857	25,889
Vermont							(a)	(a)	(a)	(a)	104,852	52,540
Virginia	10,730	6,270	11,956	4,275	23,500	3,775	315,558	137,748	238,438	66,422	553,996	204,170
Washington			(a)	(a)			396,454	136,074	748,915	202,326	1,145,369	338,400
West Virginia	(a)	(a)	35,485	9,743	95,003	38,295	641,281	478,569	108,110	53,819	749,391	532,388
Wisconsin	(a)	(a)	6,418	3,988	101,430	20,255	1,107,303	345,996	2,659,552	385,696	3,676,855	731,692
Wyoming							(a)	(a)	(a)	(a)	784,865	58,548
Concealed totals	39,356	22,498	238,716	66,466	76,509	16,089	1,046,806	420,141	1,363,051	163,819		
Total	458,617	189,709	1,944,572	651,609	6,038,919	1,110,601	40,253,977	14,438,500	26,592,982	6,720,083	66,846,959	21,158,583

a Production of States having less than three producers is included under "Concealed totals."

Production of sand and gravel in the United States in 1911 and 1912, by States and uses, in short tons—Continued.

1912.

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire sand.		Engine sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	(a)	(a)	51,107	$25,284	205,498	$66,586	(a)	(a)	(a)	(a)	(a)	(a)
Arizona					(a)	(a)						
Arkansas			291	291	266,994	108,909						
California	9,535	$8,664	41,302	22,458	332,980	134,168	(a)	(a)	(a)	(a)	28,043	$5,442
Colorado			17,283	5,906	27,220	8,822			(a)	(a)	12,606	5,303
Connecticut			(a)	(a)	20,604	7,585						
Delaware			(a)	(a)	(a)	(a)			(a)	(a)	(a)	(a)
Florida					(a)	(a)					(a)	(a)
Georgia	(a)	(a)	(a)	(a)	304,882	116,614					10,245	2,640
Idaho					(a)	(a)						
Illinois	323,467	225,434	540,728	268,521	1,910,911	598,884	67,040	$49,196	(a)	(a)	59,151	12,916
Indiana	26,040	10,641	243,766	66,620	1,461,689	411,480	247,769	3,889	(a)	(a)	142,060	27,016
Iowa			4,016	3,572	1,011,672	328,882			(a)	(a)	16,456	4,556
Kansas					880,717	178,630					(a)	(a)
Kentucky	(a)	(a)	29,169	27,850	423,389	196,302	(a)	(a)	5,120	$3,589	5,250	3,410
Louisiana	(a)	(a)			90,608	13,263					(a)	(a)
Maine					12,372	10,461						
Maryland	(a)	(a)	(a)	(a)	798,720	285,446	(a)	(a)	(a)	(a)	(a)	(a)
Massachusetts	(a)	(a)	18,575	9,313	150,217	57,315						
Michigan	(a)	(a)	152,433	40,145	902,556	94,115	(a)	(a)			18,575	4,774
Minnesota			15,738	8,673	220,889	82,098	(a)	(a)			(a)	(a)
Mississippi					319,193	119,453					140,584	51,551
Missouri	129,030	81,817	106,983	71,366	1,817,110	521,164	(a)	(a)	(a)	(a)	24,335	5,478
Montana					(a)	(a)						
Nebraska			4,097	1,826	751,233	229,452					2,305	405
New Jersey	102,782	79,027	459,397	279,948	1,425,861	316,435	95,690	47,854	105,843	97,841	55,344	22,077
New Mexico					(a)	(a)						
New York	(a)	(a)	584,314	469,116	4,125,271	1,154,062	(a)	(a)	(a)	(a)	33.975	17,964
North Carolina			2,138	1,204	(a)	(a)	(a)	(a)			(a)	(a)
North Dakota					9,903	7,232					(a)	(a)
Ohio	154,527	164,462	1,186,710	649,896	1,647,508	629,174	17,493	32,280	75,789	47,361	51,940	27,967
Oklahoma					265,596	100,685					(a)	(a)
Oregon					335,980	183,629						
Pennsylvania	427,936	517,383	792,150	627,532	1,648,996	789,819	679,155	399,881	150,068	111,023	128,162	78,671
South Carolina	(a)	(a)	12,355	2,015	(a)	(a)	(a)	(a)				
South Dakota					32,288	15,667					(a)	(a)

a Included in "Concealed totals."

Production of sand and gravel in the United States in 1911 and 1912, by States and uses, in short tons—Continued.

1912—Continued.

State.	Glass sand.		Molding sand.		Building Sand.		Grinding and polishing sand.		Fire sand.		Engine sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value	Quantity.	Value.	Quantity.	Value.
Tennessee	(a)	(a)	36,200	$15,014	363,973	$163,036	(a)	(a)	(a)	(a)	72,371	$18,129
Texas			3,135	4,050	290,675	181,617	(a)	(a)			(a)	(a)
Utah					28,668	10,595	(a)	(a)			(a)	(a)
Vermont			(a)	(a)	(a)	(a)						
Virginia	(a)	(a)	21,701	11,746	374,894	164,456	(a)	(a)	8,046	$4,851	20,205	9,091
Washington			(a)	(a)	259,270	74,394					1,943	825
West Virginia	244,881	$287,038	28,303	24,999	171,269	81,019	(a)	(a)	(a)	(a)	60,442	34,182
Wisconsin	(a)	(a)	77,026	49,599	744,182	234,441	(a)	(a)	(a)	(a)	202,720	37,560
Wyoming					(a)	(a)					(a)	(a)
Concealed totals	47,188	56,005	56,441	31,754	109,768	63,745	290,520	$134,650	110,588	54,077	201,774	58,971
Total	1,465,386	1,430,471	4,485,380	2,718,726	23,776,013	7,968,127	1,285,863	632,136	455,454	318,742	1,288,616	428,986

State.	Furnace sand.		Paving sand.		Other sands.		Gravel.		Grand total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			37,801	$14,997	(a)	(a)	497,832	$140,861	852,943	$268,111
Arizona									(a)	(a)
Arkansas			7,383	4,093	27,398	$7,438	915,674	272,908	1,217,740	393,639
California			19,767	11,554	100,354	37,521	1,652,397	293,728	2,189,432	518,516
Colorado			24,380	16,930			31,020	9,015	112,514	45,983
Connecticut					(a)	(a)			20,823	7,805
Delaware	(a)	(a)							129,157	62,047
Florida			(a)	(a)			97,394	11,922	115,450	21,050
Georgia			5,725	1,575	1,500	750	86,540	37,554	445,122	171,129
Hawaii					(a)	(a)	(a)	(a)	(a)	(a)
Idaho			(a)	(a)			(a)	(a)	(a)	(a)
Illinois			30,581	13,958	499,685	75,391	3,481,638	664,552	6,957,901	1,929,822
Indiana			93,346	39,152	232,180	40,610	2,252,065	574,292	4,701,005	1,175,370
Iowa			45,408	11,360	380,958	54,083	768,105	157,856	2,231,615	562,809
Kansas			274,492	57,996	139,049	31,092	18,420	3,744	1,381,586	287,352
Kentucky			16,754	11,822	10,329	12,311	282,906	131,105	778,241	391,477

Louisiana					112,625	89,102	722,266	313,559	933,617	417,041
Maine							(a)	(a)	34,372	26,961
Maryland			(a)	(a)			807,295	305,871	1,650,904	627,874
Massachusetts	(a)	(a)	11,499	5,610	3,027	3,036	230,179	74,966	424,375	162,208
Michigan			68,453	16,898	115,624	29,746	1,409,180	407,925	2,681,821	818,603
Minnesota			(a)	(a)	18,936	12,525	643,117	164,698	946,339	278,578
Mississippi			2,279	763	(a)	(a)	1,452,802	269,116	2,124,288	512,688
Missouri			60,814	16,897	189,632	58,766	1,193,667	253,911	3,687,380	1,088,279
Montana			(a)	(a)			(a)	(a)	11,506	4,881
Nebraska			13,271	1,858	30,569	4,495	86,348	19,561	887,823	257,597
Nevada					(a)	(a)	(a)	(a)	(a)	(a)
New Jersey			168,233	35,883	55,706	47,218	776,911	220,357	3,245,767	1,146,640
New Mexico							123,812	29,085	125,872	29,963
New York			195,869	88,520	206,640	78,145	2,076,573	742,273	7,237,303	2,561,516
North Carolina			(a)	(a)	(a)	(a)	132,317	15,268	161,198	38,487
North Dakota							11,100	8,082	31,803	16,514
Ohio			145,554	59,540	152,270	83,488	2,442,621	610,800	5,874,412	2,304,968
Oklahoma			5,590	2,605	(a)	(a)	193,342	54,684	492,858	163,298
Oregon			(a)	(a)	(a)	(a)	605,193	243,912	1,067,634	499,030
Pennsylvania			304,288	134,604	457,153	255,695	1,921,425	456,905	6,509,333	3,371,513
South Carolina					(a)	(a)	(a)	(a)	104,965	14,846
South Dakota			(a)	(a)			510,539	52,871	545,622	69,348
Tennessee			16,985	12,925	56,981	29,982	620,800	270,201	1,181,967	516,298
Texas			(a)	(a)	21,595	5,470	380,213	186,480	716,468	384,942
Utah			6,600	4,543	(a)	(a)	29,132	9,447	76,850	28,595
Vermont					(a)	(a)	(a)	(a)	97,476	13,296
Virginia			(a)	(a)	9,595	4,279	235,302	87,472	689,266	291,773
Washington			90,211	39,240	(a)	(a)	665,757	226,180	1,020,841	345,289
West Virginia			41,318	24,808	19,425	3,650	262,538	56,001	849,864	530,025
Wisconsin			12,535	8,367	696,106	50,994	1,305,015	270,911	3,051,819	664,327
Wyoming			(a)	(a)	(a)	(a)	629,085	47,674	639,031	56,753
Concealed totals	51,446	$27,258	89,394	34,182	448,951	161,278	217,990	42,195	118,258	35,967
Total	51,446	27,258	1,788,530	670,680	3,986,288	1,177,065	29,771,585	7,741,017	68,354,561	23,113,208

a Included in "Concealed totals."

IMPORTS.

Sand valued at $141,690 was imported into the United States in 1912, as compared with imports valued at $147,268 in 1911 and at $133,757 in 1910.

This is largely building sand brought to the United States as ballast, or from Canada as a near source of supply, but includes a small quantity of French molding sand which comes to this country barreled in lump and is here ground and pulverized before marketing.

USES AND DEFINITIONS OF SAND.

Sand is defined as any hard, granular, rock material finer than gravel and coarser than dust. It may have been comminuted either naturally or artificially. Quartz grains generally predominate in natural deposits, although such deposits commonly contain many other minerals.

Gravel consists of small stones or pebbles, or a mixture of sand and small stones. Specifically it is fragments of rock worn by the action of wind and water, and larger and coarser than sand.

Sand is classified in various ways: (1) By size, as fine, medium, and coarse; by composition, as siliceous, calcareous, ferruginous; (2) by origin, as eolian, river, glacial, lake, beach; (3) by use, as glass, engine, molding, and filter. Classification by use is the one by which the United States Geological Survey tabulates statistics of production. It should be borne in mind that the same sand in many cases answers for a variety of purposes, and in this case one and the same thing has several names. As an example, a New Jersey dune sand is sold to filtration plants for filter bed, to local masons for building or mortar sand, to foundrymen for core sand, and might be used for engine sand, paving sand, or other purposes. Gravel also assumes various names, depending on its use. One size of gravel is shipped from one plant for filter bed, sand blast, roofing, concrete, and asphalt paving. A high-grade silica sand is glass sand to a glassmaker, steel sand to a steel molder, grinding sand to a stonecutter, asphalt sand to a pavement contractor, facing sand to a concrete-block maker, and furnace sand to a foundryman.

The following definitions, alphabetically arranged, illustrate a few of the uses to which sand is put:

Asphalt sand is the term used by some producers to designate a clean siliceous sand of medium grain and sharpness used for mixing in the body and making the face of asphalt pavement and asphalt paving blocks.

Bedding sand is scattered over the floor of cattle cars for sanitary purposes. Any fine, clean sand is suitable.

Blast sand is clean, tough, sized sand, either round or angular grains, used by compressed air for such purposes as cleaning metal castings and dressing stone.

Brass sand is an exceedingly fine sand used in making molds for casting aluminum, brass, and bronze on which a very smooth surface is desired. It has a strong bond, but is so fine grained that its permeability is slight and care has to be taken to avoid "blowing."

Building sand is used for making mortar and concrete and sand-lime brick. For best results it should be siliceous, clean, free from salts, as sharp as can be obtained at a reasonable cost, dry, and should not contain more than 10 per cent by weight of clay or loamy material. Sand used for mortar should pass a No. 10 sieve and 80 per cent of it should be retained on a No. 74 sieve.

Core sand is a coarse molding sand used to make a solid form, usually porous, to be placed in a mold, about which the metal is poured, so as to be cast hollow. Permeability is the special quality required.

Engine sand is used on locomotives and street cars to keep the wheels from slipping on wet or slick rails. The principal requirements are that the sand be of hard minerals, preferably quartz, sharp, clean, dry, and fairly fine and even grained, so that it will run freely through the conductor pipe.

Facing sand is a molding sand used to make the face of the mold, the term being used when the material composing the face is different from the body of the mold. Sand used for facing the mold of a heavy casting may be equally well adapted for making all of the mold for a lighter casting.

Filter sand is clean silica sand in sorted sizes, used for beds in water-filtration plants and in small mechanical filters. It must be free from lime, clay, and organic matter.

Fire sand is a highly refractory silica sand, for lining furnaces and ladles used to contain molten metal; furnace sand is another name for the same thing.

French sand is a very fine, open, sharp, yellow sand imported from France for making molds for statuary, brass and bronze work.

Furnace sand is a highly refractory silica sand used for lining and patching reverberatory and other furnaces, cupolas, and ladles used to contain molten metal. As pure silica sand is noncohesive some binder is added to give bond. Furnace sand is also used for making runners for pig-iron casting.

Glass sand is the major constituent of glass, constituting from 52 to 65 per cent of the original mixture. As the quality of the glass depends largely on the quality of the sand, high-grade glass sands are over 99 per cent silica (SiO_2). Glass sand should be nearly white in color, of medium fineness (passing a 20 to 50 mesh horizontal sieve), the grains should be uniform in size, even, and angular, or, less preferably, they may be rounded.

Grinding and polishing sands are sharp, tough, hard sands free from clay or foreign material, and sized, for use in sawing, cutting, and polishing stone, and for grinding and etching glass. The size of the sand varies with the character of the material to be worked on and the kind of work to be done.

Molding sands are siliceous sandy materials used in foundries for making molds and cores for casting metal. They vary from loamy clay to clean silica sand or gravel, the character of the material used depending on the kind of metal to be poured, the size of the casting, the surface desired, and the place in the mold where the sand is to be used. Molding sands should be high in silica to be sufficiently refractory, should have a strong bond when moist, and should have less than 1 per cent of iron oxide. Some molding sands lack bond and are tempered by the addition of a small amount of clay or other binding material. Sand used for dusting brick molds to aid in separating the brick from the form is called molding sand, but should more properly be termed a "parting sand" to distinguish it from foundry molding sands.

Parting sand is a noncohesive sand with which the meeting faces of a mold are dusted to prevent their sticking together, and with which brick molds are dusted to aid in separating the form from the mold. It is a fine sand free from clay.

Paving sand is a designation applied to sand used in various ways in road and walk making. Besides the common use on country roads, sand is used for cushion foundation for brick pavement, as the body and facing of asphalt paving, as part of the composition of concrete and cement walks, as bedding for cobble pavement, and in other ways. For some of the uses almost any convenient sand is suitable, but for others special properties are required. See asphalt and building sand.

Railroad-ballast sand and gravel have usually but one requirement, bulk, although coherence is a desirable quality. Sand and gravel that will pack and set are preferable. For surfacing tracks gravel or crushed stone is used to reduce the amount of dust raised by passing trains, and in some places to keep the material from being carried away by high winds.

Silica sand is composed largely of quartz and is obtained from banks of unconsolidated material and by crushing sandstone. It is used for many purposes, including making glass, lining furnaces and ladles, molding steel, filters, facing concrete and asphalt, as an abrasive (both sand blast and sandpaper), and for fire brick, scouring soap, etc.

Steel sand is a molding sand used for casting steel. A high degree of refractoriness is required, and therefore a white clean quartz sand about 99½ per cent silica is used. As sand of this character has no bond, in order to make a mold with it a small quantity of silicous clay, molasses, or other material is added for binder. The size of grain used varies with the weight of the casting and the place occupied in the mold.

Torpedo sand is a trade term used locally in the Central States for a coarse building sand.

Other uses to which sand and gravel are put are for chicken grit, pebble dash, sandpaper, sanding woodwork, sand-lime brick, etc.

MOLDING SAND.

It is hoped that in 1914 some details can be published on the occurrence and production of molding sands in various States, perhaps with special reference to steel sand. Material for such a report is being collected.

Molding sand production is reported from 30 States. The large producers in order of rank are: Ohio, Pennsylvania, New York, and Illinois, with an output in 1912 of more than one-half million tons each. New Jersey takes fifth place with 459,397 tons, and Indiana is sixth, with 243,766 tons.

Foundry sand is an inclusive term for molding, core, and steel sands, all of which are properly described as molding sand because they are used in making molds for casting metal. Sand used to make a core in any particular mold differs so much from that employed in the rest of the mold that it is distinguished as core sand, while sand used as the core for a light casting may be equally well used for the mold of a heavier casting. Steel sands are so very different from ordinary molding sands that, although used for making a mold, they are given the more distinctive name.

The principal requisites of a molding sand are cohesiveness, refractoriness, texture, permeability, and durability. They may be discussed briefly as follows:

Cohesiveness is the quality of holding together. A slightly moistened molding sand tamped into a mold must hold together so strongly that when the pattern is removed the grains will stick together and preserve the shape of the pattern and also will resist the pressure of the molten metal when poured into the mold, and its corrosive action while flowing in. Many core sands and all steel sands are deficient in cohesiveness or bond and binder is supplied by the addition of clay, molasses, flour, or other material. Molding sands get their cohesiveness largely from the clayey material which they contain.

Refractoriness is infusibility or not melting when subjected to a high degree of heat. A molding sand must be so refractory that it will not melt or fuse and close the pores when molten metal comes in contact with it. The sand must remain sufficiently open to allow the gases to escape. Steel sand is subjected to so much higher heat than other molding sands that a very siliceous material is required, and therefore sand running above 97 per cent silica is used.

Texture in sand refers to the size of grain or percentage of grains of different sizes. This is an important quality in foundry sand, for it affects the cohesiveness and permeability, as well as determining to some extent the size and weight of casting that can be made and the character of the surface produced.

Permeability is the property which a sand possesses of allowing a gas or liquid to filter through it. This property depends on the size of the pores or open spaces between the sand grains. Porosity is the volume of pore space. This is not the same as permeability, for a sand having a few large open spaces through which a liquid or gas could easily escape may have only a small total pore space; on the other hand a sand may have a large total pore space but be almost impermeable on account of the small size of the pores. Permeability is decreased by tamping, and sands of different sized grains pack closer than those in which the grains are of the same size.

Durability in a molding sand is a desirable quality, especially when the sand used is expensive. A sand which dehydrates and loses its bond slowly or only after being used several times is preferred to one that burns out or becomes "dead" with one heating. Some sands can be used several times without treatment, and others can be used repeatedly by the addition of a small quantity of fresh sand.

Chemically, molding sands are siliceous and those used for iron work commonly contain 75 to 85 per cent silica, 5 to 13 per cent alumina, less than 5 per cent of iron oxide, rarely more than 4 per cent of combined water, and usually less than 2½ per cent of lime and magnesia. A higher percentage of iron and lime is not objectionable in a sand for brass molding.

As the principal requirement of a core sand is permeability and as a high alumina or clay sand fuses readily and stops the passage of gas or steam generated in casting, it follows that a core sand as a rule should be high in silica and low in alumina. While some sands and gravels in the raw state are adapted to use in cores of various sizes, it is common practice to make core sand by mixing ingredients. In many cases a highly refractory material suitable for a core sand is readily available and needs only the addition of a binder to make it usable. In the case of gravels for large cores, such as iron pipe, coherence or bond is obtained by the addition of loam, clay, or molding sand of strong bond. The permeability is sometimes increased by mixing rye straw in the core sand or by winding the core with rope made of swamp hay. In small cores it is customary to use coarse sand which insures sufficient permeability and to add to it a small quantity of clay or molasses water for bond.

The principal requirement of steel sand is refractoriness because the temperature of molten steel is considerably in excess of the temperature of molten iron or brass. In order to obtain sufficient refractoriness it is necessary to use almost chemically pure silica sand. The grain of the sand varies with the size of the casting and with the smoothness of surface desired. Ordinary glass sand, silica sand, and some furnace sands are adaptable to use in steel molding by the addition of a binder.

From the foregoing statements it will be seen that it is difficult to formulate a comprehensive definition of molding sand. The variety is great, ranging through many degrees of each of the required properties. Most molding sands are cohesive, some strongly so, but others are wholly lacking in this property and require the artificial addition of bonding material. Refractoriness varies from so low that a sand burns out with one using to so high that the sand can be used repeatedly. Permeability ranges widely and molding sands differ from coarse to exceedingly fine. The colors vary from white and yellow to brown and red.

Molding sand in place possesses for the most part relatively little intrinsic value. The cost of excavation and preparation makes the market value, to which must be added freight rates. Although many molders insist on sand from a particular locality, others are learning that sand equally well adapted to a special purpose can be obtained at several places. As a single example, molding sand for stove-plate work, which requires a smooth surface, is produced not only in the famous region of Albany, N. Y., but also at Zanesville, Ohio, Newport, Ky., and elsewhere. In some cases it is cheaper to screen or bolt a local sand to get the desired grade than it is to pay freight on sand from a distant locality.

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——— Standard testing sand; November 22, 1909, p. 31.
——— Gravel-washing plant of the Lake Shore Sand Co., near Algonquin, Ill.; December 22, 1909, p. 33.
——— Joliet Sand & Gravel Co.; January 22, 1910, p. 37.
——— New plant of the Washed Sand & Gravel Co., Minneapolis, Minn.; April 22, 1910, p. 34.
——— Novel sand and gravel plant; November 22, 1911, p. 3.
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GYPSUM.

By Ralph W. Stone.

DISTRIBUTION.

Gypsum deposits are widespread in the United States. This mineral, in quantity sufficient to be useful, is reported as occurring in the following States: Alabama, Arizona, Arkansas, California, Colorado, Florida, Iowa, Kansas, Louisiana, Michigan, Mississippi, Montana, Nevada, New Mexico, New York, Ohio, Oklahoma, Oregon, South Dakota, Texas, Utah, Virginia, and Wyoming. The producing localities east of Mississippi River are central and western New York, northern Ohio, two areas in the southern peninsula of Michigan, and southwestern Virginia. West of Mississippi River gypsum was mined in 13 States in 1912. It is also mined in southeastern Alaska and shipped to a mill at Tacoma, Wash.

CHARACTER.

Gypsum occurs in several varieties, commonly known as rock gypsum, alabaster, gypsite, satin spar, and selenite. It is characterized by softness in all varieties and by cleavage in the crystallized kinds. The hardness of gypsum is 2 as compared with talc, which is 1, and calcite which is 3, in the Mohs scale of hardness; in other words, it can be scratched with the finger nail. The crystalline forms cleave parallel to the principal plane into thin leaves or folia. Gypsum is characterized also by white streaks—that is, it makes a white powder when scratched, or leaves a white mark when rubbed on porcelain. It does not effervesce with acids like calcite, nor does it gelatinize. It yields much water when heated in a tube. A peculiar and distinctive property of gypsum is that if heated to a temperature of more than 222° F. and less than 400° F. much of the water will be driven off, and the resulting dehydrate will again combine with water and set.

Rock gypsum is the kind most commonly known and most extensively used. It is the gypsum of commerce, and occurs as a massive bedded deposit, generally made up of an intimate intergrowth of minute crystals. Rock gypsum is commonly white or pinkish when pure, and may be yellow or blue; but when impure has a dull or dark color, such as drab, gray, brown, earthy, or even black, depending on the character and amount of impurities present. Pure massive gypsum resembles white marble in texture and color.

Alabaster is a white or delicately tinted massive rock gypsum, suitable for sculptures and other ornamental purposes.

Gypsite or gypsum earth is an incoherent surface deposit of impure granular gypsiferous material consisting of small gypsum crystals mixed with quartz, lime carbonate, and organic matter. It is so soft that small animals and insects burrow through it.

Satin spar is a fibrous variety of gypsum consisting of an aggregate of parallel or radiating acicular crystals, white to colorless, and having pearly luster. It commonly occurs in veins which intersect bodies of massive gypsum or its inclosing rock.

Selenite is the crystalline form of gypsum and when pure is colorless and transparent. The common form of crystal is an irregular diamond or tabular parallelogram. The crystals are distinct, flattened or broad folia, often large. They cleave easily into thin, shiny leaves which are flexible, but break easily and are not elastic like mica. Selenite occurs also in curious curved forms and often is grouped in rosettes and other shapes. The crystals are sometimes twinned in the well-known swallowtail form.

Pure gypsum is a hydrated calcium sulphate having the chemical formula $CaSO_4.2H_2O$. This, when reduced to percentages of weight, corresponds to the following composition:

Gypsum ($CaSO_4.2H_2O$):
- Lime sulphate ($CaSO_4$): Lime (CaO) 32.6; Sulphur trioxide (SO_3) 46.5; total 79.1
- Water (H_2O) 20.9

Few deposits of rock gypsum large enough to be worked for plaster are, however, even approximately as pure as this. Gypsum, as excavated for making plaster, will usually carry varying and often high percentages of such impurities as clay, limestone, magnesian limestone, quartz, and iron oxide. The earthy, granular material known as gypsite may carry 10 to 30 per cent of impurities.

Analyses.—The following analyses of rock gypsum and gypsite from various localities [1] are fairly representative of the materials used for plaster in different States. Silica, alumina, iron oxide, calcium 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.

Associated with gypsum is the mineral anhydrite, or anhydrous calcium sulphate, $CaSO_4$. It is often found interbedded with deposits of gypsum. On account of its composition it lacks the property of setting with water and its presence is consequently a disadvantage to the deposit of gypsum with which it is associated.

[1] Eckel, E. C., Cements, limes, and plasters, Wiley & Sons, 1905, pp. 53–54.

OCCURRENCE.

Gypsum commonly occurs as an extensive bedded deposit interstratified with limestone, marl, or clay beds. It is deposited in the evaporation of sea water and brines, in which it exists in solution. It is also a product of volcanoes, being formed around fumaroles; and it is produced by the decomposition of pyrite in the presence of lime.

Selenite is found in isolated crystals and in crystal groups in caves, in clay beds, and particularly in the Cretaceous clays and shales of the western United States. The following forms of deposits are recognized: Efflorescent, periodic-lake, interbedded, vein, and isolated crystals.

Efflorescent deposits are formed by the evaporation of water that has percolated through gypsiferous sandstones or shales, or water contained in porous gypsiferous rocks drawn to the surface by capilarity. Gypsum thus formed is the variety known as gypsite. It is buff or creamy to rust-colored, soft, and easily crumbled in the hands. The deposits are thin, soil covered, and easily worked with pick and shovel, or plowed and handled with horse scraper. Under the microscope it is seen to be made up of thin plates of crystalline gypsum.

Periodic-lake deposits are formed by the crystallization of gypsum from the water of intermittent shallow lakes. The material is generally granular and crystalline, particles ranging from minute specks to grains one-fourth inch broad and thin in proportion. The deposits are formed principally around the shore, as the shallow water near the shore line is more highly saturated than the deeper water, and the hot sun evaporates a great quantity of water from the shore itself which is formed of fine porous silt.

Interbedded deposits are formed by deposition of gypsum from solution in sea water, a process which has resulted in the formation in some places, as in New York, Texas, Wyoming, and other States, of beds ranging from a few feet to 20 or 30 feet in thickness and many miles in extent. The beds are usually interstratified with shales, limestones, or clay.

Veins are formed where jointing or fissuring has opened passageways for water through gypsum-bearing beds. Circulating water carrying gypsum in solution deposits commonly in the form of selenite and satin spar. These veins and seams are clearly of later origin as they cut across beds of gypsum.

Isolated crystals of selenite are found in some caves in more or less abundance, and occur abundantly in some carbonaceous shales, as in the Cretaceous formations of the Western States.

GYPSUM PRODUCTS.

The bulk of the gypsum produced in the United States as well as in foreign countries is manufactured by grinding and partial or complete calcination into the various plasters, such as plaster of Paris, molding and casting plaster, stucco, cement plaster, flooring plaster, hard-finish plaster, etc. Refined grades of plaster are used in dental work, also as cement for plate glass during grinding, for making pottery molds, stereotype molds, molds for rubber stamps, and as an ingredient in various patent cements. A steadily increasing quantity is being used in the raw state as a retarder in Portland cement. Considerable quantities are ground without burning and used as land plaster or fertilizer; smaller quantities are used in the manufacture of paint, wall tints, crayons, 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, less, however, in this country than abroad.

For plaster of Paris and for dental molding and casting plasters a high grade of rock gypsum, ground very fine, is required, and the product is not mixed with any foreign substance or retarder, but is used in the pure or ''neat'' condition. Such plasters are quick setting and usually white in color. Much of the so-called cement plaster is made directly from gypsite, an impure unconsolidated earthy or sandy form of gypsum, which in many places is found to contain a suitable percentage of foreign material, so that the addition of a retarder is not necessary to effect a slow set. Where gypsite deposits are not available, cement plasters are made from rock gypsum by the addition of various mineral or organic retarders. A large part of the structural plaster now produced is used in specially prepared conditions that appeal to the builder on account of their convenience. A plaster board is pressed from plaster interlaminated with sheets of thin cardboard or wood. This plaster board is furnished in thin sheets, 32 by 36 inches, comprising 8 square feet of surface, and is designed to be nailed directly to the studding in place of lath, and to receive a coat of wall plaster directly on its outer surface. Fibered plaster is molded into both solid and hollow blocks and tiles, which are used in partitions and interior construction, and these, as well as the plaster board, have been proved to be of value as fire retarders.

The employment of gypsum wall plasters in place of lime plasters is a development of the last few years which is assuming noteworthy proportions. It now represents the most important single application of gypsum in this country. Hard wall plasters consist of plaster of Paris and some fiber like hair or wood fiber, with the addition of a retarder. These plasters are of two general grades, one a brown or gray coat and the other a white or tinted finish coat. The advantages claimed for them over lime plasters include more rapid set, less shrinkage on drying, and ability to unite with coloring agents so as to produce any desired tint. On the other hand they are somewhat more expensive than lime and inferior to it in deadening sound.

A number of hard-finish, anhydrous plasters are also made from gypsum, the most prominent representative of the group being Keenes cement, which was originally manufactured under English patents that have expired. The name ''Keenes'' is now applied by several manufacturers in the United States to their product, made by calcining very pure rock gypsum in lump form at a red heat and adding to the resulting dehydrated lime sulphate a substance like alum or borax. Keenes cement makes a very white and very hard plaster. It is used as a backing and surface for artificial marble and for ornamental moldings and castings, and its use as a wall plaster is increasing. Flooring plaster is another example of this type of plaster.

Gypsum is used in the manufacture of calcimines, in water paint and tints, and to a considerable extent as an ingredient in dry colors, notably in Venetian reds. When used in excess in mixed paints it is regarded as an adulterant. The unburned or the dead-burned forms of gypsum may be used to a certain extent with oil paints, because they are chemically inactive. The partially dehydrated form is not suitable for such use, but can be used with water.

The report on the gypsum industry in 1910, from which some of the foregoing paragraphs are taken, also included sections on the chemistry and practice of gypsum burning, on the distribution of gypsum deposits and plaster mills by States, with a map and a bibliography of publications on gypsum, all of which are omitted from the present report because a larger edition than usual was published of the advance chapter for 1910, and copies of that issue are still available for free distribution.

In the statistics of gypsum products given in this report only the product from raw material mined in the United States is considered.

PRODUCTION.

The production of crude gypsum reported for 1912 exceeds that of any previous year. The progress of the gypsum industry has been marked, although somewhat irregular. Increased production has not been recorded every year, but the gain made in good years more than offsets the decrease of less prosperous seasons. The number of short tons of raw gypsum mined in 1912 was 2,500,757, an increase of 176,787 tons over the 2,323,970 tons mined in 1911. The gypsum sold without calcining and used principally as land plaster and as an ingredient in Portland cement and in paint, amounting to 441,608 short tons, valued at $623,522, showed an increase in quantity of 54,128 tons, and in value of $34,043, as compared with 387,480 short tons, valued at $589,479 in 1911; and the material calcined for plaster increased in quantity 133,256 short tons and in value $67,830. The total value of gypsum and gypsum products in 1912 was $6,563,908, as compared with $6,462,035 in 1911, an increase of $101,873.

Gypsum was produced in 17 States and in Alaska. The total number of mills reporting in 1912 was 76. This includes mills using domestic material that calcined plaster as well as those that ground raw gypsum for land plaster and for other purposes. New York State was the largest producer of raw gypsum; Iowa ranked second; Michigan was third. Sales of gypsum products are credited to Georgia, Illinois, Minnesota, Washington, and Wisconsin, although these States are not producers. This is rendered necessary by the recent trend of the gypsum industry toward assembling calcined gypsum, retarder, fiber, sand, etc., and preparing plasters for the market at local mixing mills from which they may be more readily and economically distributed to the trade territory. Sales made from mixing plants as reported to the Survey are credited to the State in which the warehouse is located.

The raw gypsum ground and sold for land plaster amounted to 53,065 short tons, valued at $107,058, in 1912, compared with 52,880 tons, valued at $97,573, in 1911, an increase in quantity of 185 short tons and in value of $9,485. The average price per ton at the mills received for land plaster was reported to be $2.02 in 1912, compared with $1.85 in 1911, and $2.05 in 1910. The raw gypsum sold for the manufacture of paint, Portland cement, for bedding plate glass, and various other purposes, amounted to 388,543 short tons, valued at

$516,464, in 1912, compared with 334,600 short tons, valued at $491,906, in 1911, an increase in quantity of 53,943 tons and in value of $24,558. The average price of this class of products in 1912 was $1.33 per ton, compared with $1.47 in 1911, and $1.52 in 1910. The average price of calcined gypsum products, including wall plasters, plaster of Paris, Keenes cement, dental plaster, etc., was $3.43 per ton, compared with $3.67 in 1911, and $3.70 in 1910.

The following tables give the statistical data regarding the gypsum industry in 1911 and 1912, by States:

Production of gypsum in the United States in 1911 and 1912, by States and uses, in short tons.

States.	Number of mills reporting.	Total mined.	Sold without calcining.				Sold as calcined plaster.		Total value.
			Ground for land plaster.		For Portland cement, paint, bedding, plate glass, and other purposes.		Quantity.	Value.	
			Quantity.	Value.	Quantity.	Value.			
1911.									
Alaska, Arizona, Georgia,[a] Illinois,[a] Minnesota,[a] Missouri,[a] Montana, New Mexico, South Dakota, Washington,[a] and Wisconsin[a]	8	129,193	382	$1,374	13,537	$43,672	151,376	$784,164	$829,210
California	6	43,855	7,399	18,280	15 726	42 193	25,144	143,791	204,264
Colorado	4	26,226	....	....	(b)	(b)	[c]22,099	[c]67,199	67,199
Iowa	6	354,204	(d)	(d)	[e]11,032	[e]14,465	229,890	857,287	871,752
Kansas	6	122,579	(d)	(d)	[e]33,278	[e]30,768	47,765	70,795	319,504
Michigan	8	347,296	15,548	15,706	63,502	69,549	206,299	488,671	573,926
Nevada and Utah	6	133,960	(d)	(d)	[e]17,550	[e]25,329	98,419	413,463	438,792
New York	12	472,834	7,960	17,426	149,722	213,903	268,785	968,267	1,199,596
Ohio and Virginia	5	360,858	11,962	26,832	21,166	41,880	283,672	987,856	1,056,568
Oklahoma	10	108,653	(d)	(d)	[e]11,553	[e]15,316	75,081	277,986	293,302
Texas	4	179,625	(b)	(b)	(b)	(b)	[c]143,281	[c]491,685	491,685
Wyoming	3	44,687	....	....	....	....	30,740	116,237	116,237
Total	78	2,323,970	52,880	97,573	334,600	491,906	1,598,418	5,872,556	6,462,035
1912.									
Alaska, Arizona, Colorado, Georgia,[a] Illinois,[a] Minnesota,[a] Montana, New Mexico, South Dakota, Utah, Virginia, Washington,[a] and Wisconsin[a]	15	302,029	15,556	$40,995	46,902	$103,444	260,209	$1,170,136	$1,314,575
California	6	47,741	7,055	17,835	13,011	32,787	30,457	168,695	219,317
Iowa	6	411,186	(d)	(d)	42,443	40,824	273,116	804,804	845,628
Kansas	6	131,031	(d)	(d)	29,356	25,341	80,002	299,479	324,820
Michigan	8	384,297	10,103	9,375	53,716	52,470	243,656	559,702	621,547
Nevada	4	122,408	(d)	(d)	[e]15,500	[e]15,600	91,355	453,330	468,930
New York	12	506,996	10,498	23,248	170,448	224,704	274,155	993,562	1,241,514
Ohio	4	262,551	(d)	(d)	[e]6,769	[e]12,478	237,094	799,910	812,388
Oklahoma	8	135,074	(d)	(d)	[e]17,334	[e]20,904	86,741	247,714	268,618
Texas	4	160,863	(b)	(b)	(b)	(b)	[c]131,033	[c]356,579	356,579
Wyoming	3	36,581	....	....	....	....	26,773	89,992	89,992
Total	76	2,500,757	53,065	107,058	388,543	516,464	1,731,674	5,940,386	6,563,908

[a] Produces no crude gypsum.
[b] Included with calcined gypsum.
[c] Includes some crude gypsum.
[d] Included with crude gypsum for Portland cement, etc.
[e] Includes some land plaster.

Crude gypsum mined in the United States, 1880–1912.

	Short tons.		Short tons.		Short tons.
1880	90,000	1891	208,126	1902	816,478
1881	85,000	1892	256,259	1903	1,041,704
1882	100,000	1893	253,615	1904	940,917
1883	90,000	1894	239,312	1905	1,043,202
1884	90,000	1895	265,503	1906	1,540,585
1885	90,405	1896	224,254	1907	1,751,748
1886	95,250	1897	288,982	1908	1,721,829
1887	95,000	1898	291,638	1909	2,252,785
1888	110,000	1899	486,235	1910	2,379,057
1889	267,769	1900	594,462	1911	2,323,970
1890	182,995	1901	633,791	1912	2,500,757

The following table showing the marketed production of gypsum by uses in the United States from 1908 to 1912 reveals some interesting facts. There is a steady though slight decrease in value per ton of gypsum sold crude, and the prices per ton of various forms of calcined gypsum fluctuate but were generally lower in 1912 than in 1911. The quantity of gypsum sold crude has nearly doubled in five years, but the price has decreased so that the total value has increased only about 46 per cent. The total quantity of gypsum sold calcined has increased about 54 per cent in five years and its value has increased 63 per cent.

On comparing the quantities used for various purposes it is seen that the quantity of gypsum used for land plaster is comparatively small and has varied less than 1,000 tons in three years; that used by glass factories varies from 14,000 to 33,000 tons, in round numbers; and that sold calcined for Portland cement and other purposes has decreased from 84,565 tons in 1910 to 25,908 tons in 1912. On the other hand, gypsum sold crude for Portland cement has increased from 187,680 tons in 1908 to 382,952 tons in 1912, or more than doubled in five years; and gypsum sold calcined as plaster of Paris, wall plaster, Keenes cement, etc., has increased from 1,074,229 tons in 1908 to 1,678,417 tons in 1912, an increase of over 600,000 tons in annual production in five years. As Keenes cement was reported as made at only six plants in the United States in 1912, and as it is not probable that the demand for plaster of Paris as such is very great, it must be that this 600,000 tons increase in the sale of calcined gypsum is principally due to the increased use of hard wall plaster.

Marketed production of gypsum in the United States, 1908–1912, by uses, in short tons.

Year.	Sold crude.														
	For Portland cement.			As land plaster.			For paint material.			For other purposes.			Total.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
1908	187,680	$305,745	$1.63	37,972	$91,833	$2.42	1,281	$1,300	$1.01	19,770	$26,754	$1.35	246,703	$425,632	$1.73
1909	260,433	402,830	1.55	49,581	103,695	2.09	(a)	(a)	....	a 31,841	45,984	1.44	341,855	552,509	1.62
1910	334,815	522,693	1.56	53,815	110,325	2.05	1,297	2,386	1.84	31,902	34,093	1.07	421,829	669,497	1.59
1911	327,953	484,373	1.48	52,880	97,573	1.85	(a)	(a)	....	a 6,647	7,533	1.13	387,480	589,479	1.52
1912	382,952	509,400	1.33	53,065	107,058	2.02	(a)	(a)	....	a 5,591	7,064	1.26	441,608	623,522	1.41

Year.	Sold calcined.														
	As plaster of Paris, wall plaster, Keenes cement, etc.			For dental plaster.			To glass factories.			For Portland cement and other purposes.			Total.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
1908	1,074,229	$3,508,520	$3.27	174	$636	$3.66	14,412	$41,102	$2.85	36,802	$99,934	$2.72	1,125,617	$3,650,192	$3.24
1909	b 1,441,434	5,143,934	3.57	(b)	(b)	....	13,869	35,208	2.54	58,734	175,087	2.98	1,514,037	5,354,229	3.54
1910	b 1,483,046	5,599,353	3.78	115	805	7.00	15,943	29,185	1.83	84,565	224,189	2.65	1,583,669	5,853,532	3.70
1911	1,523,263	5,678,453	3.73	413	2,612	6.32	33,472	80,220	2.40	41,270	111,271	2.70	1,598,418	5,872,556	3.67
1912	1,678,417	5,805,999	3.46	c 3,190	15,564	4.88	24,159	52,741	2.18	25,908	66,082	2.55	1,731,674	5,940,386	3.43

a Paint material included under "For other purposes."
b Some dental plaster and other gypsum products included with plaster.
c Includes some casting plaster.

Marketed production of gypsum in the United States, 1908–1912, in short tons.

Year.	Sold without calcining.			Sold as calcined plaster.			Total value.
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	
1908	246,703	$425,632	$1.73	1,125,617	$3,650,192	$3.24	$4,075,824
1909	341,855	552,509	1.62	1,514,037	5,354,229	3.54	5,906,738
1910	421,829	669,497	1.59	1,583,669	5,853,532	3.70	6,523,029
1911	387,480	589,479	1.52	1,598,418	5,872,556	3.67	6,462,035
1912	441,608	623,522	1.41	1,731,674	5,940,386	3.43	6,563,908

IMPORTS.

The gypsum which is imported into the United States comes, except a few hundred tons annually from France and Great Britain, almost wholly from Nova Scotia and New Brunswick, and enters the ports of the New England and North Atlantic States, over one-half of it entering the port of New York. This imported gypsum is nearly all calcined and converted into wall plasters by plants along the seaboard as far east as Red Beach, Me. A small quantity of the material is used crude as land plaster, and some is mixed in patent fertilizers.

A decided increase in value of imports occurred in 1912. There was an increase of 22,823 tons of unground gypsum and of 3,314 tons of ground and calcined gypsum; the increase in value amounted to $17,064 and $16,356, respectively, the gain in the imports of the higher-priced ground and calcined gypsum being relatively much greater than in the raw material. The average value per ton of unground gypsum is $1.04 and of ground and calcined gypsum is $5.32. In other words, crude material made an increase of 5.85 per cent in quantity and of 4.13 per cent in value, while ground or calcined material increased 854.12 per cent in quantity and 487.80 per cent in value. The value of plaster imported increased 12.39 per cent. Attention should be called, however, to the fact that the importation of ground or calcined gypsum in 1911 was very small in comparison with former years, and the imports of 1912 show only a normal increase over those of 1909 and 1910.

The following table gives such statistics concerning the imports of gypsum and gypsum products as are issued by the Bureau of Foreign and Domestic Commerce:

Gypsum imported and entered for consumption in the United States, 1908–1912, in short tons.

Year.	Unground.		Ground or calcined.		Value of manufactured plaster of Paris.	Total value.
	Quantity.	Value.	Quantity.	Value.		
1908	300,158	$314,845	1,889	$12,825	$26,733	$354,403
1909	350,160	376,790	3,437	21,799	26,548	425,137
1910	415,321	444,263	2,414	15,072	42,776	502,111
1911	389,874	413,119	388	3,353	34,334	450,806
1912	412,697	430,183	3,702	19,709	38,589	488,481

PRODUCTION IN OTHER COUNTRIES.

The following table gives the production of gypsum in other countries from 1907 to 1911, inclusive:

Production of gypsum in other countries, 1907–1911, in short tons.

Year.	France.		United States.		Canada.	
	Quantity.	Value.	Quantity.	Value.	Quantity.[a]	Value.
1907	1,559,685	$2,598,828	1,751,748	$4,942,264	485,921	$646,914
1908	1,553,173	2,559,521	1,721,829	4,075,824	340,964	575,701
1909	1,460,271	2,426,110	2,252,785	5,906,738	473,129	809,632
1910	1,760,901	2,942,664	2,379,057	6,523,029	525,246	934,446
1911	(b)	(b)	2,323,970	6,462,035	518,383	993,394

Year.	United Kingdom.		German Empire (Bavaria).		Algeria.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.[c]	Value.
1907	263,779	$431,313	53,985	$17,456	29,101	$75,907	27,114	$68,146
1908	255,714	431,551	56,563	18,953	28,109	66,537	23,511	57,561
1909	267,676	418,242	56,911	19,254	31,967	75,656	12,230	29,754
1910	286,226	478,095	59,962	22,658	55,751	115,109	7,276	17,782
1911	309,886	507,191	66,568	26,850	(b)	(b)	(b)	(b)

[a] Quantity sold. [b] Figures not yet available. [c] Exports.

TRADE AND MANUFACTURING CONDITIONS.

A number of producers reported business conditions as practically the same in 1912 as in 1911; a small number found trade poorer, but many considered it better, for although prices were lower there was a greater demand. One new company reported production in 1912, the Kelly Plas er Co., of Sandusky, Ohio, with plant at Castalia, Ohio. Five plants were reported under construction in California, New York, Oregon, and South Dakota.

There were 78 active gypsum mines, including quarries and pits, in the United States in 1912, one being in Alaska. These mines supplied 76 plants in the United States. Of these plants 53 used gypsum, 14 used gypsite, and 9 used both gypsum and gypsite. Seven plants produced ground gypsum only, and 69 plants calcined some of their product. Of these calcining plants 63 were equipped with kettles, 2 with rotary kilns, 3 with stationary kilns, and 1 was reported as a baffle-plate furnace. There were 192 calcining kettles in operation, mainly 6, 8, and 10 feet in diameter. The total daily capacity for all these kettles as reported was 15,669 short tons, giving an average of 82 tons per kettle.

On comparing these statistics with those of 1911, when there were 78 gypsum plants in operation, 73 of which were calcining plants and 67 of which were equipped with a total of 193 kettles, it is found from the producers' reports that there was a net loss of 2 plants, a loss of 4 calcining plants, but a net loss of only 1 kettle. On the other hand, there was an apparent gain of 1,249 tons in the total daily capacity and an increase of 7 tons a day in the average daily capacity per kettle.

These summaries do not include the equipment of several plants termed "mixing mills," which are auxiliary mills established at commercial centers, such as Chicago, Ill., Milwaukee and Superior, Wis., Minneapolis and St. Paul, Minn., and Cleveland, Ohio. These mills do no calcining, but receive the calcined plaster and prepare it for the market in various forms by the addition of fiber, retarder, sand, etc.

Keenes cement was made at six of the gypsum plants in 1912, an increase of three plants over the number reporting the manufacture of this cement in 1911.

The fuel used at 50 calcining plants was coal; oil was used at 16 plants, wood at 1 plant, coal and wood at 1 plant, and coal and oil at 1 plant. The oil-burning plants are in Arizona, California, Kansas, Nevada, Oklahoma, Texas, and Washington.

OCCURRENCE OF GYPSUM AND GYPSITE IN THE UNITED STATES.

The following list of localities in which gypsum and gypsite are found is taken from an unpublished manuscript, "The occurrence of useful minerals in the United States," by Samuel Sanford and R. W. Stone.

Alabama. Choctaw, Clarke, and Dallas counties, found in small quantities; not of commercial importance.

Arizona. Cochise County, quarried at Douglas; Navajo County, used for manufacture of plaster in Fort Apache Reservation, Woodruff, and Snowflake; Pima County, occurs in Santa Rita Mountains, Sierrita Mountains, and Santa Catalina Mountains, quarried near Tucson; Pinal County, used for manufacture of plaster in San Pedro Valley. Alabaster occurs in Superstition Mountains, near Pueblo Viejo, near Sulphur Springs, in La Gija Range, and elsewhere.

Arkansas. Pike County, was mined at Tokie.

California. Widely distributed; reported from Butte, Colusa, Fresno, Kern, Los Angeles, Riverside, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Tulare, and Ventura counties. Quarried in Fresno County, at Coalinga and Mendota; Kern County, near McKittrick, Bakersfield, and Dudley; Los Angeles County, Palmdale and Los Angeles; Monterey County, King City; Riverside County, Corona; San Bernardino County, Amboy; Santa Barbara County, at Casmalia, as alabaster. Occurs, but not quarried: Kern County, near McKittrick and elsewhere in West Side oil field; Kings County, 5½ miles northeast of Dudley; Riverside County, extensive beds in Palen Mountains; San Benito County, efflorescent deposit at numerous places on southwest flank of Temblor Range, east of Carrizo Plain, poor grade.

Colorado. Custer County, occurs near Arkansas River; Delta County, west side of canyon of Gunnison River, into Montrose County; Dolores County, as gangue mineral, Rico region and elsewhere; Eagle County, at Ruedi, worked recently, occurs along Grand and Eagle rivers; El Paso County, has been worked extensively near Perry Park and near Colorado City; Fremont County, Coaldale and Canon City; Jefferson County, opened near Mount Morrison; Larimer County, worked extensively at Arkins near Loveland, thick bed at Owl Canyon and on Sand Creek east of Boxelder and at several other localities; Montrose County, several places.

Florida. Sumter County, 6 miles west of Panasoffkee, with limestone. Not used.

Iowa. Extensive deposits in Appanoose County, at Centerville; quarried in Webster County, at Fort Dodge.

Kansas. Gypsite (gypsum earth) found in low swampy ground in central Kansas, forms basis of greater portion of plaster manufacture; mined in Barber County, at Kling; Butler County; Clay County, at Longford. Rock gypsum: Mined in Comanche County, at Medicine Lodge Area; Dickinson County, at Hope; Marshall County, Blue Rapids; Saline County, near Gypsum City. In comparative abundance at numerous places in the Permian rocks of Kansas; in smaller quantities along Smoky River, Ellsworth County, and McPherson County; Tertiary formations in southwestern part of Meade County and Seward County, often in fine crystals. Nearly all gypsite beds in Kansas are exhausted.

Louisiana. Bienville arish, with limestone at Rayburn's salt works; Calcasieu Parish, large deposit in sulphur deposits at Lake Charles; Caldwell Parish, selenitic clays 85 feet thick at Grand View, on Ouachita River; St. Landry Parish, at Pine Prairie.

Michigan. Iosco County, mined at Alabaster; Kent County, near Grand Rapids and Grandville. Occurs also in northern Arenac County and southeast Ogemaw County, not mined; Mackinac County, near Point Aux Chenes, 7 miles west of St. Ignace, and in the vicinity of St. Martins Bay, not mined at present.

Mississippi. Rankin County, near Cato; also east and west of Rankin County, was formerly mined. Gypsiferous marls in Attala, Carroll, Hinds, Holmes, Leake, Madison, Rankin, and Scott counties.

Montana. Widely distributed throughout eastern flanks of the Rocky Mountains. Cascade County, mills located at Armington and Riceville; Carbon County, mill at Bridger on local deposit; Jefferson County, quarried near Limespur; Park County, occurs at Hunters Hotsprings.

Nevada. Best-known deposits are in Clark County, in Spring Mountains near Las Vegas, Arden; Esmeralda County, large bodies near Hawthorne; Humboldt County, near Lovelocks; Lyon County, Moundhouse, and an extensive bed at Ludwig mine, Yerington district. Two plaster mills at Moundhouse, one at Reno, and one at Arden.

New Mexico. Occurs in Bernalillo, Chaves, Dona Ana, Eddy, Guadalupe, McKinley, Otero, Quay, Rio Arriba, Roosevelt, Sandoval, San Juan, San Miguel, Santa Fe, Sierra, Socorro, Torrance, and Valencia counties. Used locally, but on a commercial scale only in Chaves County, at Acme; Lincoln County, Ancho; Otero County, Alamogordo, gypsum sands; and Rio Arriba County, El Rito.

New York. Found throughout central and western parts of State, in the Salina formation of the Silurian. Used for calcined plasters, agricultural plaster, and for admixture in Portland cement. Quarries in Cayuga County, at Union Springs; Erie County, Akron; Genesee County, Oakfield; Madison County, Canastota; Monroe County, Wheatland, Garbutt, and Mumford; Onondaga County, Jamesville, Fayetteville, Manlius, and Camillus; Ontario County, Victor and Port Gibson. Small quarries for local use at other places.

Ohio. Occurs in various places in the "Helderberg," encountered in most of deep wells in north and central Ohio; Ottawa County, quarried near Gypsum Station and Port Clinton.

Oklahoma. In Permian rocks; Blaine County, mined at Homestead, Watonga, and elsewhere; Caddo County, Cement; Canadian County, Okarche; Grady County, Rush Springs; Jackson County, Eldorado; Kay County, Peckham; Woodward County, Quinlan.

Oregon. White and crystalline gypsum occurs on east border of State on ridge between Burnt River and Snake River; Baker County, mined near Huntington; Crook County, deposit near Bend, undeveloped.

South Dakota. Plaster mills in Fall River County, at Hot Springs; Lawrence County, Spearfish; Pennington County, Rapid City. Extensive deposits in Butte, Custer, Fall River, Lawrence, Meade, and Pennington counties.

Tennessee. In small quantities in many caves; Grays Cave, northern part of Sumner County.

Texas. At many localities in the State, especially in the Permian rocks west of the Pennsylvanian area of rocks. Brewster County, curious forms of gypsum, curved and twisted like a ram's horn, occur in association with the quicksilver deposits in the Terlingua district; Hardeman County, mined at Acme and Quanah; much Keenes plaster is made from the gypsite beds; Jones County, mined at Hamlin; Stonewall County, extensive deposits of good alabaster are reported from the northeastern corner of the county at Kiowa Peak in beds up to 4 feet thick; Nolan County, rose gypsum occurs near Sweetwater in beautiful forms and colors. The eastern border of the Permian area contains extensive beds of gypsum and gypsum has been found in deep borings along the Gulf of Mexico.

Utah. Iron County, enormous deposits reported; Emery and Wayne counties, enormous deposits in Jurassic along margin of San Rafael Swell; Juab County, large deposits mined near Nephi and Levan; Millard County, vast deposits at White Mountains; Salt Lake County, in small quantities in fibrous and selenitic form; San Juan County, Monticello; Sevier County, Sigurd. Black gypsum found also in Grand County, between Grand River and La Sal Mountains; Kane County, near Kanab; Sanpete County, near Gunnison; Sevier County, near Richfield; Washington County, in eastern part of county; Wayne County, in South Washington.

Virginia. Mined in Smyth County, at Chatham Hill, North Holston, and Saltville; Washington County, Plasterco.

Wyoming. Albany County, rock gypsum is mined at Red Butte, and used by one mill for making plaster; mined also west of Sheridan. Occurs abundantly in Bighorn, Carbon, Converse, Crook, Fremont, Johnson, Laramie, Natrona, Sweetwater, Uinta, and Weston counties. Gypsite, or earthy gypsum, is dug near Laramie, Albany County, and used by two mills for making plaster.

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LIME.

By Ralph W. Stone.

PRODUCTION.

Although the production of lime in the United States in 1911 was considerably less than in the two preceding years, the increase in the year 1912, as reported to the Survey, was more than sufficient to counterbalance the reaction of 1911.

The figures obtained from producers of lime throughout the country show that in 1912 the demand for lime was greater than ever before, and the resulting production was the largest in the history of the industry. As the price per ton fell off slightly with increased production, the total value of lime produced in 1912 was somewhat less than the maximum value in 1910. In the following tables it is shown that the total production of lime in 1912 was 3,529,462 short tons, valued at $13,970,114, as compared with 3,392,915 short tons, valued at $13,689,054, in 1911. This represents an increase of 136,547 short tons in quantity and $281,060 in value. The average price per ton in 1912 was $3.96, as compared with $4.03 in 1911 and with $4.02 in 1910. The decline in price attending the increased demand and production appears to be due to the concentration of the industry into larger units, with the consequent lowering of cost of manufacture. Lime for building purposes suffered most by the decline in value.

The total number of plants operating in 1912 was 1,017, as compared with 1,139 in 1911. This decrease in the number of producers was due in large part to the inactivity of small kilns operated by farmers for burning lime for local use as a soil sweetener and in part to the tendency of the industry toward concentrating plants into fewer and larger units. The heaviest decrease in the number of producers was in Pennsylvania, where 561 were reported operating in 1911 and 474 in 1912, a decrease of 87. Pennsylvania is a State in which it has been a common practice for many years for farmers to burn small quantities of limestone quarried on their own farms for private use, and this large decrease in producers is due almost wholly to farmers buying their lime already burned and to the use of fertilizer in preference to lime. It should also be noted that many farmers who formerly burned lime have given up the practice on account of the high price of coal and the scarcity and high cost of labor. In 1912, 43 States, including Hawaii and Porto Rico, reported a production of lime. The five leading States in 1912 were, in the order of production, Pennsylvania, Ohio, Wisconsin, West Virginia, and Maine. Maine has supplanted Missouri, which occupied the fifth place in 1911, in the quantity of lime produced, but ranks seventh in the value of production, which is one place lower than Missouri. This is owing to the fact that in Missouri the average price of lime per ton was $4.85, while in Maine it was $4.14. Pennsylvania, which has long held first rank in both the quantity and the value of lime produced, in 1912 made a total output of 849,159 short tons, valued at $2,679,420. This was an increase of 7,436 short tons in quantity and a decrease of $8,954 in value, due to the slight tendency toward a lower price in the lime business in Pennsylvania as in the country as a whole in 1912.

The slight variations in the quantity and value of lime produced in each of the 43 States, including Hawaii and Porto Rico, can be seen by comparing the tables of production for the years 1911 and 1912 which are given on the following pages.

The following table gives the value of the total lime production in the United States for the years 1896 to 1903 and the quantity and value of the production from 1904 to 1912, inclusive:

Production of lime in the United States, 1896–1912.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1896		$6,327,900	1905	2,984,100	$10,941,680
1897		6,390,487	1906	3,198,087	12,480,653
1898		6,886,549	1907	3,092,524	12,656,705
1899		6,983,067	1908	2,766,873	11,091,186
1900		6,797,496	1909	3,484,974	13,846,072
1901		8,204,054	1910	3,505,954	14,088,039
1902		9,335,618	1911	3,392,915	13,689,054
1903		9,255,882	1912	3,529,462	13,970,114
1904	2,707,809	9,951,456			

Detailed statistics of the production of lime in 1911 and 1912 are given in the following table:

Quantity and value of lime burned in the United States in 1911 and 1912, by States, in short tons.

1911.

State or Territory.	Rank of State by quantity.	Quantity.	Value.	Rank of State by value.	Average price per ton.	Number of plants in operation.
Alabama	15	76,406	$300,787	16	$3.94	14
Arizona	25	13,844	69,940	26	5.05	4
Arkansas	23	22,847	109,067	23	4.77	6
California	16	72,858	564,175	7	7.74	22
Colorado	31	6,403	34,614	31	5.41	7
Connecticut	17	69,719	328,904	14	4.72	9
Florida	27	10,867	49,221	27	4.53	4
Georgia	32	6,282	24,067	36	3.83	3
Hawaii	39	(a)	(a)	34	9.00	1
Idaho	30	6,809	38,088	29	5.59	7
Illinois	12	92,169	423,762	11	4.60	16
Indiana	11	92,229	324,950	15	3.52	12
Iowa	24	14,791	80,914	24	5.47	4
Kansas	42	648	3,440	42	5.30	3
Kentucky	36	4,365	15,121	39	3.46	9
Maine	6	152,552	773,212	4	5.07	7
Maryland	10	114,386	362,839	12	3.17	44
Massachusetts	7	137,440	695,662	6	5.06	12
Michigan	14	80,709	352,608	13	4.37	15
Minnesota	19	39,208	242,945	18	6.20	6
Missouri	5	158,368	722,563	5	4.56	32
Montana	38	3,100	18,480	38	5.96	3
Nevada	43	(a)	(a)	43	12.50	1
New Jersey	22	27,057	113,784	22	4.21	17
New Mexico	41	1,945	13,004	41	6.68	4
New York	9	119,707	524,845	9	4.38	35
North Carolina	28	7,809	33,543	32	4.30	6
Ohio	2	405,562	1,607,524	2	3.96	40
Oklahoma	37	3,472	14,603	40	4.21	4
Oregon	35	4,557	38,216	28	8.39	8
Pennsylvania	1	841,723	2,688,374	1	3.19	561
Porto Rico	33	6,083	26,075	35	4.29	35
Rhode Island	40	(a)	(a)	37	8.00	1
South Carolina	29	(a)	(a)	33	4.36	2
South Dakota	34	5,293	37,573	30	7.10	6
Tennessee	13	91,099	282,763	17	3.10	14
Texas	18	43,064	218,007	20	5.06	12
Utah	26	11,681	74,770	25	6.40	13
Vermont	20	37,333	191,035	21	5.12	10
Virginia	8	132,133	483,016	10	3.66	45
Washington	21	35,094	228,933	19	6.52	16
West Virginia	4	179,966	536,660	8	2.98	27
Wisconsin	3	250,638	961,558	3	3.84	41
Wyoming	44	(a)	(a)	44	12.64	1
Other States	....	b 12,699	b 79,412	....	....	....
Total	....	3,392,915	13,689,054	....	4.03	1,139

a Included in "Other States."
b Includes Hawaii, Nevada, Rhode Island, South Carolina, and Wyoming.

Quantity and value of lime burned in the United States in 1911 and 1912, by States, in short tons—Continued.

1912.

State or Territory.	Rank of State by quantity.	Quantity.	Value.	Rank of State by value.	Average price per ton.	Number of plants in operation.
Alabama	14	79,957	$297,178	17	$3.72	13
Arizona	24	18,528	101,680	24	5.49	4
Arkansas	22	22,404	102,833	23	4.59	5
California	17	72,978	555,822	8	7.62	20
Colorado	29	7,281	36,478	30	5.01	7
Connecticut	15	75,981	371,356	12	4.89	10
Florida	27	12,327	69,938	25	5.67	4
Georgia	32	(a)	(a)	33	4.53	2
Hawaii	35	(a)	(a)	31	9.00	1
Idaho	28	7,402	42,380	28	5.73	7
Illinois	12	98,450	394,892	11	4.01	15
Indiana	13	98,086	329,893	14	3.36	12
Iowa	26	12,935	51,800	27	4.00	3
Kansas	42	232	1,131	42	4.88	3
Kentucky	36	3,397	11,577	39	3.41	7
Maine	5	155,559	644,255	7	4.14	5
Maryland	9	112,104	365,037	13	3.26	40
Massachusetts	7	144,384	738,597	4	5.12	12
Michigan	16	74,720	311,448	16	4.17	11
Minnesota	19	44,063	269,841	18	6.12	6
Missouri	6	148,885	721,896	6	4.85	28
Montana	37	(a)	(a)	35	7.23	2
New Jersey	25	16,538	65,241	26	3.94	17
New Mexico	41	1,325	9,434	40	7.12	3
New York	10	109,800	495,265	9	4.51	31
North Carolina	30	6,693	30,559	32	4.57	4
Ohio	2	464,479	1,929,584	2	4.15	35
Oklahoma	39	2,651	13,538	38	5.11	3
Oregon	31	6,164	39,323	29	6.38	5
Pennsylvania	1	849,159	2,679,420	1	3.16	474
Porto Rico	33	4,907	23,971	36	4.89	45
Rhode Island	38	(a)	(a)	37	6.50	1
South Carolina	40	(a)	(a)	41	3.88	1
South Dakota	34	3,914	28,585	34	7.30	5
Tennessee	11	101,339	316,364	15	3.12	15
Texas	18	45,529	236,101	19	5.19	9
Utah	23	20,325	111,291	22	5.48	12
Vermont	20	39,572	205,409	21	5.19	10
Virginia	8	124,711	488,628	10	3.92	45
Washington	21	29,078	206,032	20	7.09	11
West Virginia	4	232,584	734,644	5	3.16	30
Wisconsin	3	263,052	825,551	3	3.14	43
Wyoming	43	(a)	(a)	43	12.76	1
Other States	....	b 17,969	b 113,142	....	....	....
Total	....	3,529,462	13,970,114	....	3.96	1,017

a Included in "Other States."
b Includes Georgia, Hawaii, Montana, Rhode Island, South Carolina, and Wyoming.

USES.

The uses to which lime is put are many, but the principal ones, showing the quantity and value of lime used, are given in the following tables. These tables show that building lime is only slightly less than one-half of the total production and that the quantity produced in 1912 (1,556,446 short tons) exceeded that of 1911 by 67,879 tons, but that the value, $6,576,479, was $184,410 less than the value in 1911. This is due to the falling off of 32 cents in the average value per ton of building lime, or a decrease from $4.54 in 1911 to $4.22 in 1912. There was a slight increase in the use of lime by chemical works, paper mills, and tanneries, but a decrease in the use in sugar factories. The use of lime in fertilizers also increased, the figures for 1912 being 604,607 short tons, valued at $1,852,530, compared with

596,664 short tons, valued at $1,714,386, in 1911. This increase of lime used on the land may perhaps be attributed in part to the tendency in recent years of city people to go back to the farm and in many cases to take up agricultural pursuits on a scientific basis.

Lime is also used as a plant food; it has been the common practice for manufacturers in some parts of the country to spread it upon the fields and plow it under in order to sweeten the soil. The effect of the lime renders available the plant food already contained in the soil. The use of lime in fertilizers is one of the few uses in which the price per ton increased in 1912, the average price rising in 1912 to $3.06 from $2.87 in 1911. One other case in which the figures reported to the Survey showed an increase in average price per ton was in the lime sold to dealers; the average price per ton of lime thus classified rose from $4.15 in 1911 to $4.40 in 1912.

Production of lime in the United States in 1911 and 1912, by uses, in short tons.

1911.

	Quantity.	Value.	Average price per ton.
Building lime	1,488,567	$6,755,889	$4.54
Chemical works	256,215	933,957	3.65
Paper mills	286,485	1,107,879	3.87
Sugar factories	36,424	242,344	6.65
Tanneries	30,167	138,352	4.59
Fertilizer	596,664	1,714,386	2.87
Dealers—uses not specified	531,249	2,202,286	4.15
Other uses [a]	167,144	593,961	3.55
Total	3,392,915	13,689,054	4.03
Hydrated lime, included in total	304,593	1,372,057	4.50

1912.

	Quantity.	Value.	Average price per ton.
Building lime	1,556,446	$6,571,479	$4.22
Chemical works	282,984	989,309	3.50
Paper mills	290,347	1,107,532	3.81
Sugar factories	30,988	186,164	6.01
Tanneries	40,595	178,686	4.40
Fertilizer	604,607	1,852,530	3.06
Dealers—uses not specified	560,286	2,467,694	4.40
Other uses [a]	157,843	597,443	3.79
Total	3,529,462	13,970,114	3.96
Percentage of increase (+) or decrease (−) in 1912	+4.02	+2.05	....
Hydrated lime, included in total	416,890	1,829,064	4.39
Percentage of increase (+) or decrease (−) in 1912	+36.87	+33.31	....

[a] Includes lime for sand-lime brick, slag cement, alkali works, steelworks, glassworks, smelters, sheep dipping, disinfectant, manufacture of soap, cyanide plants, glue factories, purification of water, etc.

HYDRATED LIME.

The hydrated lime business exhibited a marked advance in 1912. The quantity of hydrated lime produced in 1912 was 416,890 short tons, valued at $1,829,064, as compared with 304,593 short tons, valued at $1,372,057 in 1911. This increase of 37 per cent in quantity of hydrated lime produced in a single year with an increase in total value of $457,007 in spite of a decrease in the average price per ton from $4.50 in 1911 to $4.39 in 1912, speaks well for the strength of the hydrated lime business. The number of lime-hydrating plants in operation in 1912 in the United States was 64, an increase of 4 from 1911. The operating plants are located in 20 States and there are idle plants in a number of other States, as shown by the accompanying table.

The following table shows the quantity and value of the hydrated lime produced in the United States from 1906 to 1912, inclusive, together with the average price per ton and the total number of manufacturers reporting to the Survey:

Production of hydrated lime in the United States, 1906–1912, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Number of plants reporting operations.
1906	120,357	$479,079	$3.98	30
1907	140,135	657,636	4.69	33
1908	136,441	548,262	4.02	46
1909	204,611	904,900	4.43	50
1910	320,819	1,288,789	4.02	51
1911	304,593	1,372,057	4.50	60
1912	416,890	1,829,064	4.39	64

The following table shows the number of lime-hydrating plants reported to the Survey as operating in the United States during the last seven years, and draws attention to the steady development of this phase of the lime industry:

Number of lime-hydrating plants in operation in 1906–1912, by States.

State or Territory.	1906	1907	1908	1909	1910	1911	1912
Alabama	1	1	1	3	2	2	2
Arizona	1	1	1	1	1	1	......
California	......	1	2	2	2	3	3
Colorado	......	1	......	1	1	......	......
Connecticut	1	......	......	1	......	......	1
Florida	......	......	1	......	1	......	......
Georgia	2	1	1	......	......	1	1
Hawaii	......	......	......	......	1	......	......
Idaho	......	......	......	1	1	1	1
Illinois	......	1	1	2	2	1	1
Indiana	2	2	2	2	2	2	2
Iowa	1	......	......	1	......	......	......
Kansas	1	1	......	1	......	......	......
Maine	1	1	1	1	1	1	1
Maryland	......	......	1	1	3	3	3
Massachusetts	......	......	......	......	1	2	......
Michigan	1	1	2	1	2	3	1
Missouri	......	2	2	3	3	3	4
New Jersey	......	......	1	1	......	2	1
New York	1	2	2	3	......	2	3
North Carolina	......	......	......	......	......	1	......
Ohio	8	9	11	8	11	15	17
Pennsylvania	8	6	11	9	8	8	15
South Dakota	......	......	......	......	1	1	......
Tennessee	......	......	1	1	1	1	1
Texas	......	......	1	3	3	3	3
Virginia	......	......	1	2	......	1	......
Washington	......	......	......	......	......	1	1
West Virginia	1	1	1	......	2	1	2
Wisconsin	1	2	2	2	2	1	1
Total	30	33	46	50	51	60	64

IMPORTS.

The imports of lime for consumption in the United States in 1912 were reported by the Bureau of Foreign and Domestic Commerce as 4,268 short tons, valued at $48,153, as compared with 5,232 short tons, valued at $55,255, in 1911, a decrease in quantity of 964 tons and in value of $7,102.

EXPORTS.

In 1912 there were exported from the United States 260,669 barrels of lime, valued at $199,515, as compared with 207,232 barrels, valued at $153,212, in 1911.

FUELS.

The statistical inquiry into the efficiency of various fuels in burning lime has yielded some results, though far from what could be wished. Information sufficient to make reliable averages is lacking, for many producers did not reply to the inquiry, and although some gave figures evidently based on measurements, others sent what appear to be mere guesses. The reports, however, are of interest, and something can be gleaned from them.

Reports on the quantity of lime burned by 1 pound of coal ranged from 1.5 to 6 pounds, but the average of 177 reports was 3.6 pounds of lime burned by 1 pound of coal. Coke used as fuel for burning lime averaged (in the few reports received) 4.2 pounds of lime to 1 pound of coke. Producer gas is used in a few places, and what little information was received on its use shows that producer gas burns from 3 to 4.1 pounds of lime and averages about 3.42 pounds of lime burned to 1 pound of coal converted into producer gas.

Wood was reported as the fuel used by 62 producers. Although this is a small number and the reports show a range from 1,000 to 6,400 pounds of lime burned by a cord of wood, the data are believed to be sufficient for an approximate average. The figures submitted by producers show that 1 cord of wood burns approximately 4,000 pounds of lime.

It is hoped that in the future more satisfactory data can be obtained on this question of the efficiency of different fuels.

The tables following show the kinds of fuel and the number of kilns using the various fuels as reported for 1911 and 1912.

Number of kilns using various kinds of fuel, by States, in 1911 and 1912.

1911.

State or Territory.	Coal.	Wood.	Oil.	Natural gas.	Producer gas.	Coke.	Shavings.	Coal and wood.	Coal and coke.	Mixed fuel, kind not stated.	Total number of kilns.
Alabama	9	3			8			30		1	51
Arizona		3									3
Arkansas		6									6
California		9	32			3					44
Colorado	6										6
Connecticut	5	23			8						36
Florida		14									14
Georgia								1			1
Hawaii			2								2
Idaho	4	6									10
Illinois	4	7			1		26	9			47
Indiana	46	2	3		2			1		2	56
Iowa	3	2									5
Kansas	1		3	1							5
Kentucky	3	5									8
Maine	43	20									63
Maryland	54	1	2			13		a 5	11		86
Massachusetts	20	16			3			15			54
Michigan	8	28									36
Minnesota	21	5									26
Missouri	32	43			2			10		4	91
Montana		4									4
Nevada			1								1
New Jersey	46	1						4			51
New Mexico	2	2									4
New York	19	5			1			2			27
North Carolina		4									4
Ohio	192	3	2	24	26						247
Oklahoma		10									10
Oregon		7									7
Pennsylvania	632	6		5	10	16	1	a 133	24	6	833
South Carolina	3										3
South Dakota		7						1			8
Tennessee	19	5				2					26
Texas		14	6	2	4					2	28
Utah	9	4				9					22
Vermont	18							9			27
Virginia	34	19			2	9		15			79
Washington		27									27
West Virginia	11	1		1	3	18		a 7			41
Wisconsin	3	80			1			4			88
Wyoming	1										1
Total	1,248	392	51	33	71	70	27	246	35	15	2,188

a Includes kilns using also some oil.

Number of kilns using various kinds of fuel, by States, in 1911 and 1912—Continued.

1912.

State or Territory.	Coal.	Wood.	Oil.	Natural gas.	Producer gas.	Coke.	Shavings.	Coal and wood.	Coal and coke.	Total number of kilns.
Alabama	16							27		52
Arizona		4								4
Arkansas		14								14
California		9	47			1				57
Colorado	6									6
Connecticut	5	26								31
Florida		19								19
Georgia	4									4
Hawaii			2							2
Idaho	4	9				1				14
Illinois	4	4			1		[a]30	8		47
Indiana	46	2		[b]3	2			1		54
Iowa		5								9
Kansas	2		2	1						5
Kentucky	3	6								5
Maine	47	18								65
Maryland	59	3				13		8	11	94
Massachusetts	16	11			3			16		46
Michigan	2	29								31
Minnesota	21	6								27
Missouri	23	36			2			15		76
Montana		3								3
New Jersey	42	1								43
New Mexico	1	2								3
New York	25	7			1			6		39
North Carolina		1						4		5
Ohio	209	7		29	30			1		276
Oklahoma		4								4
Oregon		7						2		9
Pennsylvania	673	10		5	6	17		50	[c]24	785
Rhode Island	2									2
South Dakota		8								8
Tennessee	28	9				1		8	1	47
Texas	1	12	8	2	2	4				29
Utah	12	2				7				21
Vermont		15						16	[c]1	32
Virginia	28	12			3	9		23		75
Washington		24								24
West Virginia	16	2		1	3	18		1	1	42
Wisconsin	3	90						4		97
Wyoming	1									1
Total	1,299	426	59	41	53	71	30	186	38	2,203

[a] Shavings and manure (13) included.
[b] Natural gas and oil.
[c] Includes coal, wood, and coke.

OCCURRENCE OF LIMESTONE IN THE UNITED STATES.

The following paragraphs give the localities where limestone is quarried or has been quarried for building stone, crushed stone, flux, or for burning into lime. The occurrences where the stone has been used for other purposes than burning into lime are given as a possible source of material for that use. This information, which is arranged alphabetically by States, and by counties under the State headings, has been taken from many publications and is believed to be correct so far as definite localities mentioned are concerned. It admittedly does not contain mention of all possible sources of limestone in each State, for limestone is one of our practically inexhaustible resources and occurs in many States in billions of tons.

ALABAMA.

Building stone.—Quarried in Blount County, near Blount Springs and Bangor; in Calhoun County, at Anniston; Franklin County, at Rockwood. Used in construction of locks on Tennessee River, and at Greenport and other sites on Coosa River. Quarried also in Etowah County, at Lagarde, and in Bibb, Colbert, De Kalb, Jefferson, Marshall, Shelby, St. Clair, and Talladega counties.

Crushed stone.—Quarried for macadam, riprap, in Blount County at Chepultepec; Clarke County, Coffeeville; Etowah County, Lagarde; Franklin County, Rockwood and Darlington; Jackson County, Bridgeport; Jefferson County, Gate City; Madison County, Huntsville; Morgan County, Guntersville; Tuscaloosa County, Dowdle between Vance and Bibbville; Washington County, St. Stephens.

Lime.—Quarried and burned in Blount County near Chepultepec; Calhoun County, Anniston; Colbert County, Dennis kilns; De Kalb County, Fort Payne; Etowah County, Rock Springs; Jackson County, Bridgeport; Lee County, Chewacla kilns; Morgan County, New Decatur; Shelby County, about Calera, Keystone, Longview, Newala, Saginaw, and elsewhere; Tuscaloosa County, Dowdle between Vance and Bibbville.

ARIZONA.

Cochise County, quarried for building or lime at Lee Station; Coconino County, at Flagstaff; Gila County, quarried during construction of dam at Roosevelt; Greenlee County, gray Modoc limestone quarried at Morenci; Yavapai County, at Wekon.

ARKANSAS.

Building.—Carroll County, quarried at Eureka Springs; Independence County, oolitic limestone, ornamental, has been quarried at Batesville; Izard County, quarried at Guion; Lawrence County, quarried at Imboden, for building and crushed stone.

Hydraulic.—Occurs in Saline County and many counties in northern part of State; not used.

Lime.—Benton County, quarried and burned near Rogers; Montgomery County, Cedar Glades; Stone County, east of Sylamore; Washington County, Farmington, Johnson, and elsewhere.

CALIFORNIA.

Building.—Well distributed over State, chiefly used for lime. Quarried for building, crushed stone, and road metal. Amador County, 4 miles east of Ione; Modoc County, Cedarville; San Bernardino County, Colton; Santa Cruz County, Santa Cruz; Shasta County, Redding.

Lime.—Burned for lime in the following counties: Alameda, Amador, Calaveras, Colusa, Contra Costa, Eldorado, Kern, Monterey, Riverside, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Shasta, Siskiyou, Tuolumne, Ventura, and other counties.

COLORADO.

Chaffee County, limestone quarried at Garfield and Newett; Boulder and Larimer counties, limestones of Lykins, Morrison, and Niobrara formations burned for lime along foothills of northern Colorado; Douglas County, has been quarried at Silica for lime; El Paso County, Manitou, for lime; Fremont County, quarried at Canon City and Calcite for crushed stone; Jefferson County, quarried at Mount Morrison; La Plata County, at Rockwood; Larimer County, at Ingleside for sugar refining; Pitkin County, burned for lime at Thomasville; Pueblo County, quarried at Lime near Pueblo. Abundant in many counties.

CONNECTICUT.

Crushed stone.—Litchfield County, quarried at Canaan.

Flux.—Litchfield County, was quarried at East Canaan.

Hydraulic.—Hartford County, near Berlin in Southington; in thin strata, compact, earthy, and somewhat bituminous; Northford, a gray limestone.

Lime.—Fairfield County, magnesian limestone burned near Redding, Brookfield, Ridgefield, and Danbury; Litchfield County, at Canaan.

DELAWARE.

Newcastle County, has been quarried at Jeane's, on Pike Creek; Klair's, 2 miles west of Centerville; Bullock's, on Brandywine, near Pennsylvania line.

FLORIDA.

Alachua County, has been quarried at Gainesville; Dade County, Miami oolite quarried at Miami for several large buildings, and used also as road metal; De Soto County, occurs at Charlotte Harbor; Hillsboro County, Fort Brooke; Jackson County, from Campbellton to Marianna; Manatee County, Manatee River; Marion County, Kendrick, Ocala, and Silver Springs; Monroe County, oolite at Key West; Orange County, Rock Spring; Wakulla County, St. Marks. Occurs also in Hernando, Holmes, Leon, Walton, and Washington counties.

Lime.—Marion County, burned at Ocala and Kendrick.

GEORGIA.

Building.—Catoosa County, quarried at Graysville; Walker County, Chickamauga and Rossville.

Crushed stone.—Bartow County, quarried at Cartersville and Clifford; Catoosa County, Graysville; Walker County, Chickamauga.

Flux.—Walker County, quarried at Chickamauga.

Lime.—Bartow County, quarried at Cartersville; Catoosa County, Graysville; Hall County, Gainesville; Walker County, Rossville.

IDAHO.

Lime.—Bannock County, burned at Pebble; Cassida County, Burley; Clearwater County, Orofino; Fremont County, Rexburg and Teton; and at a large deposit in Kootenai County.

Building.—Quarried in Blaine County, at Ketchun and Arco; Fremont County, Rexburg; and Oneida County, Franklin.

ILLINOIS.

Building.—Quarried in Adams County, Boone, Carroll, Cook, Jersey, Jo Daviess, Kane, Kankakee, La Salle, McHenry, Madison, Monroe, Ogle, Randolph, Will, and Winnebago counties.

Crushed stone.—Quarried in Adams, Boone, Carroll, Cook, Dupage, Hancock, Jersey, Kane, Kankakee, La Salle, Lee, McHenry, Madison, Monroe, Montgomery, Ogle, Pike, Randolph, Rock Island, St. Clair, Union, Whiteside, Will, and Winnebago counties.

Flux.—Quarried in Adams County, at Quincy; Cook County, Chicago; Jersey County, Elsah; Monroe County, Millstadt Junction; Vermilion County, Fairmount; Will County, Joliet.

Fertilizer.—Good limestone for fertilizer occurs in Alexander County, along river bluff one-half mile south of Thebes; Coles County, near Charleston; Hardin County, Rosiclare; Johnson County, Belknap; Pulaski County, near Ullin; Union County, Anna.

Lime.—Quarried in Adams County, at Marblehead and Quincy; Cook County, many points in vicinity of Chicago; Jo Daviess County, Stockton; Kankakee County, Kankakee; Madison County, Alton; Monroe County, New Hanover; Rock Island County, Port Byron; Whiteside County, Fulton; Will County, Joliet; Winnebago County, Rockford.

INDIANA.

Building.—Quarried in Adams, Bartholomew, Crawford, Decatur, Delaware, Franklin, Grant, Howard, Huntington, Jennings, Lawrence, Monroe, Shelby, and Vanderburg counties.

Laurel limestone (Niagaran) quarried from extensive beds in Decatur County, at St. Paul, New Point, and Westport; Franklin County, Laurel; Ripley County, near Osgood; Wabash County, similar stone quarried near Wabash.

Oolitic limestone, principal quarries: Harrison County, Corydon; Lawrence County, Bedford, Dark Hollow, and Oolitic; Monroe County, Bloomington, Ellettsville, Sanders, and Stinesville; Owen County, near Romona.

Crushed stone.—Grant County, crushed at Marion and near Roseburg; Wabash County, on river bluff, near Wabash.

Flux.—Quarried in Cass County, at Trimmer; Franklin County, Laurel; Lake County, Indiana Harbor; Lawrence County, Bedford; Monroe County, Bloomington and Ellettsville.

Lime.—Has been or is burned in Carroll County, at Delphi; Cass County, Keesport; Clark County, near Utica; Crawford County, Milltown; Franklin County, near Laurel; Huntington County, Huntington; Jay County, Portland; Lawrence County, Mitchell; Madison County, near Ingalls; Ripley County, near Napoleon; Washington County, Salem.

Road metal.—Quarried in Adams, Blackford, Carroll, Cass, Clark, Decatur, Delaware, Floyd, Fountain, Franklin, Grant, Hamilton, Harrison, Howard, Huntington, Jasper, Jay, Jennings, Lawrence, Madison, Montgomery, Newton, Owen, Putnam, Pulaski, Randolph, Ripley, Rush, Shelby, Vanderburgh, Wabash, Wells, and White counties.

"*Rock wool.*"—Madison County, upper layers Niagara limestone used at Alexandria, for mineral or "rock wool" by melting and blowing into threads.

IOWA.

Building, crushed stone.—Quarried at one or more places in more than half the counties in the State.

Lime.—Has been burned at several places in Benton, Blackhawk, Bremer, Cedar, Cerro Gordo, Clayton, Clinton, Davis, Des Moines, Henry, Humboldt, Jackson, Johnson, Linn, Mills, Mitchell, Monroe, Montgomery, Plymouth, Scott, Union, and other counties.

KANSAS.

Building.—Quarried in the following counties: Atchison, Bourbon, Brown, Butler, Chase, Chautauqua, Cowley, Douglas, Franklin, Greenwood, Jackson, Jewell, Johnson, Labette, Leavenworth, Lyon, Marion, Marshall, Miami, Neosho, Ness, Phillips, Pottawatomie, Riley, Rush, Russell, Shawnee, Sumner, Wabaunsee, and Wyandotte.

Crushed stone.—Atchison, Brown, Butler, Chase, Chautauqua, Cowley, Douglas, Elk, Franklin, Greenwood, Jackson, Johnson, Labette, Leavenworth, Lyon, Marion, Marshall, Miami, Morris, Neosho, Pottawatomie, Riley, Russell, Saline, Shawnee, and Wyandotte counties.

Lime.—Burned for lime: Bourbon County, at Fort Scott; Chautauqua County, at Sedan; Elk County, at Moline; Shawnee County, at Topeka; entire lime business rapidly declining.

Hydraulic, water lime, cement work.—Bourbon County, magnesian limestone occurs at Fort Scott, to some extent hydraulic. Manufactured at Fort Scott.

KENTUCKY.

Widely distributed. Used in many counties. Quarried in the following counties: Boyle, Fayette, Jefferson, Jessamine, Kenton, Pendleton, Warren. Has been quarried: Barren, Caldwell, Pulaski, also in Grayson, Meade, Simpson, Todd, Wolfe, and other counties.

Flux.—Quarried: Boyd County, at Ashland; Carter County, Lawton and Limestone; Kenton County, Covington; Rockcastle County, Burr; occurs at many other points.

Lime.—Quarried: Christian County, at Hopkinsville; Hardin County, Elizabethtown; Meade County, near Battletown and Cedar Branch; Rockcastle County, Mt. Vernon; Union County, Mississippian limestone was burned near Morganfield.

Oolitic.—Large quarries in Warren County. The oolite outcrops around eastern and northern edge of western coal field and across from there to western edge of eastern coal field.

LOUISIANA.

Building.—St. Landry Parish, small outcrops; good building stone.

Crushed stone.—Winn Parish, produced at Winnfield.

Lime.—Natchitoches Parish, was burned locally 5 miles from Natchitoches; Sabine Parish, Rocky Spring; St. Landry Parish, Pine Prairie, and on Bayou Chicot.

MAINE.

Lime.—Knox County, extensively quarried and burned in vicinity of Rockland, Rockport, Thomaston, and West Warren.

MARYLAND.

Building.—Very little limestone is quarried for dimension building stone; small quantities are taken at a few places for local use.

Crushed stone.—Quarried: Allegany County, at Cumberland; Baltimore County, Baltimore, Glyndon; Frederick County, Catoctin Furnace, Frederick, Lime Kiln; Washington County, Cavetown, near Hagerstown, at Maugansville, Pinesburg, and elsewhere.

Lime.—Quarries in which stone is or formerly was procured to burn for lime: Allegany, Baltimore, Carroll, Frederick, Howard, and Washington counties.

MASSACHUSETTS.

Building.—Berkshire County, quarried at North Adams; Middlesex County, Acton, Carlisle, Chelmsford, Littleton, and Stoneham; Worcester County, has been quarried at Bolton.

Lime.—Berkshire County, burned at Adams, Cheshire, and elsewhere.

MICHIGAN.

Extensively quarried in Alpena County; Eaton County, at Bellevue; and Wayne County, Sibley, for use in sodium bicarbonate, soda ash, etc. Limestone for Portland cement quarried in the following counties: Alpena, Eaton, Emmet, Monroe, Newaygo, and Wayne. Suitable limestone also occurs in Arenac, Charlevoix, Huron, Cheboygan, Jackson, and Presque Isle counties, but is not used.

Building.—Quarries in Alpena County, at Alpena; Arenac County, Omer; small quantity quarried in Emmet County, at Petoskey; Huron County, Bay Port; Kent County, Grand Rapids; Menominee County, Menominee; Monroe County, Monroe and Maybee.

Crushed stone.—Quarried and crushed in Alpena, Charlevoix, Cheboygan, Delta, Emmet, Huron, Mackinac, Menominee, Monroe, Oakland, Schoolcraft, and Wayne counties.

Flux.—Quarried in Alpena, Emmet, Mackinac, Monroe, Presque Isle, and Schoolcraft counties.

Lime.—Quarried and burned in Alpena, Charlevoix, Eaton, Emmet, Huron, Jackson, Kent, Monroe, Sanilac, Schoolcraft, and Wayne counties.

MINNESOTA.

Building.—Cottonwood County, limestone was quarried at Selma and Delton for foundations and walls. Lesueur County, magnesian limestone quarried at Kasota.

Crushed stone.—Quarried in the following counties: Anoka, Blue Earth, Dakota, Dodge, Fillmore, Goodhue, Hennepin, Houston, Lesueur, Nicollet, Olmsted, Ramsey, Rice, Scott, Sibley, Steele, Traverse, Wabasha, Washington, and Winona.

Hydraulic.—Dodge County, Galena limestone at Mantorville, has properties of hydraulic limestone.

Lime.—Limestones widely distributed and burned in many counties in the State.

MISSISSIPPI.

Quarried for building material for local use in Clarke, Jasper, Noxubee, Smith, and Wayne counties. Burned for lime in Jasper, Rankin, and Wayne counties.

MISSOURI.

Building.—Limestones widely distributed over the State suitable for building purposes. Large quarries in Cape Girardeau County; Greene County, Phenix; and Jasper County, at Carthage. Many other quarries in eastern, northern, and western counties of the State.

Crushed stone, road metal, etc.—Quarried extensively throughout the State, with the exception of counties in the south central part.

Flux.—Lincoln County, quarried at Ellsberry; and St. Louis County, near White House.

Lime.—Limestones excellent for lime making are burned at many localities in the State. Large plants are located at Ash Grove, Cape Girardeau, Glencoe, Glen Park, Hannibal, Louisiana, Mincke, Pierce City, Sarcoxie, Springfield, and Ste. Genevieve.

MONTANA.

Building.—Abundant in western part of the State. Quarried in Flathead County, at Kalispell; and Lewis and Clark County, Helena.

Flux and lime.—Cascade County, quarried at Albright and Logging Creek; Gallatin County, Bozeman; Jefferson County, Limespur; Lewis and Clark County, East Helena; Powell County, Elliston; and Silverbow County, Divide.

NEBRASKA.

Building.—Cass County, quarries located at Nehawka, Cedar Creek, Louisville, and Weeping Water; Gage County, Wymore and Blue Springs; Jefferson County, near Fairbury and Endicott; Johnson County, Graf and Tecumseh; Nemaha County, Auburn and Glen Rock; Otoe County, Syracuse and Nebraska City; Sarpy County, La Platte and Meadow; Cheyenne County, Sidney; small quarries at other localities.

Crushed stone.—Cass County, quarried at Cedar Creek, Louisville, and elsewhere; Cheyenne County, Sidney; Gage County, Holmesville, Rockford, and Wymore; Nemaha County, Auburn, Brock, and Johnson.

Flux.—Cass County, quarried at Nehawka.

NEVADA.

Building.—Humboldt County, abundant good building stone near Lovelocks. Some of the abundant limestones of the eastern half of the State might yield good building stone.

Lime.—Ormsby County, formerly quarried several miles southeast of Carson City. Limestone suitable for lime is common in eastern half of State; scattered occurrences in western half of State.

NEW HAMPSHIRE.

Lime.—Grafton County, was burned at Haverhill, Lisbon, and Littleton.

NEW JERSEY.

Building.—Hunterdon County, small quantities quarried at Clinton; Sussex County, near Franklin Furnace, and Newton, local use; Warren County, Blairstown, Carpenterville.

Crushed stone.—Hunterdon County, quarried at Clinton, Califon, and Vernoy; Sussex County, Ogdensburg; Warren County, Finesville and Hackettstown.

Flux and lime.—Hunterdon County, quarried at Annandale, Califon, Clinton, and elsewhere; Morris County, Mendham; Sussex County, at Andover, Hamburg, McAfee, Montague, Ogdensburg, and elsewhere; Warren County, Bloomsburg, Carpenterville, Finesville, and elsewhere; Somerset County, Peapack and Penwell.

NEW MEXICO.

Building and crushed stone.—Present in many parts of the State; Mora County, quarried at Watrous; Otero County, abundant, not used.

Lime.—San Miguel County, quarried at Las Vegas.

Onyx marble.—Grant County, reported near Silver City; Lincoln County, reported near White Oaks; Otero County, deposits worked near Alamogordo.

NEW YORK.

Building.—Limestones locally used for building; producing quarries in Albany, Cayuga, Clinton, Erie, Genesee, Greene, Jefferson, Lewis, Madison, Monroe, Montgomery, Niagara, Onondaga, Renssolaer, St. Lawrence, Schoharie, Seneca, Ulster, and Warren counties.

Crushed stone.—Quarried in the following counties: Albany, Cayuga, Clinton, Columbia, Dutchess, Erie, Essex, Fulton, Genesee, Greene, Jefferson, Lewis, Madison, Monroe, Montgomery, Niagara, Oneida, Orange, Onondaga, Ontario, Orleans, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Seneca, Ulster, Warren, Washington, and Westchester.

Flux.—Quarried for flux in Cayuga County, at Auburn; Clinton County, Chazy; Erie County, Buffalo, Clarence, and Williamsville; Essex County, Port Henry; Genesee County, Le Roy; Niagara County, Pekin; St. Lawrence County, Gouverneur; Suffolk County, Greenport.

Lime.—Burned in Albany, Cayuga, Clinton, Dutchess, Erie, Fulton, Genesee, Herkimer, Jefferson, Lewis, Monroe, Niagara, Onondaga, St. Lawrence, Ulster, Warren, Washington, Westchester, and other counties.

NORTH CAROLINA.

Produced mainly for burning into lime, and for road metal. Quarries, in 1910, in Craven County, at Newbern; Henderson County, at Fletcher and Hendersonville; Transylvania County, Brevard. Has been quarried in Beaufort, Buncombe, Jones, and New Hanover counties. Other localities known in Cleveland, Gaston, Lincoln, and Stokes counties.

OHIO.

Building.—Quarried in Allen, Butler, Clark, Clermont, Clinton, Delaware, Erie, Franklin, Greene, Hamilton, Hancock, Highland, Huron, Logan, Lucas, Marion, Miami, Montgomery, Preble, Putnam, Sandusky, Seneca, and Wood counties.

Crushed stone.—Carboniferous, Silurian, and Devonian limestones widely distributed, except for barren area extending in a north-south direction in the central part of the State. Used extensively in Allen, Butler, Clark, Clay, Clermont, Clinton, Columbiana, Crawford, Delaware, Erie, Franklin, Greene, Hamilton, Hancock, Hardin, Highland, Lawrence, Logan, Lucas, Mahoning, Marion, Mercer, Miami, Montgomery, Ottawa, Paulding, Preble, Putnam, Ross, Sandusky, Seneca, Van Wert, Wood, and Wyandot counties.

Flux.—Used as flux in iron and copper smelters and in the manufacture of glass. Quarried in Clark, Crawford, Franklin, Lawrence, Lucas, Mahoning, Marion, Miami, and Ottawa counties.

Lime.—Burned in Belmont, Clark, Crawford, Delaware, Erie, Greene, Hamilton, Hardin, Harrison, Highland, Logan, Marion, Mercer, Miami, Montgomery, Ottawa, Preble, Sandusky, Seneca, Stark, Wood, and Wyandot counties.

OKLAHOMA.

Jackson County, Creta and Olustee; Johnston County, large plant quarrying oolitic limestone at Bromide; Kay County, gray or nearly white, fine grained, quarried at Newkirk, Ponca, and Uncas; Nowata County, Nowata; Osage County, Pawhuska; Ottawa County, Boone limestone quarried in some extent at Wyandotte; Pawnee County, Jennings, and 1 mile west of Pawnee; Tulsa County, Skiatook, Lost City, and near Tulsa; Washington County, Bartlesville and Dewey.

Crushed stone.—Quarried in Atoka, Caddo, Comanche, Jackson, Kay, Murray, Nowata, Osage, Pawnee, Pittsburg, and Tulsa counties.

Lime.—Burned in Delaware County, at Grove and at other localities, for local use; Johnston County, at Bromide and Wapanucka.

OREGON.

Flux.—Baker County, Lime; Jackson County, near Rock Point on Rogue River.

Lime.—Baker County, burned near Huntington, Durkes, and Lime; Douglas County, Roseburg; Grant County, 4 miles east of Canyon City; Jackson County, on Rogue River near Rock Point, and on Kane Creek, south of Gold Hill; Wallowa County, at Lostine City.

PENNSYLVANIA.

Extensively quarried over a large part of the State for building stone, crushed stone, and flux.

RHODE ISLAND.

Providence County, is quarried and burned for lime at Limerock, town of Lincoln, and formerly near Centerdale.

SOUTH CAROLINA.

Building and lime.—Occurs at many points in State, especially in western part. Cherokee County, quarried regularly at Limestone Springs, near Gaffney, chiefly for lime, but in part for building stone; has been quarried intermittently near Blacksburg and Grover; Greenwood County, has been quarried near Ware Shoals; Oconee County, 10 miles northwest of Fort Madison, and 4 to 9 miles northwest of Walhalla.

SOUTH DAKOTA.

Building, crushed stone.—Quarried in Custer County, near Argyle, for railroad ballast; Lawrence County, at Spearfish; Meade County, Sturgis.

Chalkstone.—Bonhomme County, has been used locally for building in Scotland and Springfield; Davison County, Mitchell; Minnehaha County, Brandon.

Lime, flux.—Excellent lime made from purple limestone in Black Hills region; quarried at Deadwood, Lawrence County; and near Rapid City, Pennington County.

TENNESSEE.

Quarries: Bradley, Cumberland, Davidson, Decatur, Franklin, Giles, Hamilton, Houston, Jefferson, Knox, Lawrence, Marion, Marshall, Maury, Overton, Roane, Robinson, Rutherford, Sullivan, Sumner, White, and Wilson counties.

Flagging.—Quarried: Knox County, near Knoxville, blue flags; Morgan County, near Montgomery; Wilson County, Lebanon. Sandstone of the Mississippian limestone, Overton and White counties.

Flux.—Quarried: Carter County, Milligan; Claiborne County, Cumberland Gap; Hickman County, Bon Aqua; James County, Ooltewah; Montgomery County, Clarksville; Rhea County, Dayton; Roane County, Rockwood; Washington County, Embreeville.

TEXAS.

Lime.—Limestones in great variety of texture and composition occur in many localities. The principal quarries are in the following counties: Bell, Bexar, Bosque, Brown, Coleman, Collin, Comal, Comanche, Corvell, Dallas, El Paso, Erath, Grayson, Guadalupe, Jack, Jones, Kaufman, Lampasas, McCulloch, Nolan, Palo Pinto, Runnels, San Saba, Smith, Tarrant, Travis, Williamson. These localities also afford lime, but the chief lime-producing counties are Bexar, Comal, El Paso, San Saba, Williamson. The pure white limestones of Bexar and Williamson counties are much used for building and have the advantage of being easily sawed into shape by hand.

UTAH.

Building.—Quarried in Beaver County, at Beaver and Greenville; Carbon County, on Tie Fork of Soldier Creek, 7 miles northwest of Clearcreek; San Juan County, Grayson; Sanpete County, Ephraim; Utah County, Lehi and Provo.

Crushed stone.—Quarried at Ogden and Salt Lake City.

Flux.—Used in Salt Lake County, at Salt Lake City; Tooele County, at Topliff; Weber County, Hot Springs.

Lime.—Burned in Beaver County, at Beaver; Iron County, Cedar City; Salt Lake County, Salt Lake; Sevier County, Richfield; Utah County, near Provo.

VERMONT.

Building.—Grand Isle County, Isle La Motte.

Lime.—Addison County, Leicester Junction and New Haven; Chittenden County, Colchester; Franklin County, Highgate, Highgate Springs, St. Albans, and Swanton; Rutland County, Brandon; Windsor County, Amsden.

VIRGINIA.

Abundant west of the Blue Ridge; quarried in many localities from Frederick County to Wise County; also in Piedmont counties.

Building.—Quarried in Botetourt County, at Compton Bridge; Loudoun County, Leesburg; Roanoke County, Roanoke; Washington County, Abingdon; Wythe County, small quantity at Wytheville.

Crushed stone.—Quarried: Botetourt County, at Eagle Rock, Indian Rock, and Springwood; Campbell County, Lynchburg; Loudoun County, Leesburg; Roanoke County, Roanoke; Washington County, Abingdon.

Flux.—Alleghany, Botetourt, Pulaski, Rockbridge, Wise, and Wythe counties.

Hydraulic.—Orange County, has been quarried at Madison Run; Rockbridge County, Balcony Falls on James River (a gray magnesian stone, noted "Balcony Falls cement").

Lime.—Quarried: Augusta, Botetourt, Frederick, Giles, Loudoun, Montgomery, Rockbridge, Rockingham, Shenandoah, and Warren counties.

WASHINGTON.

Building.—Snohomish County, quarried 3 miles east of Granite Falls; shipped to Seattle and elsewhere.

Cement material.—Counties of Ferry, King, Okanogan, San Juan, Skagit, Snohomish, Stevens, and Whatcom; limestone suitable for cement making, associated with shale.

Flux.—San Juan County, worked on East Sound, Orcas Island. San Juan Island deposit extending from Roche Harbor to Westcott Bay, extensively worked; Stevens County, Evans and Northport.

Lime.—Chelan County, burned at Lake Chelan; Ferry County, burned between Republic and Wauconda; King County, near Olga and at Seattle; San Juan County, Orcas Island, Deer Harbor, and Roche Harbor; San Juan Island, deposit extending from Roche Harbor to Westcott Bay, extensively worked; Snohomish County, 3 miles east of Granite Falls; Stevens County, Springdale.

WEST VIRGINIA.

Building.—Greenbrier County, at Lewisburg; Jefferson County, near Charlestown, at Millville, and Shepherdstown; Preston County, small quantity quarried at Orr, also 1 mile west of Corinth.

Crushed stone.—Greenbrier County, at Fort Spring; Jefferson County, Keller, and three-fourths mile west of Engles Siding; Mineral County, Keyser; Monongalia County, Sturgisson; Monroe County, near Frazier; Ohio County, near Wheeling; Preston County, Afton.

Flux.—Berkeley County, has been quarried for flux at Bunker Hill and Martinsburg.

Lime.—Burned for lime: Berkeley County, at Bunker Hill; Greenbrier County, Fort Spring; Jefferson County, Millville; Monroe County, Snowflake; Preston County, Afton, Cranesville, and elsewhere.

WISCONSIN.

Building.—Quarried in following counties: Brown, Buffalo, Calumet, Crawford, Didge, Door, Fond du Lac, Grant, Iowa, Jefferson, Kewaunee, La Crosse, Lafayette, Manitowoc, Milwaukee, Oconto, Outagamie, Ozaukee, Pepin, Pierce, Polk, Racine, Rock, St. Croix, Sheboygan, Trempealeau, Vernon, Walworth, Waukesha, Winnebago, and Wood.

Crushed stone.—Quarried in the following counties: Brown, Buffalo, Calumet, Dane, Dodge, Door, Fond du Lac, Grant, Iowa, Jefferson, Kewaunee, La Crosse, Lafayette, Manitowoc, Milwaukee, Monroe, Outagamie, Ozaukee, Racine, Rock, Sheboygan, Trempealeau, Vernon, Waukesha, and Winnebago.

Flux.—Quarried: Dodge County, at Knowles and Mayville; Fond du Lac County, Hamilton.

Hydraulic, water lime, cement rock.—Fond du Lac County, quarried at Ripon; Milwaukee County, has been quarried at Milwaukee; Winnebago County, has been quarried at Poygan.

Lime.—Quarried in following counties: Buffalo, Calumet, Dodge, Door, Fond du Lac, Green, Kewaunee, Lafayette, Oconto, Outagamie, Ozaukee, Pierce, Racine, Trempealeau, Vernon, Washington, and Waukesha.

WYOMING.

Albany County, 3 miles northeast of Laramie City, used for lime in beet-sugar refining. Limestones of Carboniferous and Jurassic age in many counties afford an abundance of good lime suitable for plaster; some of these limestones are hydraulic.

Building.—Quarried: Albany County, at Laramie; Carbon County, Rawlins, Fremont County, Thermopolis; and Sweetwater County, Green River.

Flux.—Quarried: Carbon County, at Rawlins; Laramie County, Guernsey.

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SAND-LIME BRICK.[1]

INTRODUCTION.

The sand-lime brick industry has been established in the United States a little over 10 years, and in Europe, especially in Germany, where it is a large and flourishing industry, for a much longer period. In this country it has passed through many vicissitudes. At first it grew rapidly, rising from 1 plant in 1901 to 16 in 1903 and to 57 in 1904, and in 1907, 94 plants were in active operation, reporting products valued at $1,225,769. This growth was not, however, a healthy one. Many plants were erected where market conditions were not propitious and others where suitable materials were not available; others, although conditions and materials were satisfactory, failed for want of technical skill or because of poor management. Consequently many plants that were erected in the beginning of the industry are not now operating, and some of them never even began operations. Notwithstanding this serious handicap and the fact that the value of the product decreased almost constantly from 1907 to 1911, in 1912 the number of plants in operation increased and the value of the product showed a large gain. During 1912 some of the abandoned plants were taken over by skilled men, were remodeled in accordance with the latest developments, and are now being operated successfully. The prospects for 1913 are bright, the future of the industry seems established, and a steady growth may be expected. There appears to be a successful field for the sand-lime brick industry, especially where other building materials are scarce and sand is plentiful and lime accessible. The product, as shown by experience at home and abroad, may be made durable and attractive, and tests made on it show that it meets all requirements as a building material.

The manufacture of sand-lime brick showed considerable progress in 1912 over 1911. The value of the product reported in 1912 was $1,200,223, compared with $897,664 in 1911, an increase of $302,559, or 33.71 per cent. In 1911 production decreased $271,489, or 23.22 per cent, from 1910, so that the value in 1912 was slightly greater than that of 1910 and only 2.08 per cent less than that of 1907, the banner year in the industry.

[1] After the publication of the advance chapter on sand-lime brick in 1912, additional data were received which caused considerable changes in the figures of the report.

PRODUCTION.

The following table shows the production of sand-lime brick in the United States from 1903 to 1912, inclusive:

Value of production of sand-lime brick in the United States, 1903–1912.

Year.	Number of operating firms reporting.	Value of product.	Year.	Number of operating firms reporting.	Value of product.
1903	16	$155,040	1908	87	$1,029,699
1904	57	463,128	1909	74	1,150,580
1905	84	972,064	1910	76	1,169,153
1906	87	1,170,005	1911	66	897,664
1907	94	1,225,769	1912	71	1,200,223

This table shows that the value of the sand-lime brick marketed rose rapidly until 1907, the year of maximum value of production and also of the largest number of operating firms. In 1908 there was a decrease, in common with all other industries; in 1909 and 1910 there were slight increases. In 1911 the lowest value was reached ($897,664) since 1904, and the outlook did not appear encouraging. For 1912, however, there was a considerable gain in value of product and in number of firms reporting production.

The following tables show the production of sand-lime brick in 1911 and 1912 by States and kinds:

Production of sand-lime brick in the United States in 1911, by States and kinds.

State.	Number of operating firms reporting.	Common brick.		Front brick.		Miscellaneous (value).[a]	Total value.
		Quantity (thousands).	Value.	Quantity (thousands).	Value.		
California	4	1,087	$8,040	980	$11,495		$19,535
Colorado, Idaho, and Washington	5	3,795	30,008	613	7,995		38,003
Connecticut, District of Columbia, Maryland, Massachusetts, and Pennsylvania	7	12,420	76,808	(b)	(b)	(b)	80,830
Florida	3	9,266	51,266	(b)	(b)		56,274
Georgia, Kentucky, Mississippi, and Ohio	5	10,306	59,765	(b)	(b)		66,325
Indiana	3	10,192	45,891				45,891
Iowa, Kansas, Nebraska, North Dakota, and Texas	7	8,361	68,994	(b)	(b)		73,584
Michigan	10	32,889	192,224	2,726	17,777		210,001
Minnesota	4	15,957	89,569	272	4.075	(b)	93,734
New Jersey	3	1,314	8,716	674	8,994		17,710
New York	8	15,547	93,980	(b)	(b)		95,930
South Dakota	3	4,200	31,535				31,535
Wisconsin	4	10,238	68,312				68,312
Other States[c]				2,126	20,130	$2,090	(d)
Total	66	135,572	825,108	7,391	70,466	2,090	897,664
Average price per M			6.09		9.53		

[a] Including blocks and trimmings and fancy brick.
[b] Included in "Other States."
[c] Includes all products made by less than three producers in one State to prevent disclosing individual operations.
[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.

Production of sand-lime brick in the United States in 1912, by States and kinds.

State.	Number of operating firms reporting.	Common brick.		Front brick.		Miscellaneous (value).[a]	Total value.
		Quantity (thousands).	Value.	Quantity (thousands).	Value.		
California	5	1,511	$12,635	1,395	$20,875	(b)	$33,860
Colorado, Montana, and Washington	4	1,622	9,732	585	9,915		19,647
Connecticut, District of Columbia, Maryland, and Massachusetts	5	6,478	57,020	3,755	30,209	(b)	92,659
Florida	5	16,216	110,436	(b)	(b)		121,378
Georgia, Kentucky, Mississippi, and Ohio	4	10,463	61,294	(b)	(b)		63,878
Idaho	3	1,668	19,677	(b)	(b)	(b)	25,121
Indiana	3	12,056	59,929				59,929
Iowa, Kansas, Nebraska, North Dakota, Oklahoma, and Texas	8	11,684	90,265				96,450
Michigan	11	48,129	307,106	(b)	(b)		316,732
Minnesota	4	19,232	109,765	262	3,020		112,785
New Jersey	4	760	4,940	(b)	(b)		6,924
New York	5	19,858	123,500	(b)	(b)		128,700
Pennsylvania	3	6,365	36,970				36,970
South Dakota	3	1,780	14,395				14,395
Wisconsin	4	10,498	70,265	(b)	(b)		70,795
Other States[c]				4,224	42,375	$5,900	(d)
Total	71	168,320	1,087,929	10,221	106,394	5,900	1,200,223
Average price per M			6.46		10.41		

[a] Including blocks and trimmings and fancy brick.
[b] Included in "Other States."
[c] Includes all products made by less than three producers in one State to prevent disclosing individual operations.
[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 that the value of the product in 1912 increased $302,559, or 33.71 per cent, and is the second largest value reported in the history of the industry. The number of States in which production was reported in 1912 was 28, an increase of 2 over 1911, Montana and Oklahoma being added as producers. In order to avoid disclosing individual operations it has been necessary to group certain States together. Michigan continued in 1912 to be the leading State in value of output, its product constituting 26.39 per cent of the total value of all sand-lime products in 1912, and 23.39 per cent of the total of 1911. New York was second in value of product, as in 1911, reporting 10.72 per cent of the total in 1912. Florida was third in 1912, displacing Minnesota, which fell to fourth place.

Of the States for which totals are given, eight—California, Florida, Idaho, Indiana, Michigan, Minnesota, New York, and Wisconsin—showed an increase in 1912, and three—New Jersey, Pennsylvania, and South Dakota—showed a decrease. Michigan showed the largest increase—$106,731, or 50.82 per cent; Florida showed the second largest actual increase and the largest proportional gain—115.69 per cent. New York's gain was next, $32,770, or 34.16 per cent. In 1911 only two States—New York and Wisconsin—showed an increase.

Michigan had the largest number (11) of operating firms reporting in 1912, a gain of one over 1911. California, Florida, and New York each had five operating firms reporting in 1912. This was a gain of one in California and of two in Florida, and a decrease of three in New York.

The average price per thousand for common sand-lime brick was $6.46 in 1912, as compared with $6.09 in 1911, and with $6.36 in 1910; for front brick it was $10.41 in 1912, as against $9.53 in 1911 and $10.90 in 1910. In 1912 common brick represented 90.64 per cent of the value of all products, front brick 8.86 per cent, and all other products 0.50 per cent; in 1911 these percentages were 91.92, 7.85, and 0.23, respectively.

SAND-LIME BRICK INDUSTRY BY STATES.

California.—Reports were received from seven operators in California, five of whom marketed products in 1912. This was an increase of one over 1911 in the number of operating plants. The value of the sand-lime brick reported in California increased $14,325, or 73.33 per cent, in 1912 over 1911.

Colorado, Montana, and Washington.—In this group of States four plants were in operation in 1912, one in Colorado, one in Montana, and two in Washington. In Colorado conditions were reported as dull, with little building and low prices. In Montana the production from the one plant was small, and the plant was closed at the end of the year. In Washington there were three plants, two of which were in operation in 1912.

Connecticut, District of Columbia, Maryland, and Massachusetts.—In this group there were five operating firms, one in Connecticut, one in the District of Columbia, one in Maryland, and two in Massachusetts. In Massachusetts a new plant was under construction, which was expected to market its products during 1913.

Florida.—Florida was third in value of sand-lime brick in 1912. There were five operating plants reporting for 1912, two of which began operations late in the year. In 1911 only three plants were in operation. The value of the product marketed in Florida in 1912 was more than double that of 1911—$121,378 in 1912, against $56,274 in 1911, an increase of $65,104, or 115.69 per cent. The prospects for 1913 are good for a further increase in production. The scarcity of clay suitable for brickmaking and the abundance of sand in Florida should foster the sand-lime brick industry in that State.

Georgia, Kentucky, Mississippi, and Ohio.—There was only one operating plant in each of these four States in 1912. In Georgia the condition of trade was reported much better than in 1911; and in Kentucky, Mississippi, and Ohio trade was about the same as in 1911, with an improvement in Ohio during the latter part of 1912.

Idaho.—Three plants were in operation in Idaho in 1912, an increase of one over 1911. The value of the product also increased considerably, and the prospects for a still larger increase in 1913 are good. A part of the increase in 1912 was due to the higher prices which prevailed during the year.

Indiana.—In 1912 there were five plants in Indiana, only three of which were in operation. It is stated that one plant which has been idle for two years will be remodeled and started again early in 1913. The value of the product in this State increased $14,038, or 30.59 per cent, over that of 1911.

Iowa, Kansas, Nebraska, North Dakota, Oklahoma, and Texas.—In this group of States there were eight operating firms. Two plants in Iowa, one in Kansas, one in Nebraska, one in North Dakota, one in Oklahoma, and two in Texas reported business. In Iowa and Kansas conditions were not so favorable as in 1911, and the value of the product there fell off considerably. In North Dakota and Texas business was much better than in 1911, and the value of the product in those States showed a large increase.

Michigan.—Michigan has been the leading State in the production of sand-lime brick since the beginning of the industry in this country except in 1906, when New York led. In 1912 there were 11 plants in the State, an increase of one over 1911, all of which reported sales, and nearly all reported better business in 1912 than in 1911. This improvement is shown by an increase of $106,731, or 50.82 per cent, in the value of the product. The value of Michigan's product was more than twice as much as the value of the product of the second State, New York, and constituted over 25 per cent of the total value.

Minnesota.—There were four operating plants in Minnesota in 1912, and one new plant which was expected to be in operation early in 1913. Business conditions in the State were generally favorable, and the product increased in value $19,051, or 20.32 per cent. Minnesota was fourth among the States in value of sand-lime brick in 1912.

New Jersey.—Four plants were in operation in New Jersey in 1912, an increase of one over 1911. All the plants reported sales. Notwithstanding the increase in the number of plants, the product decreased in value $10,786, or 60.9 per cent.

New York.—New York was second in the production of sand-lime brick in 1912, reporting a product valued at $128,700, an increase of $32,770, or 34.16 per cent, over 1911. Five plants reported sales, a decrease of three, and one new plant had not begun operations at the close of the year. Business was exceptionally good.

Pennsylvania.—Three plants reported sales and two were idle in Pennsylvania in 1912. The value of the product in this State was less in 1912 than in 1911, business being reported as poor.

South Dakota.—Three plants were in operation in South Dakota in 1912, all of which disposed of products. Conditions were reported as poor, and the value of the product decreased $17,140, or 54.35 per cent.

Wisconsin.—Four plants in Wisconsin in 1912, as in 1911, reported sales of sand-lime brick. Conditions in 1912 were about the same as in 1911, and the product showed a slight increase in value of $2,483, or 3.63 per cent.

SLATE.

By A. T. Coons.

PRODUCTION.

GENERAL CONDITIONS OF THE INDUSTRY.

CHANGES IN OUTPUT AND VALUE.

An increase of $315,299, or 5.50 per cent, marked the slate production of the United States in 1912 as compared with 1911. The output in 1912 was valued at $6,043,318 and in 1911 at $5,728,019. In 1911 there was a decrease of $508,740, or 8.16 per cent, from the output of 1910, which was valued at $6,236,759.

Although the increase for 1912 was encouraging to the operators, it did not represent unusual activity in the slate trade, which since the statistics of production were first collected in 1879 has shown only very gradual progress, fluctuating but slightly with trade and financial conditions. In fact, as compared with 1903, 10 years ago, when the slate output was valued at $6,256,885, the output in 1912 shows a decrease in value of $213,567. In only 1 year in these 10—1908—was the value more than in 1903. The average price per square of roofing slate has fluctuated but little in these 10 years, being $3.88 in 1903 and $3.87 in 1912; the highest average price per square during this time was $3.89 in 1908 and the lowest was $3.66 in 1906.

As stated in previous reports, the statistics of the production of slate represent the output of slate as reported by the slate quarrymen and include the quantity and the value of roofing slate and of mill stock sold by them and the value of a quantity of slate sold for other purposes. The values given for both mill stock and roofing slate represent prices f. o. b. at the point of shipment, the mill stock being classed as rough or manufactured, according to the condition in which it is sold by the quarrymen, whether as rough blocks to slate mills or in a finished or partly finished condition from mills at the quarries.

The slate operators in general reported demand better in 1912 than in 1911 and conditions of trade much better, especially during the last six months of the year. In some districts, however, and especially in Pennsylvania, the demand was reported as rather slow, with prices lower than in 1911. Roofing slate increased slightly, both in quantity and in value, and the average price remained the same in 1912 as in 1911. The quantity of mill stock, exclusive of the blackboard and school-slate output, increased somewhat while the value decreased, with proportionate decrease in price per square foot. The slate used for blackboards, school slates, and minor purposes, increased in value in 1912 as compared with 1911.

All the States except New Jersey and Arkansas increased in total value of output of slate, but Pennsylvania, the largest producer, showed only a very slight percentage of increase. Maryland, New York, Vermont, and Virginia increased and Arkansas, Maine, New Jersey, and Pennsylvania decreased in value of output of roofing slate. The production of mill stock in Pennsylvania, including blackboards and school slates, increased, as did that of mill stock alone in Maine; Vermont's production decreased.

In 1912 eight States contributed to the commercial output of slate in the United States. These States, in order of output, were: Pennsylvania, Vermont, Maine, Virginia, New York, Maryland, New Jersey, and Arkansas. In 1911 the rank was the same, with the inclusion of Georgia between New Jersey and Arkansas. Of more than 280 firms owning slate deposits, 175 companies were active in 1912. In 1911, 176 active firms reported. The other firms reported their quarries as idle, as in course of development, or as abandoned.

CAUSES OF SLOW DEVELOPMENT OF SLATE INDUSTRY.

Many reasons have been advanced in the trade papers for the lack of continuous increase in the slate trade. Generally the first reason advanced is that the quarrymen are more and more hampered by the continually increasing quantity of waste slate in the large quarries. This waste, which is said to amount to 60, 80, or even 90 per cent of the material quarried, must be handled by the quarrymen, and necessarily adds to the cost of production and forms huge mounds of scrap, some of them lying in the path of future development, or obstructing roads and passageways to and from the quarry. This waste has been discussed considerably, and experiments intended to discover methods of disposing of it have been made both by the United States Government, through the Bureau of Standards, and by private persons, including several chemists, but no use which will quickly obliterate the obnoxious heaps has yet been found. Some of the scrap slate is of suitable color and quality to be ground and used in the manufacture of paint; some is ground as material for shale brick; some of the discarded pieces are cut into regular shapes, embedded in an asphaltic mixture, and used for flat roofs; some of the material is broken into small pieces and sprinkled over a soft asphaltic surface for use on flat or slightly inclined roofs, where it presents a pleasing appearance, according with the color of the slate used; some may be used as a foundation for stucco work; and a small quantity is sold for structural material and for flagging. Scrap slate is also put on roads, but objection is made to this use on account of the fine dust into which the slate crushes. This objection does not apply to the nonfissile slate found in Massachusetts, which is largely used as road material. Another suggestion for utilizing the waste is that a small mill should be erected at or near each quarry for turning most of the scrap into mill stock. Almost innumerable uses have been found for milled slate, and although no great increase in its output has been made from year to year, there seems to be no adequate reason why the output should not be increased if a demand for the material can be created by exploiting it in the markets. Other uses are noted in the report on slate for 1909.

The uneconomic treatment of quarries and the extravagant methods of quarrying have also been advanced as causes retarding the progress of the slate industry. Many of the quarries are leased on royalty and are worked by the lessees to produce the greatest quantity of merchantable stone at the lowest cost of production without regard to the future of the quarries. Unskillful methods of blasting result in breaking up much of the stone quarried. The slate quarries of the United States are not the only sufferers from these methods. The quarries of Wales have been worked in this same manner, and the slate trade of Great Britain has suffered correspondingly. The slate quarries of the United States were first operated, indeed, by Welsh miners, who brought with them the methods of mining that had been followed for years in Wales.

SLATE QUARRIES AND SLATE QUARRYING.

Most of the quarries in this country and in Great Britain are worked from the surface, and the older and deeper the quarry becomes the greater is the expense incurred in bringing the slate to the top. In France, the quarries are worked by underground tunnels, like a mine, a method of working that does away with a large part of the expense of quarry stripping, enables the quarry to be worked in all kinds of weather, and provides a dump for much of the waste slate in the excavations made. Whether for this reason, or on account of cheaper labor and better rates of transportation, French roofing slates of small size have been the successful rivals of the United States slates in export trade. At the time of the great strike in the Welsh quarries, from 1897 to 1903, the American slate trade received a decided impetus, which it could not hold on account of these small-sized French slates. A recently opened quarry in the United States is now being worked on the French system.

So much has the inactivity of the slate trade been discussed that the industrial world, as well as the quarry operators, has taken the matter under consideration, and for the last few years the idea has prevailed that means must be devised both to curtail the quantity of waste slate and to find a use for it. To this end more machinery is being introduced into slate quarries. The peculiar bedding and cleavage in slate, and the problems presented by joints of various sorts make the opening and the proper operation of a slate quarry a task that is very different from the opening and operation of a regular building-stone quarry, containing massive beds and few seams and faults, or of a quarry for crushed stone, where broken pieces are desirable. So, too, it is difficult to operate a slate quarry with the usual stone machinery. In recent years, however, much less powder has been used, and channeling and drilling machines have been installed in some quarries in which the cleavage, being either nearly horizontal or nearly vertical, allows the use of such machines. Compressed air and electricity are also being used for power, and in one quarry in Virginia the refuse slate is carried back into the quarry hole by means of continuous belts. The company operating this quarry also uses circular saws to cut the large blocks channeled out into blocks of the small size required by the splitters.

Falls or slides of rock form one of the greatest sources of expense and the principal cause of loss of life in a slate quarry; and to remove the débris caused by such falls and again uncover good slate may curtail the output for two or three years. At one of the quarries in Maine iron beams embedded in concrete are used as props between opposite sides of the opening.

The removal of the "top" of a slate quarry is also a matter of considerable time and expense, and experiments are being carried on with a view of utilizing some of this overburden for making brick. Two different series of tests in this connection were made by the United States Bureau of Standards, with the following results:

Two samples were submitted, one called top material and one a slate proper. It was requested that tests be made, (*a*) using the top material alone, (*b*) with a mixture of two parts of top material and one of slate. In this report the top material is identified as No. 1 and the above mixture as No. 2.

It was found that both materials lacked plasticity in the sense of that property possessed by clays. The only process, therefore, by which they can be fashioned into bricks or similar shapes is that of dry pressing.

The materials were ground to pass the 20-mesh sieve and then moistened so that they formed a damp powder. Any excess of water caused the ground materials to lack cohesion. In the form of a damp powder the mass was easily pressed into the desired shape, in this case, disks 3½ inches in diameter (in the green state). The test pieces were rather tender for handling.

After pressing, the specimens were dried, which process, of course, takes place rapidly, owing to the open structure.

The trial pieces were burnt in a test kiln of about 10 cubic feet capacity, fired with natural gas. It was found that with a 30-hour burn a good red color was produced at cone 3, about 2,215° F.; with a longer burn, three days, the same red color was obtained at cone 1, about 2,100° F. The color of No. 1 was somewhat lighter and cleaner than that of the mixture, No. 2. Furthermore, it was ascertained that No.1 can be burned more rapidly, owing to the fact that the slate contains a higher content of carbon, which must be burned out at a low temperature, 1,380° F. It is important that the kiln be held at this point, since otherwise bad discoloration and even bloating may occur. As soon as the black core is oxidized the temperature of the kiln may be raised in the usual way. This is easily ascertained by drawing trial pieces and breaking them.

The structure of the two kinds of trial pieces were satisfactory for face-brick purposes, though No. 1 showed a less granular and more compact fracture, indicating greater strength.

Further tests were then made as regards the rate of vitrification and hardening by raising the heat in the kiln at the rate of 36° F. per hour and drawing test pieces at different temperatures.

After cooling, the absorption and porosity of the specimens were determined.

The results are shown in the accompanying table:

Temperature.	Specimen No. 1.			Specimen No. 2.		
	Cone No.	Absorption in per cent of dry weight.	Porosity in per cent of volume.	Cone No.	Absorption in per cent of dry weight.	Porosity in per cent of volume.
°*F.*						
1960	1	20.0	34.7	1	13.8	26.3
1995	2	16.5	30.7	2	11.0	21.6
2015	3	14.3	27.6	3	8.5	17.1
2035	4	13.2	26.0	4	7.5	15.2
2070	6	7.8	16.6	6	5.0	8.5
2100	7	3.6	7.0	7	5.8	7.4
2140	8	3.9	6.3	(*a*)	(*a*)	(*a*)

a Beginning to swell.

From these figures it appears that No. 1 stands up better in the fire than No. 2, owing to the fact that No. 2 begins to develop a vesicular, bubbly structure. Hence No. 1 should not be burned beyond 2070° F. and No. 2 not beyond 2030° F. In ordinary slow firing the best working temperature for good color is about 2015° F.; for certain uses where less absorption is required the heat may be raised to the temperatures mentioned above.

Both materials appear to be suitable for the manufacture of dry-pressed face brick of a good red color. No evidence of discoloration has been observed, and there seems to be no objection to the utilization of these slates. As much of the top material should be used as possible, and it is not advisable to use more of the lower slate than in the proportion of 2 of top slate to 1 of the bottom material for best results. It is suggested that the grinding be fine enough so that all material passes at least a 12-mesh sieve.

In the second experiment the material appeared to be a decomposed mica schist of a dark-green color and quite soft in structure. When ground and made up with water it possessed practically no plasticity as compared with clay. For this reason the dust was moistened with about 9 per cent of water and pressed into disks on the dry-press machine. In this way the material worked very satisfactorily. The specimens could be readily handled and were smooth in exterior appearance.

The proper burning temperature was found to be 1100° C (2012° F.), at which heat the samples acquired a good red color and possessed a stonelike, hard, and sound structure. The total shrinkage was found to be 3.5 per cent.

It seems, therefore, that the schist, while not being workable by the soft and stiff clay processes, will make satisfactory bricks or similar clay ware when made up by the dry-press method and burned to the proper temperature. By this treatment the erection of a drier would be unnecessary, since the bricks can be set in the kiln direct from the machine. The use of down-draft kilns is essential for making this kind of product, owing to the fact that sufficiently close control of heat can not be had with the common scove kilns.

The cost of manufacture would be higher than for common bricks, but would be about the same as that of face bricks made from clay by the usual methods.

Attention is also called to the fact that only the hard-burned product is salable, since the underburned material is deficient both in strength and in color.

MACHINERY.

Probably one of the most important economical devices in the slate trade is the machine for splitting slate. As now practiced, the making of roofing slate is nearly all done by hand by a dressing gang of three men—a block maker, a splitter, and a dresser. The mechanical device does away with the dressing gang and makes the slates, it is claimed, more rapidly, more perfectly, and more economically.

T. Nelson Dale, in the manuscript of his report on slate in the United States, now in preparation, states that this machine is on exhibition (January, 1913) at the plant of the Genuine Washington Slate Co., at Berlinsville, Pa.

Mr. Dale also states that a recent economical contrivance by the same inventor is:

> A punch for making beveled holes of any shape in slate, with a view of utilizing slates of various thicknesses as a foundation for plaster and stucco work. The perforated slates are nailed to the studding or furring, and the plaster, applied directly to the slate, passes through the perforation and clinches itself on the back.

Objection to the use of the mechanical slate splitter has been made on the ground that some of the slates are full of ribbons and other defects which would break up the slate under the machine. The ribbons and defects, however, are not a condition of all slate, and the defective slates would break under hand-splitting as well as under the machine. Also a point in favor of the splitting machine is that it will split blocks which have become somewhat dry, having lost their quarry water on continued exposure to the air. It is almost impossible to work up this class of slate by hand, and it has hitherto always found a place on the dump.

CONSOLIDATION.

It has been proposed to strengthen the slate trade by a merger under one control of a number of the slate quarries in the Pennsylvania region, but at the time of the writing of this report (March, 1913) the consolidation has not been effected. The same idea has been suggested for the Vermont quarries, but so far as is known no change has been effected in the status of the companies.

CLASSIFICATION OF SLATE.

Mill stock.—For general purposes slate is classified as mill stock and roofing slate, and the use for these different purposes depends largely, although not entirely, on the character of the slate. Mill stock requires a finer, more even-grained, and more compact slate than roofing slate, with a smooth cleavage surface. It must be of a fairly uniform color and not too hard to be easily worked by the slate-dressing machinery. The slates of Maine and Vermont and the "soft vein" slates of Lehigh and Northampton counties, Pa., are well adapted for this purpose, and these slates are also among the best of the roofing slates. The Arkansas slate has been used for both electrical and roofing purposes, and the Maryland and New York quarries also furnish a small quantity of mill stock. As has been suggested, much of the slate that goes on the dump from a roofing-slate quarry might be utilized as mill stock.

The value of mill stock, including slate sold for all purposes other than roofing, increased from $1,379,448 in 1911 to $1,407,133 in 1912, a gain of $27,685. Exclusive of blackboard and school slates, the mill stock increased from 5,744,577 square feet, valued at $1,027,605, in 1911, to 5,765,273 square feet, valued at $1,027,605, in 1912, an increase of 20,696 square feet in quantity and a decrease of $14,385 in value. The average price per square foot was $0.176 in 1912 and $0.178 in 1911. The greater part of the slate was either entirely milled by the producer or sold to other mills in a partly milled state.

Mill stock includes blackboards, school slates, flooring, wainscoting, vats, tiles, sinks, laundry tubs, grave vaults, sanitary ware, refrigerator shelves, flour bins and dough troughs for bakeries, electrical switchboards, mantels, hearths, well caps, and billiard, laboratory, kitchen, and other table tops. This material is made in the form of slabs, from 1 inch to 3 inches or more thick, and is sold at prices ranging from 4 cents to 50 cents per square foot, according to the size, thickness, and quality of the slate and to the work done on it. It is sold in rough slabs by the quarrymen to the slate mills, or is milled by quarrymen operating their own mills.

It is noteworthy that quarries in Lehigh and Northampton counties, Pa., report the only stock produced for school slates and blackboards. These quarries can best produce this material on account of the unusually fine cleavage of the slate and the thickness and size of the beds. The quantity and value of the slate produced for these uses increased in 1912.

Roofing slate.—Slate used for roofing is not necessarily of so fine a texture nor with so smooth a cleavage as the mill stock, but it must be hard, strong, and tough, and should not contain minerals, such as carbonates, iron pyrites, etc., which decompose or oxidize under atmospheric conditions. The color should be uniform and free from streaks, and although the slate may fade somewhat upon exposure, it is not undesirable unless it weathers mottled, owing to irregular distributions of the coloring matter, and thus produces an unsightly roof. A description of the process of dressing roofing slates was given in the report for 1911.

Roofing slate is sold in the United States by the "square," a "square" being a sufficient number of pieces of slate of any size to cover 100 square feet of roof, with allowance generally for a 3-inch lap. The size of the pieces of slate making up a square ranges from 7 by 9 inches to 16 by 24 inches, and the number of pieces in a square ranges from 85 to 686, according to the size of the pieces. The ordinary thickness of a piece is from one-eighth to three-sixteenths of an inch, and the approximate weight per square is about 650 pounds. The slate is generally shipped in carload lots, each lot consisting of 50 to 100 squares, according to the size of the pieces.

The price per square for ordinary slate of No. 1 quality ranges from $3.50 to $10 per square f. o. b. at the quarries and depends on the color, size, thickness, smoothness, straightness, and uniformity of the pieces. Specially prepared slate, with pieces carefully selected with regard to color, quality, extra thickness and size, and extra cutting commands from $30 to $200 per square. For ordinary slate the red slates of New York command the highest prices. The red slates of New York and the green slates of Vermont are the kinds generally prepared for special work.

About 76 per cent of the value of the slate production in the United States in 1912 was represented by slate for roofing, and the roofing-slate output from Pennsylvania and Vermont represented, respectively, about 54 and 34 per cent of the total value of roofing-slate output. Besides roofing slate, Pennsylvania and Vermont produce also mill stock; practically the only use of slate from the other producing States, except Maine, is for roofing.

In 1912 the output of roofing slate was reported as 1,197,288 squares, valued at $4,636,185, the average price per square being $3.87; in 1911 there were reported 1,124,677 squares, valued at $4,348,571, with the same average price per square, an increase in 1912 of 72,611 squares in quantity and of $287,614 in value.

QUANTITIES AND VALUES.

The following table shows the number of squares and the value of roofing slate, the average price per square, and the quantity and the value of mill stock, by years, from 1879 to 1912, inclusive:

Quantity and value of roofing slate and mill stock produced in the United States, 1879–1912.

Year.	Roofing slate.			Millstock.			Other uses (value).	Total value.
	Number of squares.	Value.	Average price per square.	Quantity (square feet).	Value.	Average price per square foot.		
1879	367,857	[a]$1,231,221	$3.35					[a]$1,231,221
1880	457,267	[a]1,529,985	3.35					[a]1,529,985
1881	454,070	[a]1,543,838	3.40					[a]1,543,838
1882	501,000	[a]1,753,500	3.50					[a]1,753,500
1883	506,200	[a]1,898,250	3.75					[a]1,898,250
1884	481,004	1,843,865	3.83		$8,000			1,851,865
1885	536,960	1,638,467	3.05		10,000			1,648,467
1886	536,790	1,610,370	3.00					1,610,370
1887	573,439	1,720,317	3.00					1,720,317
1888	662,400	2,053,440	3.10					2,053,440
1889	835,625	2,797,904	3.35		684,609			3,482,513
1891	893,312	3,125,410	3.50		700,336			3,825,746
1892	953,000	3,396,625	3.56		720,500			4,117,125
1893	621,939	2,209,049	3.55		314,124			2,523,173
1894	738,222	2,301,138	3.12		489,186			2,790,324
1895	729,927	2,351,509	3.22		347,191			2,698,700
1896	673,304	2,263,748	3.36		482,457			2,746,205
1897	1,001,448	3,097,452	3.09		427,162			3,524,614
1898	916,239	3,129,390	3.42		594,150			3,723,540
1899	1,100,513	3,454,817	3.14		507,916			3,962,733
1900	1,194,048	3,596,182	3.01		644,284			4,240,466
1901	1,304,379	4,114,410	3.15		673,115			4,787,525
1902	1,435,168	4,950,428	3.45		745,623			5,696,051
1903	1,378,194	5,345,078	3.88		911,807			6,256,885
1904	1,233,757	4,669,289	3.78		947,906			5,617,195
1905	1,241,227	4,574,550	3.69		921,657			5,496,207
1906	1,214,742	4,448,786	3.66		1,219,560			5,668,346
1907	1,277,554	4,817,769	3.77	5,979,624	943,409	$0.157	[b]$258,042	6,019,220
1908	1,333,171	5,186,167	3.89	4,793,812	793,304	.165	[b]337,346	6,316,817
1909	1,133,713	4,394,597	3.87	5,112,894	876,089	.171	[b]170,732	5,441,418
1910	1,260,621	4,844,664	3.84	5,181,498	999,098	.192	[b]392,997	6,236,759
1911	1,124,677	4,348,571	3.87	5,744,577	1,027,605	.178	[b]351,843	5,728,019
1912	1,197,288	4,636,185	3.87	5,765,273	1,013,220	.175	[b]393,913	6,043,318

[a] Estimated.

[b] Includes in 1907, 5,711,105 school slates, valued at $48,152, and 1,531,330 square feet of blackboard material, valued at $198,995; in 1908, 5,036,147 school slates, valued at $42,364, and 2,388,886 square feet of blackboard material, valued at $291,500; in 1909, 3,650,831 school slates, valued at $32,319, and 1,095,540 square feet of blackboard material, valued at $130,195; in 1910, 5,610,518 school slates, valued at $47,075, and 2,821,689 square feet of blackboard material, valued at $334,070; in 1911, 4,308,292 school slates, valued at $35,153, and 2,636,650 square feet of blackboard material, valued at $300,034; in 1912, 4,482,571 school slates, valued at $38,852, and 2,898,742 square feet of blackboard material, valued at $352,109.

The following table shows the total value of the slate produced in the United States from 1908 to 1912, inclusive, and the percentage of increase or decrease in 1912 compared with 1911:

Value of slate produced in the United States, 1908–1912, by States, with percentage of increase or decrease.

State.	1908	1909	1910	1911	1912	Percentage of increase (+) or decrease (−).
Arkansas	$2,500			(a)	(a)	(a)
California	60,000	(a)	(a)			
Georgia		(a)	(a)	(a)		
Maine	213,707	$227,882	$249,005	$263,516	$282,678	+ 7.27
Maryland	102,186	129,538	78,573	76,035	92,184	+21.24
New Jersey	130,619	(c)	(a)	(a)	(a)	(a)
New York		107,436	84,822	120,359	135,207	+12.34
Pennsylvania	3,902,958	2,892,358	3,740,806	3,431,351	3,474,247	+ 1.25
Tennessee			(a)			
Vermont	1,710,491	1,841,589	1,894,659	1,624,941	1,849,975	+13.85
Virginia	194,356	180,775	148,721	188,808	195,392	+ 3.49
Other States		b 61,840	c 40,173	d 23,009	e 13,635	−40.74
Total	6,316,817	5,441,418	6,236,759	5,728,019	6,043,318	+ 5.50

a Included in Other States.
b Includes California, Georgia, and New Jersey.
c Includes California, Georgia, New Jersey, and Tennessee.
d Includes Arkansas, Georgia, and New Jersey.
e Includes Arkansas and New Jersey.

A detailed statement of the production, by States and uses, in 1911 and 1912, is given in the following table.

Quantity and value of roofing, mill, and other slate produced in the United States in 1911 and 1912, by States and uses.

1911.

State.	Number of operators.	Roofing slate.			Mill stock.						Other.	Total value.
		Number of squares.	Value.	Average price per square.	Manufactured.		Rough.		Total.			
					Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
					Square feet.		Square feet.		Square feet.			
Arkansas	2			$7.08								(a)
Georgia	1			5.50								(a)
Maine	5	14,879	$98,074	6.59	394,531	$165,442			394,531	$165,442		$263,516
Maryland	4	14,816	74,692	5.04							$1,343	76,035
New Jersey	2			4.03								(a)
New York	9	21,452	120,359	5.61								120,359
Pennsylvania	97	699,344	2,508,435	3.59	3,694,621	547,725	335,042	$27,241	4,029,663	574,966	b 347,950	3,431,351
Vermont	49	328,760	1,335,244	4.06	1,145,703	261,787	174,680	25,410	1,320,383	287,197	2,500	1,624,941
Virginia	7	40,040	188,808	4.72								188,808
Other States c		5,386	22,959								50	23,009
Total	176	1,124,677	4,348,571	3.87	5,234,855	974,954	509,722	52,651	5,744,577	1,027,605	351,843	5,728,019

1912.

State.	Number of operators.	Number of squares.	Value.	Average price per square.	Manufactured Quantity.	Manufactured Value.	Rough Quantity.	Rough Value.	Total Quantity.	Total Value.	Other.	Total value.
Arkansas	1			$7.50								(a)
Maine	3	16,640	$96,079	5.77	428,689	$186,599			428,689	$186,599		$282,678
Maryland	4	18,236	90,993	4.99							$1,191	92,184
New Jersey	2			4.45								(a)
New York	10	27,024	135,136	5.00							71	135,207
Pennsylvania	93	716,770	2,528,791	3.53	3,663,518	520,734	437,682	$32,195	4,101,200	552,929	d 392,527	3,474,247
Vermont	54	373,638	1,576,294	4.22	1,087,513	245,753	146,871	27,829	1,234,384	273,582	99	1,849,975
Virginia	8	42,220	195,392	4.63								195,392
Other States c		2,760	13,500				1,000	110	1,000	110	25	13,635
Total	175	1,197,288	4,636,185	3.87	5,179,720	953,086	585,553	60,134	5,765,273	1,013,220	393,913	6,043,318

a Included in other States.

b Composed of 4,308,292 school slates, valued at $35,157; 2,636,650 square feet of blackboard material, valued at $300,034; and slate used for other purposes, valued at $12,759.

c Includes in 1911, Arkansas, Georgia, and New Jersey; in 1912, Arkansas and New Jersey.

d Composed of 4,482,571 school slates, valued at $38,852; 2,898,742 square feet of blackboard material, valued at $352,109; and slate used for structural and other purposes, valued at $1,566.

IMPORTS.

Practically no slate is imported into the United States. In 1912, slate valued at $14,768 was imported in the form of mantels, chimney pieces, roofing slate, slabs, etc. In 1911, the imports were valued at $8,367 and included the same articles.

EXPORTS.

For a period of nine years, or from 1897 to 1905, inclusive, the United States had a large export trade in slate, the years 1898 and 1899 showing exports valued at more than $1,000,000. About two-thirds of these exports were to Great Britain, where a strike in the large Welsh quarries enabled slates from other countries to gain a foothold. Since 1905 there has been a marked decrease in slate exports from the United States, until in 1909 the exports amounted to only $209,383. Since that year exports of slate have not been kept separate from exports of other varieties of stone.

It is of interest to note, however, that according to the Slate Trade Gazette, of London, the exports of slate from the United States to Great Britain in 1912 were 4,441 tons, valued at £18,133.

SLATE INDUSTRY BY STATES AND LOCALITIES.

The slate production of the United States is practically confined to the northeastern part of the country. Although scattered deposits, more or less developed, occur elsewhere, the eastern slate is shipped to supply markets on the western coast as well as in the central and southern parts of the country. The location of the principal deposits, whether producing in commercial quantities or in process of development, are given below by States.

The slate of most of the deposits in the various States has been described either in Bulletin 275 of the United States Geological Survey, or in previous reports on the slate industry. Bulletin 275 is out of print but has been revised and a new edition will shortly be printed as a publication of the United States Geological Survey.

Arizona.—No operations, other than assessment work, were carried on during 1912 at the slate deposits in Maricopa County, Ariz., belonging to the Arizona Slate Co. and the Phoenix Slate Co.

Arkansas.—The National Slate Co. near Big Fork, Polk County, was the only slate company reporting a commercial output of slate in Arkansas in 1912. There was, however, considerable activity in the development work at other properties and Arkansas will doubtless have permanent rank in the near future among the slate-producing States. The deposits are in Garland, Montgomery, Polk, Pulaski, and Saline counties. Lack of transportation is the principal drawback to the development of the industry. Most of the operators report a good demand for the material. The slate is of good quality, both for roofing and mill stock, and is found in red, green, gray, and black colors.

Full descriptions of these deposits may be found in Bulletins 275 and 430 of the United States Geologial Survey and in a report by the Arkansas Geological Survey.[1]

California.—There was no commercial production of slate in California in 1912. The Eureka Slate Co., owning quarries near Placerville and Slatington, Eldorado County, reported that it expected to resume operations in the spring of 1913. Stripping and development work and the installing of machinery have been continued on the new quarry of the California Slate Co., opened in 1911 near Planada, Merced County, with the expectation of active operations in 1913. Slate from this quarry was described in the slate report for 1911. No work was done at the deposit at Hornitos, Mariposa County.

Colorado.—No work other than for assessment was done at Marble, Gunnison County, Colo., in 1912.

Georgia.—Slate has been quarried in Georgia at irregular intervals for many years, mostly near Rockmart, Polk County, and recently from a deposit of green slate near Bolivar, Bartow County, described in the slate report for 1910. No commercial output was made in 1912, although the slaty shale overlying the slate in the Rockmart district was used for making brick, cement, and a small quantity of mineral paint.

Maine.—Although but three companies, the Maine Slate Co. of Monson, the Monson Maine Slate Co., and the Portland-Monson Slate Co., operated slate quarries in Maine during 1912, there was an increase of over 7 per cent in the value of the output. The Brownville & Boston Slate Co., a new firm, began operations in December, 1912. The entire output of the State is from Piscataquis County and increased in value from $263,516 in 1911 to $282,678 in 1912, a gain of $19,162. About two-thirds of the product is mill stock, of which the output in 1912 was 428,689 square feet, valued at $186,599, an increase of 34,158 square feet in quantity and of $21,157 in value, as compared with the product of 1911, which was 394,531 square feet, valued at $165,442. Much of this mill stock is used for electrical purposes for which it is especially adapted. The roofing slate output, which, with some of the companies, is simply a by-product, amounted in 1912 to 16,640 squares, valued at $96,079; in 1911 the roofing slate output was 14,879 squares, valued at $98,074, an increase in 1912 of 1,761 squares in quantity and a decrease of $1,995 in value. The average value per square was $5.77 in 1912 and $6.59 in 1911.

Mr. Dale, in the manuscript mentioned, describes a novel condition in a quarry in Maine, as follows:

> These quarries are about a mile south of Monson village and 1,600 feet west of the railroad. The largest opening measures 225 feet along the bed, 18 feet across, and 180 feet in depth; another is 90 feet long, and of same width and depth; and two others are 75 feet long, 18 feet wide, and 60 and 40 feet deep, respectively. The slate surface is glaciated and covered with 10 feet of gravel. The strike of the quartzite and the cleavage of the slate are both N. 63° E., the dip 90°, and the grain vertical and at right angles to the cleavage.
>
> A channeler is used on horizontal joints for vertical cuts along and across the cleavage to obtain working faces. In order to avoid the falling in of the lateral walls, steel

[1] Dale, T. N., and others, Slate deposits and slate industry of the United States: Bull. U. S. Geol. Survey No. 275, 1906, pp. 51–55.
Purdue, A. H., Slates of Arkansas: Bull. U. S. Geol. Survey No. 430, 1910, pp. 317–334.
The slates of Arkansas: Geol. Survey Arkansas, 1909.

beams 20 inches in height are used as braces in groups of three or four, set 2 feet into the wall on either side, and inclosed in concrete. The reenforced braces measure about 5 feet square and are placed 30 feet apart and in alternate superposition. A supporting mass of slate, which can be tunneled later, is left every 60 feet.

Maryland.—Four quarries, near Cardiff, Harford County, were the source of the slate output (chiefly roofing slate) of Maryland in 1912, which increased 21.24 per cent as compared with the output of the same quarries in 1911. A small quantity of slate for purposes other than roofing is produced annually in Maryland, and this product decreased slightly in 1912. The roofing-slate output increased from 14,816 squares, valued at $74,692 in 1911, to 18,236 squares, valued at $90,993 in 1912, a gain of 3,420 squares in quantity and of $16,301 in value. The average price per square decreased from $5.04 in 1911 to $4.99 in 1912. Operators reported conditions of trade and demand as about the same as in 1911. Development work and quarry improvement were also features of the work of the year. The product is a black slate commercially known as "Peach Bottom," and is the same slate as that quarried in York County, Pa.

New Jersey.—The Newton Slate Co., of Newton, and the Lafayette Slate Co., of La Fayette, both in Sussex County, continue to be the only producing companies in New Jersey. This practically unfading black slate is used almost entirely for roofing. The output was somewhat less in 1912 than in 1911; but the average price per square increased from $4.03 in 1911 to $4.45 in 1912. Demand was reported as about the same as 1911, with the cost of labor considerably increased.

New York.—The New York slate is almost entirely for roofing and was all produced in Washington County in 1912, in the northeastern part of the State and adjacent to the slate-producing region of Rutland County, Vt. The output was about 12 per cent greater in 1912 than in 1911; but the average price per square decreased from $5.61 in 1911 to $5 in 1912. The production increased from 21,452 squares, valued at $120,359, in 1911 to 27,024 squares, valued at $135,136, in 1912, a gain of 5,572 squares in quantity and of $14,777 in value. The demand was reported as better than in 1911, but with a cutting of prices due to competition. Less demand was reported for red slate, which commands the highest prices. The increase or decrease of sales of this slate causes considerable variation in the yearly average prices of New York slate. Some of the red slate is also used in the manufacture of paint.

Pennsylvania.—Pennsylvania was the only one of the regular slate-producing States that did not show a decided increase in value of output in 1912. The figures of production for 1912 were practically the same as for 1911; $3,474,247 in 1912, against $3,431,351 in 1911, an increase of $42,896, or 1.25 per cent.

The fluctuations were as follows: In 1912 the output of roofing slate was 716,770 squares, valued at $2,528,791; in 1911, 699,344 squares, valued at $2,508,435, an increase of 17,426 squares in quantity and of $20,356 in value. The average price per square decreased from $3.59 in 1911 to $3.53 in 1912. The mill stock sold, exclusive of blackboard and school slate material, was 4,101,200 square feet, valued at $552,929, in 1912 and 4,029,663 square feet, valued at $574,966, in 1911, an increase of 71,537 square feet in quantity, but a decrease of $22,037 in value. The average price per square foot decreased from

14.3 cents in 1911 to 13.4 cents in 1912. Slate for blackboards, school slates, and a few minor purposes increased in value $44,577, from $347,950 in 1911 to $392,527 in 1912. Pennsylvania produced 57.48 per cent of the value of the total slate product in the United States in 1912, as compared with 59.90 per cent in 1911; 59.98 per cent in 1910; 53.15 per cent in 1909; and 61.79 per cent in 1908.

Pennsylvania slate is used both for roofing and for mill stock. In 1912 Pennsylvania produced 59.86 per cent of the total quantity and 54.54 per cent of the total value of the output of roofing slate in the United States. The average price per square in Pennsylvania in 1912 was $3.53, compared with $3.59 in 1911, a decrease of $0.06. Besides leading in the production of roofing slate, Pennsylvania has a larger output of mill stock than any other State, producing in 1912, exclusive of blackboard stock and school slate, 54.57 per cent of the total value and 71.14 per cent of the total quantity of this material for the United States. The output of mill stock for other purposes than blackboards and school slates was 4,101,200 square feet, valued at $552,929, in 1912, compared with 4,029,663 square feet, valued at $574,966, in 1911, an increase of 71,525 square feet in quantity and a decrease of $22,037 in value. The average price per square foot was 14 cents in 1911 and 13 cents in 1912.

Blackboard slate increased from 2,636,650 square feet, valued at $300,034, in 1911 to 2,898,742 square feet, valued at $352,109, in 1912, an increase of 251,792 square feet in quantity and of $52,075 in value. The average price per square foot was 11.4 cents in 1911 and 12 cents in 1912.

School slates increased from 4,308,292 slates, valued at $35,157, in 1911 to 4,482,571 slates, valued at $38,852, in 1912, a gain of 174,279 slates in quantity and of $3,695 in value. The average price per thousand was $8.16 in 1911 and $8.67 in 1912. Both school slates and blackboard material decreased in quantity and value in 1911 as compared with 1910.

In 1912 the slate was quarried in Lancaster, Lehigh, Northampton, and York counties. The quarry in Carbon County operated in 1911 was idle in 1912. A description of the slate from this quarry was given in the report on the production of slate for 1909. No further development was made on the deposit in Dauphin County, slate from which was described in the report for 1910.

The only quarries reporting operation in Lancaster County in 1912 are those located at Peters Creek. The slate of this county was described in the report for 1911.

The slate from Lehigh County is used for roofing and for ordinary mill stock and also, on account of the fineness of its cleavage, for school slates and blackboard material. In 1912 Lehigh County produced 22.12 per cent of the quantity and 22.59 per cent of the value of the Pennsylvania roofing slate output and 13.24 per cent of the quantity and 12.32 per cent of the value for the entire United States. In 1911 the Lehigh County production was 22.90 per cent of the quantity and 22.56 per cent of the value of the Pennsylvania roofing slate, and 14.24 per cent of the quantity and 13.02 per cent of the value of the United States. There was a small decrease in quantity and a small increase in value of the slate produced in this county in 1912 as compared with 1911, although the number of producers was but one less. Although most of the producers reported a good demand for 1912, some reported dull trade, poor demand, and lower prices. The average price per square of roofing slate, however, increased from $3.53 in 1911 to $3.60 in 1912. There was a considerable decrease in quantity of mill stock, but an increase in value of output. Blackboard stock decreased in value, but school slate increased.

The slate of Northampton County has the same uses as the Lehigh County slate, but the total value of the output is over three times as large. In 1912 Northampton County produced 75.34 per cent of the quantity and 73.46 per cent of the value of the Pennsylvania roofing slate, and 45.10 per cent of the total quantity and 40.06 per cent of the total value for the United States. In 1911 the Northampton County output was 74.62 per cent of the quantity and 73.78 per cent of the value of the Pennsylvania roofing slate, and 46.40 per cent of the quantity and 42.56 per cent of the value for the United States. There was an increase of $34,561 in the output of this county as compared with 1911. The value in 1912 was $2,600,449; in 1911 it was $2,565,888. The producers generally reported a fair demand for roofing slate, but with lower prices. The average price per square decreased from $3.55 in 1911 to $3.44 in 1912. The demand for mill stock was better than for roofing slate and the mill stock increased in quantity, but decreased in value. The blackboard output increased both in quantity and in value, while that of school slates decreased.

York County produces nothing but roofing slate of the same Peach Bottom variety as that of Harford County, Md. There was an increase in production for this county in 1911, but a slight decrease in average price—from $5.55 in 1911 to $5.50 in 1912. There was a general report of increased demand and better trade conditions throughout this region.

Mr. Dale in his manuscript gives the following description of a new quarry in this district:

> The Baltimore Peachbottom Slate Co., of Delta, Pa., has recently adopted the tunnel method in its Cardiff quarry in order to save the expense of removing the "top." It is found that this method also has the advantages of not only affording a shelter to the workmen but a uniform temperature of 60° F. both day and night, and of preserving the moisture in quarried blocks for an indefinite period. The tunnel is 6 to 7 feet high, 12 feet wide, and about 600 feet long at right angles to the cleavage. It has lateral chambers, one on either side, measuring, respectively, 70 and 30 feet in length, 60 and 50 feet in width. One is 60 feet deeper than the tunnel floor, the other is 12 feet higher than its roof. Channeling and overcutting machines operated by compressed air are used.

The Pennsylvania slate is mostly of a dark-gray or other dark color. Many of these dark slates, however, become somewhat lighter in color on exposure to the atmosphere.

The table following shows in detail the production of slate in Pennsylvania, by counties and uses, in 1911 and 1912.

Production of slate in Pennsylvania in 1911 and 1912, by counties and uses.

1911.

County.	Number of operators.	Roofing slate.			Mill stock.								Other (value).	Total value.
		Number of squares.	Value.	Price per square.	Manufactured.		Rough.		Blackboards.		School slates.			
					Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
					Sq. ft.		*Sq. ft.*		*Sq. ft.*		*Number.*			
Carbon	1			$3.58										
Lancaster	1	17,354	$91,573	5.00	....	....	....	....	....	....	....	....	....	$91,573
York ("Peachbottom slate")	5			5.55										
Lehigh	34	160,150	566,101	3.53	506,461	$60,710	194,941	$19,078	1,040,593	$107,967	1,832,293	$14,971	$5,063	773,890
Northampton	57	521,840	1,850,761	3.55	3,188,160	487,015	140,101	8,163	1,596,057	192,067	2,475,999	20,186	7,696	2,565,888
Total	98	699,344	2,508,435	3.59	3,694,621	547,725	335,042	27,241	2,636,650	300,034	4,308,292	35,157	12,759	3,431,351

1912.

County.	Number of operators.	Number of squares.	Value.	Price per square.	Manufactured Quantity.	Manufactured Value.	Rough Quantity.	Rough Value.	Blackboards Quantity.	Blackboards Value.	School slates Quantity.	School slates Value.	Other (value).	Total value.
Lancaster	2	18,135	$99,810	$5.71	....	....	....	....	....	....	....	....	....	$99,810
York ("Peachbottom slate")	3			5.50										
Lehigh	33	158,603	571,269	3.60	394,419	$53,764	197,930	$19,619	902,697	$101,686	3,109,417	$27,650	....	773,988
Northampton	55	540,032	1,857,712	3.44	3,269,099	466,970	239,752	12,576	1,996,045	250,423	1,373,154	11,202	$1,566	2,600,449
Total	93	716,770	2,528,791	3.53	3,663,518	520,734	437,682	32,195	2,898,742	352,109	4,482,571	38,852	1,566	3,474,247

Tennessee.—No commercial quarry operations were reported in 1912 from the Tennessee slate deposits. Lack of transportation facilities was reported as an obstacle to development.

Utah.—The Utah Slate & Granite Co., owning slate deposits near Provo, Utah County, did no work in 1912.

Vermont.—Vermont is second among the slate-producing States, being ranked by Pennsylvania. In 1912 Vermont produced 30.61 per cent of the total slate quarried in the United Slates and Pennsylvania 57.48 per cent. In 1911 these figures for Vermont and Pennsylvania were 28.37 and 59.90 per cent, respectively—an increase for Vermont and a decrease for Pennsylvania. The total value of the slate production in Vermont increased 13.85 per cent in 1912, that of Pennsylvania only 1.25 per cent. About six-sevenths of the slate marketed in Vermont is roofing slate. This amounted to 373,638 squares, valued at $1,576,294, in 1912, as compared with 328,760 squares, valued at $1,335,244, in 1911, an increase of 44,878 squares in quantity and of $241,050 in value. The average price per square advanced from $4.06 in 1911 to $4.22 in 1912. The total mill stock manufactured decreased from 1,320,383 square feet, valued at $287,197, in 1911, to 1,234,384 square feet, valued at $273,582, in 1912, a decrease of 85,999 square feet in quantity and of $13,615 in value. The average price per square foot was 22.2 cents in 1912, as compared with 21.8 cents in 1910.

Of the mill stock (exclusive of blackboards and school slates) produced in the United States, Vermont produced 27 per cent of the total value in 1912, compared with 54.57 per cent from Pennsylvania.

Most of the producers report the demand much better than in 1912, with considerable improvement both in trade conditions and in prices during the latter part of the year. The Vermont slate is practically all from Rutland County, and the quarries are in the same belt as the New York slate quarries. The Rutland County slate varies in color and is known in the trade as "sea-green," "grayish green," "unfading green," "greenish gray," "purple," "purplish brown," "variegated," and other variations of green, gray, and purple.

Virginia.—Virginia ranks fourth among the slate-producing States with productive quarries at Esmont, Albemarle County, and Arvonia and Penlan, Buckingham County. This slate is used entirely for roofing, and the production in 1912 was 42,220 squares, valued at $195,392, or $4.63 per square. This was an increase of 2,180 squares in quantity and of $6,584 in value, as compared with 1911, when the output was 40,040 squares, valued at $188,808, or $4.72 per square. The average price per square decreased $0.09 in 1912.

The producers reported in general poorer trade conditions, slower demand and lower prices than in 1911, but better demand and conditions were also reported, which bears out the showing in the statistics of lower prices per square and larger output.

PUBLICATIONS ON SLATE.

Requests are continually coming to the United States Geological Survey for reports on the distribution, production, and composition of slate and on the methods of working slate quarries.

Bulletin 275 of the Survey,[1] which is a very comprehensive report on slate deposits and slate industry of the United States, is now out of print, but it can be consulted in libraries or purchased from dealers in secondhand books. This report, however, has been revised for publication as another bulletin of the Survey.

Maps showing the commercial deposits of slate are published in the reports on the stone industry of the United States for 1911 and 1912.

The United States Geological Survey has published a report on the slates of Arkansas by A. H. Purdue.[2]

The State geological surveys of Arkansas, California, Maryland, and New Jersey have also published descriptions of the slate and slate deposits of these States, and information may be had of these publications by applying to the State geologists of the respective States.

A publication by E. C. Eckel [3] contains a chapter on slate which gives information on the slates of the United States and of foreign countries and also many analyses and tests of slate.

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[1] Dale, T. N., and others, Slate deposits and slate industry of the United States: Bull. U. S. Geol. Survey No. 275, 1906.

[2] Purdue, A. H., The slates of Arkansas: Bull. U. S. Geol. Survey No. 430, 1910, pp. 317-334.

[3] Eckel, E. C., Building stones and clays, their origin, character, and examination, John Wiley & Sons, New York, 1912.

THE COMMERCIAL QUALITIES OF THE SLATES OF THE UNITED STATES AND THEIR LOCALITIES.

By T. Nelson Dale.

INTRODUCTION.

In a forthcoming bulletin on slate in the United States by the writer and several colaborers, which is a revised and enlarged edition of Bulletin 275, published in 1906, the subject is to be treated in both its scientific and its economic bearings, considerable attention being given to the geology, texture, chemistry, and petrography of slate. This bulletin will also be illustrated by geologic maps, sections, and views.

In the present chapter only those qualities of the slates that directly affect their commercial value are to be considered; but wherever the geologic structure or the methods of quarrying bear upon the cost of production, these are briefly explained. The data of this chapter are all taken from the more comprehensive work, but they are here separated from material whose value is purely scientific or is designed to be of educational value to the operators of quarries. The slates are taken up by States alphabetically, but no reference is made to deposits of doubtful commercial value that are mentioned in the bulletin.

The geographic distribution of the slate deposits herein described is shown on the map (Pl. I).

ARIZONA.

A specimen of bluish-gray "black" mica slate, without carbonate but with some pyrite, from an extensive deposit about 6½ miles north of Phœnix, Ariz., is marked by two sets of incipient slip or "false" cleavage at right angles to each other. The slate breaks along the finer set more readily than along the other. This deposit ought to be explored for slate free from these lines and planes of weakness.

ARKANSAS.

Several of the mica slates of Arkansas, first examined microscopically by the writer, not only showed all the qualities of mica slates, together with a superior cleavage, but also possessed attractive colors. In actual use, however, they were found to be greatly lacking in strength and toughness, and some weathered as badly on the dumps as shales would have done.

Purdue,[1] in his reports on the slates of Arkansas, states that slaty cleavage does not uniformly pervade the deposits, and that even the

[1] Purdue, A. H., The slates of Arkansas: Arkansas Geol. Survey, 1909; Bull. U. S. Geol. Survey No. 430, 1910, pp. 317–334.

slate, mostly red, which is now used only for mill stock, is liable, after being finished, to crack either at right angles to or parallel to its cleavage. He also mentions a gray slate (Fork Mountain slate) which, although possessing the requisite toughness for roofing, has a superabundance of joints.

The geologic and economic explorations of the slate region of Arkansas have not thus far proved it of great economic value.

CALIFORNIA.

Eldorado County.—The slate deposits of Eldorado County, Cal., have been visited and described by Lindgren, Turner, and Eckel. The dark gray "black" slate quarried at points 3 to 6 miles north-northwest of Placerville in this county is a mica slate containing a small amount of carbonate and ought to retain its shade for many years. A band several feet in width of grayish-green slates of igneous origin, described by Eckel, is used in connection with the dark sedimentary slate for trimming and lettering.

Merced County.—A recently prospected deposit, about 11 miles east of Planada, consists of a dark bluish-gray "black" mica slate. As it contains no carbonate it ought to retain its color indefinitely. It does contain, however, considerable pyrrhotite (magnetic iron pyrite) and is therefore unsuitable for electric purposes.

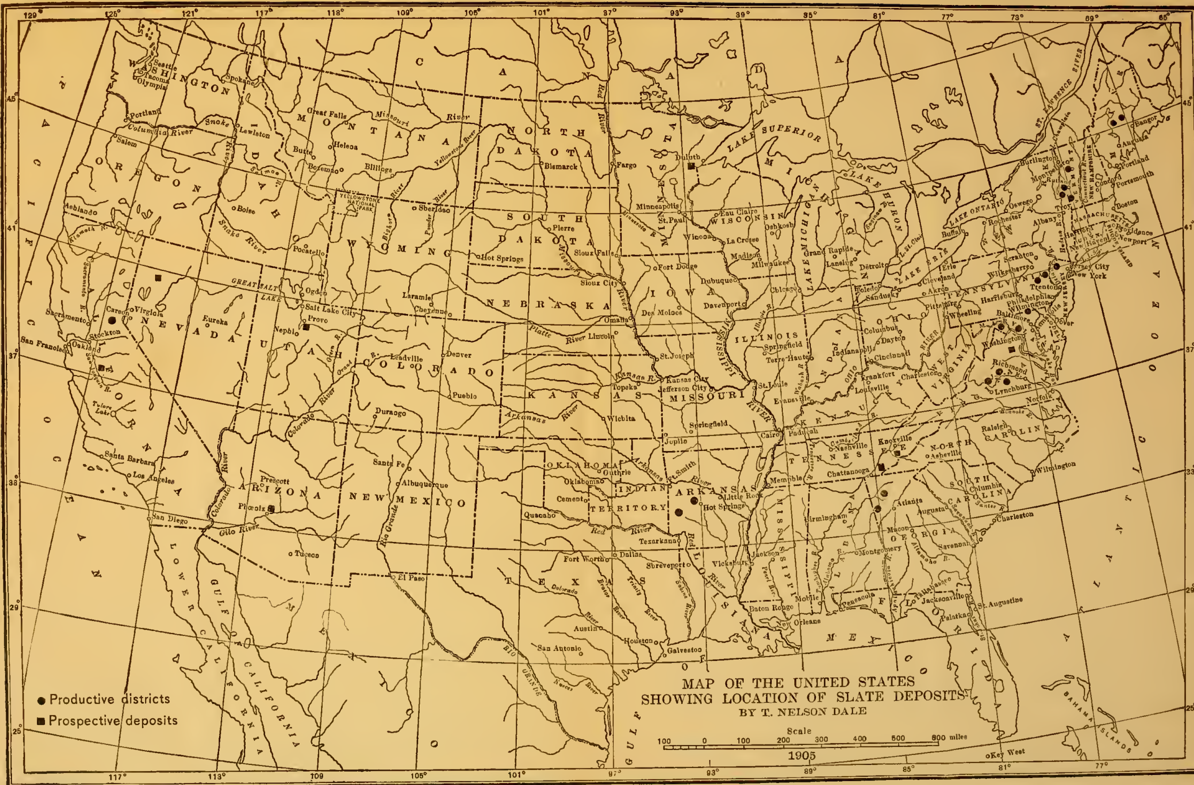
GEORGIA.

Bartow County.—A quarry opened in 1910 by the Georgia Green Slate Co., of Fairmount, Ga., near Bolivar station, on the Louisville & Nashville Railroad, suspended operations shortly before the writer's visit in 1912. The slate is a mica slate of light-blue greenish-gray color, with some dark bluish-green ribbons, streaks, and lenses. It contains very little magnetite, is very sonorous, and has a fair degree of fissility. The slates about the quarry show some but not much discoloration. An analysis by E. Everhart, of the Geological Survey of Georgia, shows 1.22 per cent of lime (CaO), which is also the average percentage in the "sea-green" fading slates of Vermont. Thin sections of the slate near Bolivar show an amount of carbonate intermediate between that of the "unfading green" and the "sea-green" slates of Vermont.

The discoloration of the slates is reported as the cause of the cessation of work, although the location of the quarry at the bottom of a ravine must also have proved unfavorable.

Other exposures of the green slate should be sampled and examined microscopically, as beds may yet be found in the same formation containing less carbonate and therefore of more durable color.

Polk County.—East and southeast of the village of Rockmart, on Euharlee Creek, is an east-northeastward-trending ridge of slate rising 100 to 200 feet above the creek. The limestone which underlies the slate occupies the valley on the northwest and also crops out in contact with the slate at the disused most easterly quarry. The slate is covered in places with 20 to 30 feet of weathered slate, some of which has passed into a yellow ocher. This ocher is overlain by 5 to 10 feet of reddish clay. There are several large abandoned slate quarries on the southeast side of the ridge. The most important economic consideration suggested by the stratigraphy is that, as the slate is limited in



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depth by the underlying limestone and in places limited also in height by the zone of residual ocher, the actual thickness of workable slate can not be very considerable and should be carefully determined before any large expenditures are made.

The only quarry in operation at the time of the writer's visit in 1912 was that of Pritchard & Davis. This is a small opening in a little transverse ravine between the disused Hood quarry and the Southern Slate Co. quarry.

The slate is very dark bluish gray "black," with a slightly roughish lusterless surface. It is a carbonaceous mica slate of somewhat coarse lenticular texture, with little magnetite and much carbonate, and is therefore of the fading series. Its fissility and sonorousness are fair.

MAINE.

The slate industry of Maine is now confined to the township of Monson, in Piscataquis County, although a quarry has recently been opened or reopened at Brownville in the same county.

Monson.—The stratigraphy in the Monson district imposes peculiar difficulties upon slate quarrying. The slate beds, ranging from 1 to 18 feet in thickness and very nearly vertical, alternate with beds of quartzite ranging from a few inches to 20 feet in thickness, the slate beds making up from 46 to 63 per cent of the entire series. These beds of quartzite would make excellent retaining walls for the sides of the quarries were they not greatly weakened by abundant joints undulating in a horizontal direction. Consequently the greater the depth and the length (along the strike) of the excavation, the greater the danger of the falling in of the walls. This not only jeopardizes the lives of the workmen, but entails great expense for the removal of the débris. In order to obviate accidents the Portland & Monson Slate Co. is using wrought-iron horizontal beams, incased in cement, fitted at intervals between the walls, and is also leaving supporting masses of the rock at short intervals. The Monson Maine Slate Co. is also shortening the length of its openings.

At the Matthews quarry, 3½ miles west-southwest of the village, the tunneling method is being used, reliance being placed upon lateral crustal compression contracting the walls of the tunnel sufficiently to prevent the overhanging slate from sliding down vertically along the cleavage.

The slate of the quarries near the village of Monson is a dark, more or less bluish-gray, "black" graphitic mica slate of the unfading series, with a more or less roughish, lusterless, cleavage surface and a fair cleavage. Judged by the specimens examined, the slate of the Pond quarry contains little magnetite and more pyrite, while that of the Portland & Monson Co.'s quarry contains more magnetite and less pyrite. Whether more elaborate tests of a series of specimens obtained from different beds and different parts of beds at both of these quarries would yield average results corresponding to those cited is uncertain.

The slate from the quarries of the Monson Maine Slate Co. and of the Portland & Monson Slate Co. is used largely for mill stock.

The slate of the Matthews quarry (Maine Slate Co., of Monson) has a finer texture and a smoother and more lustrous cleavage surface than the slate about Monson village. It has very little magnetite and much more pyrite than magnetite. It is a graphitic mica slate of the unfading series, and is used exclusively for roofing.

Brownville.—The slate at Brownville is also interbedded with quartzite and quartzitic slate. At the Old Merrill quarry 42 beds of slate alternate with as many of quartzite, the whole series measuring 165 feet. At the Hughes quarry 28 beds of each rock measure altogether 161 feet 6 inches.

The slate of the Old Merrill quarry is a very dark gray, "black" graphitic mica slate of the unfading series with fine texture, very smooth and bright cleavage surface, and a high grade of fissility and sonorousness. It contains some pyrite and considerable magnetite, which makes it unsuitable for electric purposes, but it is one of the best slates for roofing in the United States.

MARYLAND.

The active slate quarries of Maryland are now confined to Cardiff, in Harford County, about 30 miles northeast of Baltimore in what is known as the "Peach Bottom slate district," which extends into Pennsylvania and will be considered under that State.

Certain slightly talcose mica slates of dark-purplish color formerly quarried near Thurston, in Frederick County, are reported as serviceable but unmarketable on account of their softness and deficient sonorousness, which are due to their content of about 5 per cent of talc and of considerable chlorite. Their microscopic texture is lenticular, which is not unfavorable. They contain no carbonate.

NEVADA.

Slate has been discovered about 21 miles northwest of Winnemucca in the Blue Mountains in Humboldt County, Nev. The deposit is reported as extensive. Specimens from more or less weathered outcrops on the Gibraltar group of claims examined by the writer shows this to be a graphitic or carbonaceous mica slate of dark blue-gray, "black" color, fine texture, and smooth lustrous cleavage surface. As it has no carbonate it belongs to the unfading series. Its fissility appears to be equal to that of the slate of Lehigh and Northampton counties, in Pennsylvania. It is sonorous and contains a little magnetite. Large blocks of the slate should be tested by an experienced slate workman for grain and false cleavage. Although the thin section showed no slip cleavage the hand specimen showed a tendency to break at angles of 30° and of 50 to 70° to the apparent grain.

NEW JERSEY.

The only slate quarry in operation in New Jersey in 1912 was that of the Lafayette Slate Co., of Newton, N. J., situated about 2 miles north-northeast of Lafayette village in Sussex County, and about 28 miles northeast of the Delaware Water Gap.

The beds, "ribbons," dip 20°–30° NW. and the cleavage 20° S. 20° E. Owing probably to secondary motion, the cleavage is more or less bent, but not curved, at its intersection with each ribbon.

The slate is a carbonaceous mica slate of dark bluish-gray, "black" color and fine texture, with a roughish lusterless cleavage surface and a high grade of fissility and a fair sonorousness. It contains much carbonate, and therefore belongs to the fading series, although it is said to preserve its color on the roof for 30 years. It has very little magnetite and is reported as being harder than the slate of Bangor, Pa.

The product is supplied to the market in two grades: No. 1 is generally very slightly bent; No. 2 has one or two obtuse angles parallel to the short side, which gives a zigzag outline to a longitudinal section, and of course makes it impossible for adjacent slates to cover a roof tightly.

As bearing upon the durability of the blackness of this slate there is an abandoned quarry about half a mile S. 70° W. of this one, visited by the writer in 1912, which, although not exactly in the direction of the strike of the other, yet belongs to the same belt. Its dumps, covering several acres and exposed for many years, are still dark and bright.

NEW YORK.

The New York and Vermont boundary, which runs nearly north-south between Washington County on the west and Rutland County on the east, divides the Cambrian-Ordovician slate belt into two somewhat unequal parts, most of the quarries in Cambrian greenish and purplish slate being on the Vermont side and all but one of the quarries in Ordovician red slate being on the New York side.

At the present time few of the quarries of Cambrian "sea-green slate" in Granville, Hampton, Hebron, and Salem, Washington County, N. Y., are in operation, and these are in the townships of Granville and Hampton. Their product is so small that the slate will be considered in connection with that of the quarries on the Vermont side of the belt.

The red slate (Orodvician) is quarried almost exclusively on the New York side of the boundary. The quarries are in the townships of Granville and Hampton.

Beds of red and bright-green slate alternate vertically and replace one another along the strike and also pass into shales of the same colors. The thickness exposed at the quarries reaches 50 and 75 feet, mostly red, with about 25 feet of green overlying, but that which is too hard or too soft or badly veined or ribboned being subtracted there are in places only 10 feet and rarely more than 25 feet of good red slate exposed in any one quarry, although the slate does in some places reach 42 feet in thickness. The thinness and the irregularity of the deposit largely explain the high cost of this, the most expensive of American slates.

The "red slate" is decidedly reddish brown, becoming brighter instead of fading on exposure. It is a mica slate of fine texture with a lusterless, slightly roughish cleavage surface, some of it speckled with minute protuberances (lenses). Its fissility and sonorousness are fair. It owes its color to a content of nearly 5 per cent of hematite. It abounds in carbonate, which is probably dolomite instead of a combination of dolomite and siderite, as in the fading green slates of the Ordovician areas of the New York-Vermont slate belt, in which the siderite has been shown to be the cause of the discoloration, as appears in the discussion of the slates of Vermont on a later page.

The bright-green slate, associated with the red, is a mica slate of light bluish-green color, peculiarly bright by lamplight, and owes its color to a large content of chlorite. The color is permanent and forms a strong and pleasing contrast to the red when both slates are used on the same roof. Its carbonate is also probably dolomite. Its fissility and sonorousness are also fair.

Flagstones of the red slate with "ribbons" of light green and purple an inch or two in width crossing the cleavage are striking objects. At Granville an expensive house has been built of small blocks of red slate set with the cleavage in horizontal position. The red slates are used effectively by architects on the roofs of houses built of red sandstone.

PENNSYLVANIA.

The slates of Pennsylvania may be divided into three groups—the "soft vein" black carbonaceous slates of Lehigh and Northampton counties, belonging to the fading series; the "hard vein" black carbonaceous (and graphitic?) slates of Northampton County, also of the fading series; the unfading graphitic slates of York and Lancaster counties, extending also into Harford County in Maryland.

The "soft vein" black slate of Lehigh and Northampton counties.—The productive belt of this slate lies on the south side of Blue Mountain and extends from the Delaware Water Gap in a west-southwest direction 32 miles to a point 4 miles west of Lehigh Gap. Similar slate has, however, been prospected in the same geologic formation about 27 miles farther west-southwest; and it also occurs in Carbon County, on the north side of Blue Mountain a little northeast of Lehigh Gap. Maps showing the location of the quarries in Lehigh and Northampton counties will be found in the bulletin on slate in the United States.

"Ribbons," or small beds of calcareous and pyritiferous grit, from a fraction of an inch to 2 feet in thickness characterize the slate throughout and occur at intervals of 3 to 9 feet and, exceptionally, at even greater intervals. As all the beds are in small folds, intersected at various angles by the cleavage, the value of the commercial slate depends largely on the spacing of these ribbons—that is, on the thickness of the beds of good slate; also on their inclination and, further, on the degree of the inclination of the cleavage, for where that is very low machines for cutting the slate vertically and horizontally can be used.

Several varieties of the slate will be described. They all belong to the fading series, all have a high grade of fissility and fair sonorousness, and all contain some magnetite.

The product of the "Old Bangor" quarry is a mica slate of very dark-gray shade, with a fine, almost lusterless, cleavage surface. It contains much carbonate and is also quite pyritiferous. The slate of Slatington is almost identical, but apparently contains more pyrite. The slate of the Heimbach quarry apparently contains more carbonate and less pyrite than that of the "Old Bangor." The slate of the Albion quarry at Pen Argyl, which is regarded as being near the bottom of the "soft-vein" series, is a mica slate of dark-gray shade with fine texture and roughish, almost lusterless, cleavage surface. It contains much carbonate and appears to carry less pyrite than any of the others enumerated. The slate of an exceptionally gray bed, 44 inches thick, at the Albion quarry, is a mica slate of dark greenish-gray color, with a somewhat granular texture and a roughish, almost lusterless, surface. It has less carbonate than the dark-gray of the same quarry, about as much pyrite, and little or no graphite or carbon.

The only quarry in Carbon County is that near the village of Aquashicola, approximately 2 miles east-northeast of Palmerton station. The slate is identical with that of the "soft-vein" belt. The cleavage dips 75° S. 17° E., and the beds 80° N. 20° W.

The product of the "soft-vein" quarries is used for roofing, mill stock, and blackboards. The thick beds supply material especially adapted for blackboards; those with fine-grained ribbons supply mill stock, and the smaller ones produce roofing. Some ribboned slates are also used for roofing and reach the market in two grades—No. 1, in which the ribbons are confined to one-half of the surface, which can be covered by the overlapping tier; and No. 2, in which the ribbons extend all over the surface and in which the cleavage is apt to be slightly bent at its intersection with the ribbon. At some quarries the cleavage of some beds is slightly curved, and slates made from these beds are in demand for the roofing of towers.

The "hard-vein" black slate of Northampton County.—These slates lie in a belt south of the "soft-vein" belt and occur in folds that underlie it.

The principal quarries are at Chapman. The ribbons are finer-grained, thinner, and spaced more closely than those of the soft vein. The slate is a mica slate of dark-gray shade, fine texture, and slightly roughish and slightly lustrous cleavage surface. It contains less carbonate than the soft-vein slate, and is harder and probably more quartzose. It appears to be less pyritiferous than the slate of Bangor and Slatington, but more so than that of Pen Argyl. It belongs to the fading series, but it is said to discolor less rapidly than the slate of the "soft vein," the amount of discoloration being small in 30 years' exposure. This slate was formerly used largely for flagging, posts, steps, etc., but in recent years has been used only for roofing, for which only selected material is available.

The unfading graphitic slates of York and Lancaster counties and of Harford County, Md.—This slate deposit and district seems to have derived its name from that of a small village in a township of the same name bordered by the Maryland line on the south, and Susquehanna River on the northeast, and forming the southeast corner of York County, Pa.

The slate forms a belt and low ridge from one-fifth to one-half mile in width, which extends from a point about a mile northeast of the Susquehanna, in the town of Fulton, in Lancaster County, Pa., in a southwest direction across the river and across Peach Bottom Township in York County, and continues for about 3 miles in the same direction into the town of Cardiff, in Harford County, Md. Its total length is about 10 miles, of which 1 mile lies in Lancaster County, Pa., 1½ miles are submerged by the Susquehanna, 4½ miles are in York County, Pa., and about 3 miles are in Hartford County, Md. Most of the quarry population is congregated along one street, which follows the western foot of the ridge. The northeastern part of this street is Delta, Pa.; the southwestern is Cardiff, Md.

In 1912 seven firms were operating quarries in the Peach Bottom belt.

The following particulars as to methods of quarrying have been obtained through the courtesy of Mr. C. F. Guild, general manager of the Baltimore Peach Bottom Slate Co., of Delta, Pa. This company has recently adopted the tunnel method in its Cardiff quarry in order to save the expense of removing the "top." In addition, this method has the advantages of affording a shelter to the workmen in rain, of a uniform temperature of about 60° F. in which to work both day and night, and of preserving the moisture in quarried blocks for an indefinite period. The tunnel is 6 to 7 feet high, 12 feet wide, and about 600 feet long at right angles to the cleavages It has lateral chambers, one on either side, measuring, respectively, 70 and 30 feet in length and 60 and 50 feet in width. One is 60 feet deeper than the tunnel floor; the other is 12 feet higher than its roof. Channeling and overcutting machines operated by compressed air are used.

The Peach Bottom slate is a highly crystalline graphitic mica slate of very dark gray color, with a slightly bluish tinge and a minutely granular, rather coarse, almost schistose texture, and a slightly roughish but very lustrous cleavage surface. It is very sonorous, and has a fair degree of fissility. It contains some magnetite, but no carbonate. It can always be identified microscopically by its abundant minute crystals of andalusite (silicate of alumina), which impart the granular surface to the cleavage. This slate is used exclusively for roofing, but it also makes excellent gravestones.

The slate of a prospect opened in 1910 on Peters Creek in Lancaster County, Pa., proves to be identical with the typical Peach Bottom slate.

TENNESSEE.

Slate deposits of probable economic value occur in Blount and Monroe counties in the eastern part of Tennessee.

Blount County.—Deposits of "black" slate southeast of Knoxville were described by Arthur Keith[1] in 1895 in the Knoxville folio in these words:

> Two formations in this region contain beds of slate—the Wilhite and Pigeon slates. The Wilhite slate is too calcareous and soft for commercial use in the vicinity of Little Tennessee River, but has the necessary hardness, evenness, and cleavage along Little Pigeon River. Along this stream the slate is well exposed over great areas, but has never been developed. Quarries have been opened in the Pigeon slate along the Little Tennessee River at many points and slates and flags taken out for local use. Recently a quarry has been opened on a small creek 2 miles from the river and much good material taken out for shipment. The slates are of fine, even grain, and split into slabs an inch thick of any desirable size or into roofing slates. In this particular quarry the cleavage crosses the bedding and produces ribbons in much of the slate. An old quarry about 2 miles north of this shows the cleavage and bedding coincident, and flags of great size are readily loosened. Some of the slate layers contain pyrite, necessitating selection of the material for use. There are a great number of available places for quarrying in the bluffs along the river and the adjacent small streams on either side. That this slate resists weathering is amply proved by the high, sharp slate cliffs that border the river along most of its course.

The Southern Slate Co., of Columbus, Ohio, quarried a little slate near Chilhowie in 1910. There is also a slate prospect on the Virgil grant, 3½ miles from Chilhowie.

Monroe County.—Several slate prospects on Tellico River and its tributaries were visited by the writer in 1912. They consist of purplish, greenish, and "black" mica slates interbedded here and

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[1] Knoxville folio (No. 16), Geol. Atlas U. S., U. S. Geol. Survey, 1895.

there with quartzite and fine conglomerate. The openings all lie within a radius of 3 miles of Tellico Plains station, the terminal of the Nashville & Tellico Railroad, and were made by the Tellico Co. of Tellico Plains.

The Falls Branch prospect is 3 miles nearly south of Tellico station and 400 feet above it, on a brook flowing north into Laurel Creek, a tributary of Tellico River. The slate is a graphitic mica slate of very dark bluish-gray color, with a lustrous ribboned cleavage face of more or less smoothness. It contains some magnetite and a little carbonate, and ought not to discolor much. It possesses fair fissility and sonorousness. The excavation should be enlarged and core drilling done.

The Laurel Creek quarry is but little over a mile southeast of Tellico station, on the southeast side of the creek, about one-fourth mile from its junction with Tellico River. The opening made in 1902 is about 50 feet deep. The slate is a mica slate of light-blue greenish-gray color with minute dark-green lenses and a lusterless smooth cleavage surface with fair sonorousness and but tolerable fissility. It contains attenuated brownish-weathering lenses of carbonate along the bedding which intersect the cleavage at a very acute angle and detract from the fissility. It contains little magnetite and some carbonate, but slates reported as exposed 10 years on the dumps show scarcely any discoloration. This slate incloses a bed of purple slate, 5 feet thick, of similar characteristics.

The Tellico River prospects are about half a mile east-southeast of Tellico station on the north bank of the river, east of a conspicuous road angle. The section seems to consist, beginning on the northwest, of 250 feet of slate, mostly purplish, underlain by 75 feet of greenish and purplish slate, underlain by still another bed of quartzite. The purplish slate is a mica slate of medium purplish-gray color, with an almost lusterless cleavage surface dotted with minute lenses, and containing very delicate limonitic films without carbonate. These films may have been pyrite originally. The slate contains some carbonate, but does not show magnetite. The green slate is a mica slate of light greenish-gray color, corresponding otherwise to the purple and presumably like that of the Laurel Creek prospect.

UTAH.

E. C. Eckel in 1906 contributed the following data on the slates of Utah to Bulletin 275:

> The slate deposits occur about 2 miles southeast of Provo station in Slate Canyon. The slate here covers a considerable area, but that exposed at the surface is so badly broken up that large slabs can not be obtained. It is possible, however, that this condition will disappear if the deposits are worked deeper.
>
> The Provo deposits furnish green and purple slates, the latter being apparently present in greater quantity. The green slates show little tendency to cleavage in their surface outcrops, and will probably be less satisfactory for roofing purposes than the purple. The green slates rub very smooth, however, and would make good slabs or mill stock if obtainable in masses of sufficient size. The purple slates split well, with a surface about as smooth as that of Peach Bottom (Pa.-Md.) slate. From samples seen it appears that they also bear punching well.

Some development work was done on these deposits in 1911, as reported by A. T. Coons in Mineral Resources for that year.

VERMONT.

There are at least four distinct slate districts in Vermont. The most easterly district extends along Connecticut River for more than two-thirds the length of the State. The slate is black or dark gray and has been worked in Guilford, in Windham County, at the extreme south end of the State, and also in Thetford, in Orange County, and at Waterford, in Caledonia County. The next district extends along the east flank of the Green Mountain Range from the Canada line to about the middle of the State, and has been worked extensively at Northfield, and a little at Montpelier, in Washington County. The most important district, which furnishes the well-known "green" and "purple" slates, lies between the Taconic Range and Lake Champlain, extending from the town of Sudbury, in Rutland County, southward to Rupert, in Bennington County, a distance of 26 miles. The fourth is black slate, as yet undeveloped, and covering only from 2 to 3 square miles in the town of Benson, in Rutland County, near Lake Champlain.

Northfield.—In 1904 but one quarry was in operation in the Northfield district, that of the Vermont Black Slate Co., 2 miles south of the village. Later the company reopened the Clark quarry 100 feet above and one-fourth mile east of the first. In 1909 both quarries became idle and were so at the time of the writer's second visit in 1912. The dip of the cleavage and bedding at both quarries is very steep. At the Clark quarry quartzose and pyritiferous beds, one-fourth to 3 inches thick, devoid of cleavage, and weathering a muddy brown, occur at intervals of 6 inches to 3 feet. A slip cleavage, "false cleavage," confined to certain beds and horizontal zones dips 15° in a direction at 55° to the strike of the slaty cleavage. At both quarries there is a scarcity of horizontal joints; at the upper quarry there are but three such joints in a height of 30 feet.

The slate is a very dark-gray, graphitic mica slate with a very lustrous cleavage face, smooth or dotted with minute lenses or with longish crystals of pyrite pointing in the grain direction. It is very sonorous, very fissile, almost entirely free from carbonate, and therefore of unfading series. It contains more or less magnetite and magnetic iron pyrite and is thus unsuitable for electric purposes.

This is a superior roofing slate resembling that of Brownville, Me. Owing to the scarcity of horizontal joints, the company gave its attention almost entirely to the production of mill stock. The true method of operating such a quarry would be to use a channeling machine adapted to horizontal cutting and to split the blocks having little or no slip cleavage into roofing slates and then to use the rest for mill stock. Roofing slates from the Clark quarry with not a little slip cleavage are yet strong.

The "green" and "purple" slate belt.—Geologic maps showing the quarry locations will be found in the forthcoming bulletin on slate in the United States, also in the writer's paper on the slate belt of eastern New York and western Vermont in the Nineteenth Annual Report of the Survey, part 3, Plate XIII.

The belt is divided into two parts: One begins in Sudbury in Rutland County and extends 18 miles south to the latitude of a point 2 miles north of Poultney in the same county. This is known as the "unfading-green" slate district. The other begins at the south end of the first and extends about 20 miles south to West Rupert in Bennington County. This is known as the "fading-green" slate district.

The entire thickness of the slate throughout these districts is estimated at about 240 feet. Although the beds are in minor folds, the cleavage is generally somewhat steeply inclined. At two or three quarries the beds are so doubled over on themselves that quarrying operations are governed by the structure. The chief difficulties in quarrying are: Quartz veins of irregular form and direction, excessive jointing, shear zones, beds of quartzite up to 5 feet in thickness, and beds of limestone (breccia or conglomerate) up to 40 feet in thickness. Dikes are of rare occurrence.

The "sea-green" slate of the southern district when freshly quarried varies from a light gray to a slightly greenish gray. It is a mica slate of fine texture and of somewhat smooth cleavage surface with a waxy luster. It is quite sonorous, very fissile, very slightly magnetitic, and contains considerable carbonate. This carbonate is a triple carbonate of lime, magnesia, and iron. After a few years' exposure, owing to the oxidation of the iron carbonate and the formation of limonite, it changes its color to brownish gray, and as the beds contain different percentages of the carbonate the slates from different beds discolor variously so that a roof covered with slates from different beds acquires a mottled color. This slate is used exclusively for roofing and is the cheapest of American slates. Its high grade of fissility and its tendency to discolor sufficiently explain its low price. Some architects, however, are reported as preferring it to unfading-green slate for artistic reasons.

The "unfading green" slate of the northern district is a mica slate of greenish-gray color—the green tint being a little stronger than in the "sea-green" slate—and it has a slightly irregular texture and roughish, lusterless cleavage surface. It is sonorous, less fissile than the "sea-green," contains much less carbonate and a little magnetite. Several years' exposure produces so little change of color that only when a fresh slate is put in is any change perceptible, and that is but slight.

The "purple" and "variegated" slate.—The "purple" slate is dark purplish brown. The "variegated" is like the "sea-green" and the "unfading green," but irregularly patched with purplish brown These purplish slates are interbedded with both the "sea-green" and the "unfading green." The texture, surface, luster, and sonorousness correspond generally to those of the green slates with which they are interbedded. The purple of the "sea-green" areas discolors less than the "sea-green" and is very slightly magnetitic. The variegated of the Poultney quarries has very little carbonate. The color of these purplish slates is due to the mixture of red from hematite and of bluish green from chlorite. In the "variegated" the mottling is due to the irregular distribution of the hematite. Some of the "purple" slates are banded across the cleavage by pale-green "ribbons" from one-half inch to 2 inches wide and make very striking effects when used as flagging or for roofing.

Mill-stock slate.—In the northern and western part of the "unfading green" slate district those beds of green and purple, or of both mixed, that have a less perfect cleavage or are crossed by slip cleavage are used as mill stock and find a market as blackboards, billiard-table tops, electric switchboards, tiles, vats, mantels, etc. Such slates were also at one time subjected in Fair Haven, Vt., to the process known as "marbleizing" and were in much demand for mantelpieces. The "purple" of some of these beds is paler than the "purple" used for roofing, and it is also spotted with green; on the other hand some of the green is brighter than the "unfading green" used for roofing.

Black slate of Benson.—Half a mile east of Benson village and 7½ miles north-northwest of Fair Haven, in Rutland County, black roofing slate was quarried in 1895, but the quarry was abandoned not long afterwards. The slate-bearing area probably hardly exceeds 2 or 3 square miles, although the shale and schist area in which it occurs extends to within a mile of Lake Champlain and from West Haven on the south to the Addison County line on the north, and covers about 14 square miles.

The slate is a mica slate of bluish-black color with fine texture and somewhat smooth, slightly lustrous cleavage surface. It is sonorous, has a fair degree of fissility, contains a little magnetite and considerable carbonate. It belongs to the fading series and in composition and quality is closely related to the "soft-vein" slates of Lehigh and Northampton Counties, Pa.

Whether the geologic structure warrants extensive quarrying needs investigation.

VIRGINIA.

According to the recent investigations of T. L. Watson and S. L. Powell, of the Virginia Geological Survey, and their map (which is to be republished in the bulletin on slate in the United States), there are three slate belts in Virginia—the western, in Amherst and Bedford counties; the eastern, in Buckingham and Fluvanna counties and Quantico; and the central, in Albemarle and Fauquier counties. The only belts now being worked are the eastern and the central.

BUCKINGHAM COUNTY.

Arvonia.—This village lies southwest of James River, about 2¼ miles from the mouth of Slate River. It is connected with the Chesapeake & Ohio Railway by a branch starting from Bremo Bluff station. The quarries are scattered along the sides of Hunts Creek, a small tributary of Slate River, for 1½ miles northeast of the village. The slates strike N. 30° to 40° E. and dip very steeply eastward. Bedding and cleavage are parallel.

The slate is a highly crystalline graphitic mica slate of very dark-gray ("black") shade, with a faintly greenish hue and minutely granular, very lustrous surface. It is slightly magnetitic, very sonorous, has a fair grade of fissility, and belongs to the unfading series. It contains some carbonate, but this evidently does not include any appreciable amount of ferrous carbonate, for some of these slates put on the old Richmond Theater over 70 years ago, when removed about 1902, showed no discoloration whatever, and some have been on buildings near the quarries more than a century without losing any of their blackness. Slates from the Arvonia region were used on the first Capitol at Washington and also on the early buildings of the University of Virginia.

Penlan.—Penlan station is 2 miles south-southwest of Arvonia. The quarry of the Penlan Slate Co. is a mile farther south. This quarry is 100 by 150 feet and 100 feet deep. Tunnels are being made from the north and the south sides of the opening, and it is planned to extend one of these to a length of 500 feet and to sink a shaft to meet it in order to mine the slate from both ends. The cleavage and bedding of the slate are nearly vertical, as at Arvonia.

The only other quarry at Penlan is that of the Arvon Slate Manufacturing Co., which is about one-fourth mile southeast of the station, and 1,000 feet east of the railroad.

FLUVANNA COUNTY.

Bremo.—Slate has been prospected north of the James in the same belt on the estate of the late Dr. Casey Charles Cocke, 2 miles west-northwest of Bremo Bluff. It occurs in a ravine east of the mansion, and also on the hill northeast of it. The strike is about N. 20° E., differing a little from that of the beds across the river, and the dip is nearly vertical. A little northwest of the house is a dike of olivine basalt, 5 to 10 feet wide. The slate differs but slightly from that of Arvonia and Penlan. Specimens from the "top" are of a little lighter shade, and show more pyrite and no carbonate. Core drilling should be done to get at the fresh slate.

Slate has also been prospected at several other points in this county between James River and Palmyra, but no quarry was in operation in 1912. A company is being organized to open a quarry at a point 1¾ miles northeast of the Bremo prospect, and a little south of the road, which has a zigzag course generally parallel to that of James River. A specimen of slate from this locality, obtained from Mr. J. O. Shepherd, of Palmyra, and reported as coming from about 7 feet below the surface, is of medium bluish-gray color with a slight purplish tinge. It has a lustrous, roughish cleavage surface dotted with minute blackish lenses, is fissile and sonorous, very graphitic and magnetitic, and in the powder effervesces slightly in acid test. It is a highly crystalline mica slate containing sparse minute lenses of carbonate with many of magnetite and a few of pyrite. It belongs to the same class as the slate of Arvonia, although lighter in shade.

ALBEMARLE COUNTY.

Esmont.—The slate of the Esmont area lies east of the Blue Ridge and from 10 to 12 miles west of the strike of the slate in Buckingham and Fluvanna counties. The quarries of the Standard Slate Corporation lie west of Ballinger Creek, a small tributary of James River, 5 miles northwest of Warren on the James, and a mile west of Porter Precinct. A branch railroad starts from Warren, on the Chesapeake & Ohio Railway, passes through Esmont and near some talc quarries, and meets the Southern Railway at Rockfish station.

The slate appears to lie in acute folds and the cleavage dips about 70°. There are some undulating flat joints, a slip cleavage, and shear zones to contend with. There seem to be about 50 feet of "black" slate, overlain by a like thickness of combined "green" and "variegated," which recur several times, so that the apparent thickness is much greater.

There are four varieties of slate:

"No. 1, blue-black," is a mica slate of dark bluish-gray color. The bluish tint is marked, and in the wet slate resembles that of specular iron, to the presence of which mineral it is due. It has a lustrous granular surface, with an obscure foliation crossing the grain. It is sonorous, and has a good cleavage, is graphitic, slightly magnetitic, and contains little carbonate, which is mostly confined to minute lenses. It is a superior roofing slate of the unfading series.

The "dark green" is a mica slate of medium greenish-gray color, devoid of bluish tinge, and becoming a little darker on exposure. It has a lustrous finely spangled or coarsely and sparsely granulated surface, contains a little magnetite, is quite sonorous and fissile, and contains a little carbonate, but probably not enough to produce much discoloration.

The "variegated" is a mica slate of purplish-gray color, irregularly streaked with greenish-gray, or of a peculiar light brownish-purplish gray, with meandering parallel ribbons of dark greenish-gray 0.1 to 0.3 inch in width. The banding and coloring vary greatly. The surface has but little luster, and is granular. The slate is sonorous, contains a little carbonate in lenses and bands, also very little magnetite, and has a fair fissility. It may possibly show a little discoloration on continued exposure.

The "ferrous" is a mica slate, an inferior quality of the "dark-blue," with dark-brownish spots and a general very slight brownish tinge, both probably due to ferrous and other carbonates. It has a lustrous granular surface, is sonorous, and has a fair fissility. It belongs to the fading series.

Channeling machines are used by this company for both horizontal and vertical cuts. The finishing plant also includes various improved labor-saving devices.

AMHERST COUNTY.

Snowden.—The slate of Snowden belongs to the Amherst-Bedford belt, the westernmost of the three slate belts. It is on the southeast side of the axis of the Blue Ridge north of the cut through which James River flows. It lies about 18 miles north-northwest of Lynchburg in a longitudinal valley with Rocky Row Mountain on its northwest side and a spur of Big Piney Mountain on its southeast side. It strikes N. 65° E.

The only quarry in operation in 1904, situated 3 miles north-northeast of Snowden station, is now closed on account of litigation.

The slate is a mica slate of dark-gray shade, with minutely granular texture, somewhat smoothish cleavage surface, and very little luster. It contains neither graphite nor magnetite, and very little carbonate. It has been found less well adapted for mill stock than for roofing.

Thompson prospect.—About 1½ miles northeast of the Snowden quarry slate was prospected in 1886 on the Thompson property on a small tributary of Otter Creek, which flows into the James 1½ miles downstream from Snowden. Beds 20 feet thick are exposed. The beds strike N. 53° E. and the cleavage is nearly horizontal.

The slate is a mica slate, with carbonate, and is probably of the fading series, although it is claimed that slates obtained from this prospect in 1886 and put on the courthouse at Amherst and on Kenmore College in this county show no discoloration. The slate closely resembles that of the Snowden quarry.

CLASSIFICATION.

In the following table the slates are classified for commercial purposes. The clay slates of Group A are represented by the slate district of Martinsburg, W. Va., which was prospected in 1904 and is described fully in the bulletin on slate in the United States. In view of the ample supply of mica slate the clay slate of Martinsburg is not likely to be of economic value.

Commercial classification of American slates.

Group.			
(A) Clay slates, fading, (blackish), Martinsburg, W. Va.			
(B) Mica slates	Fading	(*a*) Carbonaceous (rarely graphitic?) (blackish).	Lehigh, Northampton, and Carbon counties, Pa.; Sussex County, N. J.; Rockmart, Ga.; Benson, Vt.
		(*b*) Chloritic (greenish)	"Sea-green," Vt.; Green, Bartow County, Ga.
		(*c*) Hematitic and chloritic (purplish).	"Purple" of "Sea-green" belt, Vt.
	Unfading	(*a*) Graphitic (carbonaceous?) (blackish).	Peach Bottom, Pa.-Md.; Arvonia, Penlan, Va.; Northfield, Vt.; Brownville, Monson, Me.; Merced County, Cal.; Humboldt County, Nev.
		(*b*) Hematitic (reddish)	Granville and Hampton, Washington County, N. Y.; Polk County, Ark.
		(*c*) Chloritic (greenish)	"Unfading green," Vt.; "Bright-green," Granville, N. Y.; green of Tellico, Tenn.
		(*d*) Hematitic and chloritic (purplish).	Purplish of "Unfading green" slate belt, Vt.; also of Tellico, Tenn.
		(*e*) Hematitic (specular) and graphitic (bluish-black).	"Blue-black," Esmont, Va.

STONE.

By Ernest F. Burchard.

INTRODUCTION.

The present report on the stone industry contains—in addition to the usual large amount of statistical data on the production of the various commercial types of stone, subdivided into the several forms in which the stone is marketed—a continuation of the general discussion of the stone resources of the United States which was begun in the report for 1911. The report for 1911 dealt with the stone quarried in the States east of Mississippi River and was illustrated by seven maps showing the location of the stone quarries by the types of stone. The report for 1912 is illustrated by six maps and concerns itself with the 15 Middle States west of the Mississippi. It is hoped to conclude this discussion in the report for 1913.

In the report for 1911, the statistical data chronicled no important industrial changes and showed none of the marked reductions in output that characterized some other leading industries in 1911. The statistics for 1912, however, for four of the six varieties of stone under which the data are grouped, showed decreases of 1 to 20 per cent. The two varieties which showed increase in value—marble and limestone—increased 3 and 8 per cent, respectively, making the total increase a little more than 1.5 per cent. It is of interest to note, however, that the increase of over 3 per cent in the value of marble was due not to the increased quantity marketed but to an increase of over 70 cents in average price per cubic foot of the stone as sold by the quarrymen. Over 50 per cent of the gain in limestone was in the increased production of fluxing stone demanded by the greatly increased activity in pig-iron manufacture.

An encouraging feature of the stone industry was the fact that in a year of comparative depression the stone used for exterior building decreased in value only 0.8 per cent. It is well known that stone has suffered severe competition for several years past from various types of cheaper structural materials, and a large number of owners of small quarries who were accustomed to quarry stone for foundation and rough rubble work have closed their quarries on account of lack of demand, this stone having been replaced by brick and cement. The demand for the more expensive grades of building stone has continued fairly regular, and the decrease caused by the closing of quarries furnishing the cheaper type of building stone has been offset in the grand total by the increase in the output of crushed stone, which at one time was considered only a by-product.

The stone industry outside of regular quarry centers shows great irregularity in its fluctuations, being influenced largely by local demand. Construction of seawalls, river improvement work, ballasting of railroad tracks, construction of roads, reservoirs, and dams, repairing and constructing locks on canals, and other similar structural work may call for the opening of a quarry in the vicinity of the work, and for the abandonment of this quarry as soon as the work is completed. This naturally causes a large increase and corresponding decrease in the output of those States where there is no regularly defined quarry region, and even in States having regular quarry centers a contract for a large public building or any extra construction work influences the output of the region.

It is possible that the figures for production may omit the reports of a number of small quarries where the stone finds only a very restricted local use. They may also omit some stone quarried and used where it has been impossible to get even an estimate of the output owing to the fact that stone is sometimes obtained by contractors from various small quarries, where it is not sold or measured, but is used in construction work and the cost is included in the total cost of the work without any separation of details. This applies in 1912 particularly to the work done by the city of Los Angeles in the construction of the Los Angeles aqueduct. In this case stone was quarried in three different counties over a distance of 200 miles, some of the stone consisting of crushed bowlders and some of it being quarried; but no definite information is given as to the kind or quantity of the stone used other than that it was all used for concrete. On the other hand many contractors are able to furnish estimates of the stone used each year at their various places of employment. An interesting example is contained in this report of stone excavated from cellars dug in New York City and either crushed and used for concrete in foundations or used directly for structural work.

In the statistical part of this report, which is entirely the work of Miss A. T. Coons, of the United States Geological Survey, new tables are added nearly every year which give not only the value of the stone production but the quantity of stone quarried as well, and it is hoped in this way to increase the value of the statistics from year to year by the inclusion of quantitative data. This latter work is hindered by the lack of uniform units of measurement in the reports of the quarrymen and in many cases by their omission of any quantities whatever.

The figures presented in the following report, as in previous years, have to do with the stone produced and sold by the quarrymen and include only such manufactured product as is put on the market by the quarrymen themselves. This applies especially to rough and dressed building stone, rough and dressed monumental stone, crushed stone, flagstone, curbstone, and paving blocks. The value given to the manufactured product is the price received by the producer free on board at point of shipment, and includes therefore the cost of labor necessary to dress the stone. The stone reported as sold rough includes stone sold as rough stock to monumental works and to cutstone contractors for building purposes; stone sold as riprap, rubble, and flux; and includes the value of only such labor as is required to get the stone out of the quarry in the shape required by the purchaser. The value given to this stone is the price received by the quarryman free on board at point of shipment. In case the stone is sold to local trade the value is given as the quarryman sells the material, generally at the quarry, but in some cases delivered, if this is done by the producer. In some instances a long haul to market or to the railroad increases the cost of the material, and therefore the selling price.

For simplicity of treatment the kinds of stone covered by the figures in this report are classified as granite, trap rock, sandstone, bluestone, limestone, and marble.

Granite includes true granites and other crystalline rocks, as gneiss, mica schist, andesite, syenite, rhyolite, trachyte, quartz porphyry, lava, tufa, diabase, basalt, diorite, gabbro, dolerite, and a small quantity of serpentine used for exterior building. 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 for California, Hawaii, 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 these States consists largely of basalt.

Sandstone includes the quartzites of South Dakota and Minnesota and the fine-grained sandstones of New York and Pennsylvania, known to trade as bluestone. As the bluestone is a product of a distinct industry, its production is also shown apart from that of the other sandstones. Bluestone is also quarried in New Jersey and West Virginia, but this product is small and is not separated from sandstone. 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 sandstones quarried in Michigan, Ohio, and West Virginia; nor does the total sandstone value include sandstone crushed into sand and used in the manufacture of glass and as molding sand. The production of these materials is published in other reports in Mineral Resources.

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 and Pennsylvania, and also a small quantity of the so-called "onyx" marble or travertine obtained from caves and other deposits in Kentucky and other States.

UNIT OF MEASUREMENT.

Owing to the variety of uses to which stone is put there is no regular unit of measurement employed by the quarrymen, the stone being sold by the cubic yard, the cubic foot, the ton, cord, perch, rod, square foot, square yard, square, etc. Building and monumental stone, especially the dressed product, is usually sold by the cubic foot or the cubic yard, although this unit varies with the class of stone and with the locality; a large quantity of the rough stone is sold by the perch, cord, and ton. Rubble and riprap, including stone for heavy masonry, such as breakwater and jetty work, are generally sold by the cord and ton. Fluxing stone and stone for chemical use—as for alkali works, sugar factories, carbonic-acid plants, paper mills, etc.—are sold by the long ton. Flagstone and curbstone are sold by the square yard and the square foot, the thickness being variable and depending on the orders received. Paving blocks are sold invariably by number of blocks, and as such have been tabulated and published for several years; these blocks, however, are not of uniform size, the value depending on the size and amount of labor necessary to cut the block into the shape desired. Crushed stone is reported as sold by the cubic yard or ton, the short ton being more generally used. The weight of a cubic yard varies from 2,300 to 3,000 pounds, the average weight being about 2,500 pounds. In certain localities this crushed stone is sold by the "square" of 100 square feet by 1 foot, or 100 cubic feet to a square. It is also of interest to note the selling of crushed stone by the bushel, 21½ bushels representing a cubic yard of about 2,700 pounds. As most of the crushed-stone producers report the quantity according to some unit, it has been possible to convert the crushed stone into short tons, which unit represents the larger number of producers and is the most convenient.

On the statistical inquiry cards showing the production of building stone, monumental stone, rubble, and riprap, the producers do not always report the quantity, but it has been possible to publish in this report the quantity as well as the value of the granite production of Maine, Minnesota, and Vermont; of the limestone production in the Bedford, Ind., Carthage, Mo., and Bowling Green, Ky., limestone districts; and of the marble produced in California, Georgia, Massachusetts, New York, Tennessee, and Vermont, as well as the quantity of the total marble output.

PRODUCTION.

The total value of the stone produced in the United States in 1912 was $78,284,572, as compared with $77,108,567 in 1911, an increase of $1,176,005, or 1.53 per cent. The year 1912 surpassed all previous years in the value of its stone output, but the value of granite, trap rock, sandstone, and bluestone decreased 4.53, 1.46, 7.97, and 19.76 per cent, respectively, from the value for 1911. The value of the marble increased 3.18 per cent and of the limestone 8.36 per cent. The decrease in the value of granite was chiefly in the stone sold for building purposes, paving blocks, and crushed stone; trap rock decreased in crushed stone output, and sandstone and bluestone in practically all of the different uses of this stone. Marble showed an increase in stone used in the interior of buildings and in dressed building stone, and limestone increased in value of stone used for building, crushed stone, and flux, the increase in flux corresponding to a considerable increase in pig-iron production.

Although the total increase for 1912 over 1911 was not large, and some of the varieties of stone showed a decrease, the total increase,

$1,176,005, was considerably larger than the increase of 1911 over 1910, when the total value was $76,520,584, and the increase was $587,983, or only 0.76 per cent.

Pennsylvania has always held first rank among the stone producing States—except in the year 1908 when Vermont reported the largest production—and in 1912 it produced 11.68 per cent of the total of the entire United States, Vermont being second, with 8.41 per cent. Other large stone producing States following in order of rank of output are New York, Ohio, Indiana, California, Illinois, Massachusetts, Missouri, and Wisconsin, each of whose production was valued at more than $2,000,000. In 1911 the leading States were Pennsylvania, New York, Vermont, Ohio, California, Indiana, Massachusetts, Illinois, Wisconsin, Missouri, and Maine. In 1912 Vermont supplanted New York; Indiana supplanted California; Illinois supplanted Massachusetts; Missouri supplanted Wisconsin; and Maine went with the States producing less than $2,000,000. In 1911 twelve States produced stone valued at between $1,000,000 and $2,000,000, and in 1912 fourteen States fell between these limits.

The following table shows the value of the different kinds of stone produced in the United States from 1901 to 1912, inclusive:

Value of the different kinds of stone produced in the United States, 1901–1912.

Year.	Granite.	Trap rock.	Sandstone.	Bluestone.	Marble.	Limestone.	Total.
1901	$14,266,104	$1,710,857	$6,974,199	$1,164,481	$4,965,699	$18,202,843	$47,284,183
1902	16,083,475	2,181,157	9,430,958	1,163,525	5,044,182	20,895,385	54,798,682
1903	15,703,793	2,732,294	9,482,802	1,779,457	5,362,686	22,372,109	57,433,141
1904	17,191,479	2,823,546	8,482,162	1,791,729	6,297,835	22,178,964	58,765,715
1905	17,563,139	3,074,554	8,075,149	1,931,625	7,129,071	26,025,210	63,798,748
1906	18,562,806	3,736,571	7,147,439	2,021,898	7,582,938	27,327,142	66,378,794
1907	18,064,708	4,594,103	6,753,762	2,117,916	7,837,685	31,737,631	71,105,805
1908	18,420,080	4,282,406	5,831,231	1,762,860	7,733,920	27,682,002	65,712,499
1909	19,581,597	5,133,842	6,564,052	1,446,402	6,548,905	32,070,401	71,345,199
1910	20,541,967	6,452,141	6,394,832	1,535,187	6,992,779	34,603,678	76,520,584
1911	21,194,228	6,739,141	5,854,395	1,876,473	7,546,718	33,897,612	77,108,567
1912	20,234,041	6,640,662	5,387,848	1,505,763	7,786,458	36,729,800	78,284,572
Percentage of increase (+) or decrease (−)	−4.53	−1.46	−7.97	−19.76	+3.18	+8.36	+1.53

The foregoing table shows the following relations between the values of the various classes of rock and the changes that occurred in the totals from 1911 to 1912:

Granite.—The value of granite represented 25.85 per cent of the total value of stone in 1912. The decrease in value was from $21,194,228 in 1911 to $20,234,041 in 1912, $960,187, or 4.53 per cent. Granite for building, crushed stone, curbing and paving blocks decreased in value, but there was an increase in the value of granite for monumental work and flagging.

Trap rock.—Trap rock decreased in value from $6,739,141 in 1911 to $6,640,662 in 1912, $98,479, or 1.46 per cent. The trap rock output is chiefly crushed stone.

Sandstone.—Sandstone, including quartzite, but excluding bluestone, decreased in value from $5,854,395 in 1911 to $5,387,848 in 1912, $466,547, or 7.97 per cent.

Bluestone.—The value of bluestone decreased from $1,876,473 in 1911 to $1,505,763 in 1912, a decrease of $370,710, or 19.76 per cent.

Marble.—The value of marble represented 9.95 per cent of the total stone value in 1912 and increased from $7,546,718 in 1911 to $7,786,458 in 1912, $239,740, or 3.18 per cent.

Limestone.—The value of limestone represented 46.92 per cent of the total value of stone produced in 1912. It increased from $33,897,612 in 1911 to $36,729,800 in 1912, a gain of $2,832,188, or 8.36 per cent.

The following table shows the rank of States and Territories in 1911 and 1912, according to value of production of stone, and the percentage of the total produced by each State or Territory.

Rank of States and Territories in 1911 and 1912, according to value of production of stone, and percentage of total produced by each State or Territory.

1911.

Rank of State.	State or Territory.	Total value.	Percentage of total.	Rank of State.	State or Territory.	Total value.	Percentage of total.
1	Pennsylvania	$8,147,505	10.57	27	Virginia	$821,798	1.07
2	New York	6,895,466	8.94	28	Kansas	803,222	1.04
3	Vermont	6,145,351	7.97	29	Oklahoma	a801,879	1.04
4	Ohio	5,796,829	7.52	30	Iowa	736,207	.95
5	California	4,676,902	6.07	31	Texas	588,777	.76
6	Indiana	4,413,655	5.72	32	Oregon	a580,978	.75
7	Massachusetts	a3,846,211	4.99	33	Arkansas	a528,947	.69
8	Illinois	3,467,930	4.50	34	New Mexico	406,454	.53
9	Wisconsin	2,375,102	3.08	35	Hawaii	339,519	.44
10	Missouri	2,338,585	3.03	36	South Carolina	a335,617	.44
11	Maine	a2,257,034	2.93	37	Nebraska	a268,971	.35
12	Georgia	1,967,077	2.55	38	Delaware	218,234	.28
13	Minnesota	1,702,525	2.21	39	Utah	a215,307	.28
14	Washington	1,679,872	2.18	40	Montana	212,233	.28
15	Colorado	a1,610,434	2.09	41	Florida	a184,545	.24
16	New Jersey	1,597,410	2.07	42	South Dakota	a147,865	.19
17	Tennessee	a1,499,648	1.94	43	Idaho	64,250	
18	Kentucky	a1,221,609	1.58	44	Arizona	55,714	.21
19	Maryland	a1,152,714	1.49	45	Wyoming	40,544	
20	West Virginia	1,106,012	1.43	46	Alaska	(a)	....
21	Connecticut	a1,068,174	1.39	47	Louisiana	(a)	....
22	Michigan	1,065,520	1.38	48	District of Columbia	(a)	....
23	New Hampshire	1,017,272	1.32	49	Nevada	(a)	....
24	Rhode Island	a957,743	1.24				
25	Alabama	923,998	1.20		Total	77,108,567	100.00
26	North Carolina	826,928	1.07				

a To prevent disclosure of individual figures, Arkansas includes a small value for Oregon and South Dakota; Colorado for Alaska, Oregon, and Utah; Connecticut for Maine, Massachusetts, and Rhode Island; Florida for Louisiana; Maryland for District of Columbia; Massachusetts for Connecticut; Nebraska for Nevada; Oklahoma for Kentucky; and Tennessee for South Carolina.

Rank of States and Territories in 1911 and 1912, according to value of production of stone, and percentage of total produced by each State or Territory—Continued.

1912.

Rank of State.	State or Territory.	Total value.	Percentage of total.	Number of plants.
1	Pennsylvania	$9,144,214	11.68	700
2	Vermont	6,581,203	8.41	56
3	New York	6,415,015	8.19	255
4	Ohio	6,197,388	7.92	245
5	Indiana	5,091,924	6.50	131
6	California	3,902,313	4.98	150
7	Illinois	3,841,504	4.91	106
8	Massachusetts	3,663,279	4.68	137
9	Missouri	2,486,505	3.18	194
10	Wisconsin	2,211,847	2.83	186
11	Georgia	1,983,016	2.52	42
12	Minnesota	1,845,746	2.36	74
13	Maine	1,810,590	2.31	79
14	New Jersey	1,716,829	2.19	102
15	Tennessee	1,656,812	2.12	85
16	Connecticut	1,467,458	1.87	65
17	Colorado	1,420,607	1.81	47
18	New Hampshire	1,311,488	1.67	36
19	Kentucky	1,282,148	1.64	100
20	Michigan	1,192,204	1.52	62
21	Washington	1,174,047	1.50	32
22	West Virginia	1,164,877	1.49	70
23	Maryland	1,097,022	1.40	68
24	North Carolina	1,054,872	1.35	42
25	Iowa	946,436	1.21	95
26	Virginia	877,746	1.12	63
27	Alabama	842,300	1.08	26
28	Rhode Island	768,067	.98	19
29	Kansas	763,228	.97	97
30	Texas	680,365	.87	37
31	Arkansas	513,844	.66	20
32	Oklahoma	429,788	.55	32
33	Nebraska	336,189	.43	13
34	New Mexico	335,937	.43	7
35	Oregon	268,002	.34	22
36	South Carolina	263,905	.34	13
37	Utah	249,782	.32	27
38	Hawaii	231,351	.30	9
39	Montana	216,079	.28	18
40	Delaware	193,074	.25	5
41	South Dakota	162,295	.21	21
42	Alaska	(a)		
43	Florida	(a)		
44	Wyoming	68,479	.09	10
45	Arizona	67,124	.09	18
46	Idaho	63,974	.08	11
47	Louisiana	(a)		
48	Nevada	(a)		
	Other States	[b] 293,699	.37	11
	Total	78,284,572	100.00	3,638

[a] Included in "Other States." [b] Includes Alaska, Florida, Louisiana, and Nevada.

Of 49 States reporting in 1911, 27 States showed an increased production in 1912 and 21 a decrease. The District of Columbia dropped out in 1912.

The most noticeable decrease was in Washington, Oregon, and Oklahoma, due in Washington and Oregon to less stone quarried for use as riprap in the mouth of Columbia River, and in Oklahoma the decrease was caused by the closing of quarries formerly producing large quantities of railroad ballast. An increase in production of dressed building stone, crushed stone, and curbstone in North Carolina caused this State to enter the rank of States producing over a million dollar's worth of stone.

The number of active operations are given for the first time in this table with Pennsylvania, Ohio, and New York having, respectively, 700, 255, and 245 quarries in operation. Only 56 quarries in Vermont produced stone of sufficient value to give that State second rank in production.

The following table shows the value of the stone used for various purposes in 1911 and 1912. Only such values are given as are for uses common to two or more varieties of stone.

Value of granite, trap rock, sandstone, limestone, and marble used for various purposes in 1911 and 1912.

Kinds.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving stone.	Crushed stone.
1911.						
Granite	$6,411,287	$4,364,203	$24,700	$972,358	$2,788,088	$4,175,792
Trap rock	83,330				197,477	6,068,152
Sandstone	2,317,074		749,604	1,124,760	689,826	1,634,074
Limestone	4,721,800		27,409	153,893	482,268	16,548,357
Marble	2,910,267	2,621,213				
Total	16,443,758	6,985,416	801,713	2,251,011	4,157,659	28,426,375
1912.						
Granite	$6,126,754	$4,643,919	$41,640	$898,209	$2,594,677	$3,868,240
Trap rock	93,175				265,335	6,004,063
Sandstone	2,263,289		721,069	1,108,545	585,275	1,165,634
Limestone	5,051,896		14,393	153,015	278,930	17,619,599
Marble	2,771,645	2,115,200				
Total	16,306,759	6,759,119	777,102	2,159,769	3,724,217	28,657,536

This table, besides showing the comparative value of the different varieties of stone according to their common usage, shows the changes for the total output with respect to the different stone products.

A comparison of the figures for 1911 and 1912 shows a decrease in the totals for all uses with the exception of crushed stone, which, however, showed an increase of only $231,161. Limestone was the only variety of stone showing an increase of this material.

Building stone decreased in value from $16,443,758 in 1911 to $16,306,759 in 1912, or $136,999. Limestone and trap rock showed an increase in values for this material, while the other varieties showed a decrease.

Monumental stone decreased in value $226,297. The decrease was in the marble output. Granite showed an increase for this product. Flagstone showed a slight decrease in total value, occasioned by a smaller output of sandstone and limestone for this use. Curbstone showed a decrease for all varieties of stone. The total value of paving stone showed a loss of $433,442 for 1912 as compared with 1911. Only the value of trap rock used for paving showed an increase.

The following table gives in a form convenient for comparison the value of building stone and of crushed stone from 1900 to 1912:

Value of building stone and of crushed stone, 1900–1912.

Year.	Building stone (rough and dressed).	Crushed stone.	Year.	Building stone (rough and dressed).	Crushed stone.
1900	$10,672,598	$6,525,368	1909	$17,594,455	$24,078,780
1901	15,112,600	8,560,432	1910	16,105,856	27,264,535
1902	20,790,341	11,480,959	1911	16,443,758	28,426,375
1903	19,795,491	13,188,938	1912	16,306,759	28,657,536
1904	18,883,455	15,530,122	Percentage of increase		
1905	20,240,809	16,419,614	(+) or of decrease		
1906	20,681,625	17,467,486	(−), 1911 and 1912	− 0.84	+ 0.81
1907	16,675,811	22,054,297	Percentage of increase		
1908	16,040,630	20,262,012	of 1912 over 1900	+52.79	+339.17

This table shows the very striking increase in the crushed-stone industry. The year 1900 is the first year for which exactly comparable tables are to be had. For four or five years prior to 1900 crushed stone had been reported to a considerable extent, chiefly as used for road making and ballast, but figures for the year 1898 were the first ones published and amounted to $4,031,445.

The comparison is made with the figures for building stone, as prior to the advent of crushed stone building and monumental stone were the chief stone products. The crushed stone for concrete and cement took the place of a great quantity of building and foundation stone.

The following table shows the quantity and value of crushed stone produced in the United States in 1911 and 1912, by States and Territories and by uses:

Production of crushed stone in 1911 and 1912, by States and Territories and by uses, in short tons.

1911.

State or Territory.	Road making.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	64,703	$37,511			155,748	$103,077	220,451	$140,588
Arizona			7,500	$6,000	10,000	10,000	17,500	16,000
Arkansas	24,887	16,627	193,334	153,090	116,763	101,482	334,984	271,199
California	1,878,120	1,259,123	762,858	460,419	1,674,211	1,151,595	4,315,189	2,871,137
Colorado	16,381	21,014			20,259	13,466	36,640	34,480
Connecticut	442,214	263,782	107,226	50,346	475,010	200,642	1,024,450	514,770
Delaware	15,956	12,465	44,465	31,125	38,011	35,609	98,432	79,199
Florida	158,625	78,170	42,363	16,945	29,375	35,130	230,363	130,245
Georgia	30,265	31,366	45,756	42,615	168,446	148,767	244,467	222,748
Hawaii	42,242	47,577	9,040	8,625	95,694	134,503	146,976	190,705
Illinois	1,594,298	777,821	952,108	453,465	1,990,382	1,038,882	4,536,788	2,270,168
Indiana	1,424,110	783,336	317,455	118,486	180,159	103,858	1,921,724	1,005,680
Iowa	56,409	39,582	488,150	215,229	416,211	270,549	960,770	525,360
Kansas	232,399	143,595	584,395	275,373	219,090	165,168	1,035,884	584,136
Kentucky	551,399	374,010	784,021	349,714	230,995	141,412	1,566,415	865,136
Louisiana			9,700	7,615	27,600	21,666	37,300	29,281
Maine	1,386	1,524	11,358	9,180	20,656	16,242	33,400	26,946
Maryland	552,425	375,855	333,453	185,158	203,396	165,696	1,089,274	726,709
Massachusetts	588,648	526,590	17,448	13,048	816,330	573,571	1,422,426	1,113,209
Michigan	237,307	126,145	91,713	34,998	351,635	175,714	680,655	336,857
Minnesota	137,546	114,187	71,772	45,230	222,423	193,324	431,741	352,741
Missouri	515,382	411,831	296,099	176,101	579,942	459,319	1,391,423	1,047,251
Montana	14,681	10,265	490	245	2,291	751	17,462	11,261
Nebraska	12,040	9,610	2,500	1,950	226,205	200,318	240,745	211,878
New Hampshire	2,000	1,350	1,392	1,306	21,329	14,312	24,721	16,968
New Jersey	958,907	760,736	384,305	240,308	434,032	316,009	1,777,244	1,317,053
New Mexico	500	725	803,086	388,119	27,806	13,650	831,392	402,494
New York	2,735,105	1,664,897	1,590,242	753,966	1,983,097	1,294,978	6,308,444	3,713,841
North Carolina	63,169	61,493	59,514	26,808	82,549	77,154	205,232	165,455
Ohio	3,212,152	1,509,752	1,244,508	520,795	927,106	437,025	5,383,766	2,467,572
Oklahoma	21,950	16,850	682,523	383,550	243,557	146,637	948,030	547,037
Oregon	538,292	434,001			80,839	87,899	619,131	521,900
Pennsylvania	1,628,923	1,006,014	1,534,424	843,166	1,324,782	792,440	4,488,129	2,641,620
Rhode Island	25,028	33,616			16,054	20,496	41,082	54,112
South Carolina	18,839	18,039	2,416	1,045	125,265	129,950	146,520	159,034
South Dakota	2,275	1,450	400	100	32,389	25,746	35,064	27,296
Tennessee	519,688	406,448	210,534	90,444	148,698	80,904	878,920	577,796
Texas	124,240	91,171	406,881	175,386	181,888	151,633	713,009	418,190
Utah	4,480	1,680			20	5	4,500	1,685
Vermont	13,500	8,952			12,810	9,020	26,310	17,972
Virginia	109,963	83,582	609,049	293,856	212,292	146,077	931,304	523,515
Washington	229,193	138,183	2,755	1,874	1,330	2,378	233,278	142,435
West Virginia	14,483	10,627	835,979	400,163	109,627	63,977	960,089	474,767
Wisconsin	611,988	336,773	99,836	44,143	540,649	268,650	1,252,473	649,566
Wyoming					22,840	18,383	22,840	18,383
Total	19,426,098	12,048,325	13,641,048	6,819,986	14,799,791	9,558,064	47,866,937	28,426,375

Production of crushed stone in 1911 and 1912, by States and Territories and by uses, in short tons—Continued.

1912.

State or Territory.	Road making.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	85,754	$54,270	30,298	$14,093	65,144	$38,235	181,196	$106,598
Arizona	1,875	2,250	14,950	13,000	11,703	20,956	28,528	36,206
Arkansas	129,577	104,258	177,295	115,725	125,236	107,605	432,108	327,588
California	1,451,487	964,300	948,046	548,578	1,157,665	808,847	3,557,198	2,321,725
Colorado	14,860	15,350	1,222	376	2,945	3,149	19,027	18,875
Connecticut	441,828	288,548	211,460	89,645	314,605	194,119	967,893	572,312
Delaware	30,614	27,861	20,100	14,070	29,533	24,536	80,247	66,467
Florida	84,224	57,836	43,500	15,000	23,514	25,646	151,238	98,482
Georgia	35,621	33,927	42,695	53,223	206,818	199,754	285,134	286,904
Hawaii	105,147	128,854			75,595	94,140	180,742	222,994
Idaho	14,978	10,131	25,000	16,000	5,750	4,600	45,728	30,731
Illinois	2,643,251	1,083,803	960,602	368,349	2,035,113	963,617	5,638,966	2,415,769
Indiana	1,771,521	1,033,673	286,186	102,841	72,603	45,197	2,130,310	1,181,711
Iowa	37,567	30,821	601,137	235,326	422,332	404,877	1,061,036	671,024
Kansas	126,078	95,642	560,322	274,176	317,112	234,261	1,003,512	604,079
Kentucky	514,124	319,057	1,024,538	473,023	200,209	109,355	1,738,871	901,435
Louisiana	10,197	8,158	15,351	12,281	47,776	38,221	73,324	58,660
Maine	7,090	5,062	18,666	14,000	6,627	5,075	32,383	24,137
Maryland	489,921	360,726	383,371	212,879	144,634	133,674	1,017,926	707,279
Massachusetts	460,564	431,162	14,651	13,985	934,432	741,835	1,409,647	1,186,982
Michigan	625,358	313,815	54,327	28,368	196,778	106,638	876,463	448,821
Minnesota	76,783	65,952	59,905	40,642	328,445	287,600	465,133	394,194
Missouri	333,591	262,438	599,799	387,449	837,096	674,986	1,770,486	1,324,873
Montana	4,141	1,365	184	101	30,593	18,115	34,918	19,581
Nebraska	40	20	9,037	5,985	275,430	252,063	284,507	258,068
New Hampshire	5,270	2,875	2,022	2,527	24,178	20,228	31,470	25,630
New Jersey	855,537	679,768	417,482	266,136	515,311	395,142	1,788,330	1,341,046
New Mexico			710,149	326,022	15,325	7,950	725,474	333,972
New York	1,978,666	1,256,354	1,441,326	742,156	2,333,612	1,466,316	5,753,604	3,464,826
North Carolina	76,746	70,985	116,664	33,254	209,265	206,579	402,675	310,818
Ohio	3,595,221	1,675,300	2,093,441	787,486	600,729	305,267	6,289,391	2,768,053
Oklahoma	89,413	60,862	340,936	178,440	183,680	111,435	614,029	350,737
Oregon	150,587	128,272	28,028	14,636	176,070	102,013	354,685	244,921
Pennsylvania	1,506,457	948,364	1,249,713	723,476	1,205,257	754,231	3,961,427	2,426,071
Rhode Island	58,577	64,777			19,508	24,140	78,085	88,917
South Carolina	40,719	41,252	22,926	21,234	68,035	67,878	131,680	130,364
South Dakota	3,875	4,160			67,671	54,598	71,546	58,758
Tennessee	325,964	268,509	267,267	114,011	214,007	127,076	807,238	509,596
Texas	79,694	52,753	110,212	49,956	633,301	434,332	823,207	537,041
Vermont	2,700	1,975	5,000	2,000	21,396	15,007	29,096	18,982
Virginia	140,697	112,496	300,240	166,856	222,684	156,889	663,621	436,241
Washington	166,926	96,775	5,645	2,847	40,659	29,591	213,230	129,213
West Virginia	40,938	27,440	700,669	328,871	234,883	100,855	976,490	457,166
Wisconsin	755,795	370,559	75,983	26,726	612,741	335,568	1,444,519	732,853
Wyoming	452	703			5,731	6,133	6,183	6,836
Total	19,370,425	11,563,458	13,990,345	6,835,749	15,271,731	10,258,329	48,632,501	28,657,536

According to this table nine States in 1912 produced crushed stone valued at more than $1,000,000, as follows, by rank: New York, Ohio, Pennsylvania, Illinois, California, New Jersey, Missouri, Massachusetts, and Indiana.

The following table shows the quantity and value of crushed stone produced in the United States in 1911 and 1912, by uses and kinds of stone:

Quantity and value of crushed stone produced in the United States in 1911 and 1912, by kinds and uses, in short tons.

1911.

Kind.	Road making.		Railroad ballast.		Concrete.		Total.		Average price per ton.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
Granite	2,569,256	$1,836,171	1,644,808	$896,774	1,810,953	$1,442,847	6,025,017	$4,175,792	$0.69
Trap rock	4,436,800	3,068,334	1,555,032	944,020	3,102,306	2,055,798	9,094,138	6,068,152	.67
Limestone	12,075,515	6,886,855	9,708,418	4,619,972	8,664,508	5,041,530	30,448,441	16,548,357	.54
Sandstone	344,527	256,965	732,790	359,220	1,222,024	1,017,889	2,299,341	1,634,074	.71
Total	19,426,098	12,048,325	13,641,048	6,819,986	14,799,791	9,558,064	47,866,937	28,426,375	
Average price		$0.62		$0.50		$0.65		$0.59	

1912.

Kind.	Road making.		Railroad ballast.		Concrete.		Total.		Average price per ton.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
Granite	1,946,354	$1,482,924	1,394,658	$815,337	1,892,213	$1,569,979	5,233,225	$3,868,240	$0.74
Trap rock	3,653,356	2,668,277	1,721,393	995,465	3,333,865	2,340,321	8,708,614	6,004,063	.69
Limestone	13,292,935	7,130,843	10,560,779	4,854,301	9,268,928	5,634,455	33,122,642	17,619,599	.53
Sandstone	477,780	281,414	313,515	170,646	776,725	713,574	1,568,020	1,165,634	.74
Total	19,370,425	11,563,458	13,990,345	6,835,749	15,271,731	10,258,329	48,632,501	28,657,536	
Average price		$0.60		$0.49		$0.67		$0.59	

As shown by this table, the quantity and value of the crushed-stone output in 1912 was 48,632,501 short tons, valued at $28,657,536, as compared with 47,866,937 short tons, valued at $28,426,375, in 1911, an increase of 765,564 tons in quantity and of $231,161 in value. The average price per ton was 59 cents for both 1911 and 1912.

Crushed granite decreased 791,792 short tons in quantity and $307,552 in value. The average price per ton increased from 69 cents in 1911 to 74 cents in 1912.

Crushed trap rock decreased 385,524 short tons in quantity and $64,089 in value. The average price per ton was reported as 69 cents in 1912, compared with 67 cents in 1911.

Crushed limestone increased 2,674,201 short tons in quantity and $1,071,242 in value. The average price per ton decreased from 54 cents in 1911 to 53 cents in 1912.

Crushed sandstone decreased 731,321 short tons in quantity and $468,440 in value. The average price per ton was 71 cents in 1911 and 74 cents in 1912.

Crushed stone used for road making decreased 55,673 short tons in quantity and $484,867 in value. The average price per ton was 60 cents in 1912, compared with 62 cents in 1911.

Crushed stone for railroad ballast increased 349,297 short tons in quantity and $15,763 in value. The average price per ton decreased from 50 cents in 1911 to 49 cents in 1912.

Crushed stone for concrete increased 471,940 short tons in quantity and $700,365 in value. The average price per ton increased from 65 cents in 1911 to 67 cents in 1912.

EXPORTS AND IMPORTS.

The following figures, compiled from statistics furnished by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, give the value of the exports and imports of stone for the calendar years 1911 and 1912.

Exports of stone from the United States in 1911 and 1912.

Kind.	1911	1912
Marble and stone, unmanufactured	$674,134	$645,889
All others	[a] 1,136,048	1,193,989
Total	[a] 1,810,182	1,839,878

[a] Includes exports of slate.

Imports of stone into the United States in 1911 and 1912.

Kind.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Marble:				
In block, rough, etc. cubic feet	624,735	$953,258	636,843	$1,001,703
Sawed or dressed do	353	603	117	148
Slabs or paving tiles do	411,583	75,742	311,895	79,577
All other manufactures		200,265		249,008
Mosaic cubes (loose) pounds	2,111,194	27,692	2,156,611	129,551
Total		1,257,560	3,105,466	1,459,987
Onyx:				
In blocks, rough, etc. cubic feet	15,917	102,487	13,029	49,237
All other manufactures		1,412		713
Total		103,899		49,950
Granite:				
Dressed		143,523		108,917
Rough cubic feet	14,688	2,945	9,467	3,421
Total		146,468		112,338
Stone (other):				
Dressed		18,400		16,951
Rough cubic feet	61,986	30,071	54,012	23,005
Total		48,471		39,956
Grand total		1,556,398		1,662,231

In 1912 the total exports are given exclusive of slate, and comparison for the two years is impossible, but there is an obvious increase for 1912. The value of the imports increased $105,833.

GRANITE.

PRODUCTION.

The figures given in this report as representing the value of the granite production in the United States include also the values of small quantities of gneiss, mica schist, lava, tuff, trachyte, andesite, syenite, quartz porphyry, basalt, and other igneous rocks. The quantities of these allied rocks quarried are too small to tabulate separately, and also the production of the igneous rocks other than granite would have to be concealed for certain States because there are less than three producers reporting. The quarrying of trap rock, consisting largely of basalt and diabase in California, Connecticut, Hawaii, Massachusetts, northern Michigan, New Jersey, New York, and Pennsylvania, represents, however, an industry sufficient by itself to make it advisable to tabulate this stone separately, and, therefore, its value is not included in the grand total of granite. The value of the granite produced in the United States in 1912 was

$20,234,041, a decrease of $960,187, or 4.53 per cent, as compared with $21,194,228, the value in 1911.

Granite for all purposes, except dressed monumental work, flagging, crushed granite for concrete, and granite for miscellaneous uses, decreased in value in 1912. Fourteen States reported a production of more than $500,000 in 1912 in the following order: Vermont, Massachusetts, Maine, California, New Hampshire, Wisconsin, North Carolina, Minnesota, Georgia, Maryland, Washington, Rhode Island, Connecticut, and Pennsylvania. In 1911 the order was as follows: Vermont, Massachusetts, Maine, California, Wisconsin, Washington, New Hampshire, Rhode Island, Georgia, Maryland, Minnesota, North Carolina, Oregon, and Connecticut.

In 1912 the first six States produced granite valued at more than $1,000,000; in 1911, the first seven. In 1911, Vermont, Massachusetts, California, Washington, Rhode Island, and Connecticut showed an increase in value of output; in 1912 these States were Vermont, New Hampshire, North Carolina, Minnesota, Connecticut, and Pennsylvania.

The following table shows the value of the production of granite, including a small output of other igneous rocks, in the United States from 1908 to 1912, inclusive:

Value of granite, etc., produced in the United States, by States and Territories, 1908–1912.

State or Territory.	1908	1909	1910	1911	1912
Alabama	....	....	....	(a)	....
Arizona	$8,544	(a)	(a)	$13,105	$26,501
Arkansas	152,567	$150,179	$226,690	354,041	366,354
California	1,684,504	1,310,520	1,520,299	1,738,094	1,583,583
Colorado	121,282	74,326	93,679	137,356	55,010
Connecticut	592,904	610,514	410,535	574,673	761,757
Delaware	195,761	456,328	357,708	218,234	193,074
District of Columbia	....	....	....	(a)	....
Georgia	970,832	843,542	1,049,186	847,023	823,207
Hawaii	81,219	68,955	139,724	(b)	(b)
Idaho	(a)	(a)	(a)	(a)	30,300
Maine	2,027,508	1,939,524	2,315,730	2,257,034	1,803,679
Maryland	762,442	771,224	982,746	845,936	814,555
Massachusetts	2,027,463	2,164,619	1,567,754	2,361,624	2,220,279
Michigan	....	[c] 660,823 (Michigan and Minnesota)	[c] 858,734 (Michigan and Minnesota)	....	....
Minnesota	629,427			797,244	950,033
Missouri	157,968	155,717	120,663	139,070	97,776
Montana	(a)	(a)	(a)	29,670	28,666
Nevada	....	....	(a)	(a)	(a)
New Hampshire	867,028	1,215,461	1,239,656	1,017,272	1,311,488
New Jersey	125,804	60,175	80,105	167,112	142,515
New Mexico	....	(a)	(a)	(a)	(a)
New York	367,066	443,910	330,716	344,038	431,910
North Carolina	764,272	743,876	839,742	772,685	983,615
Oklahoma	23,239	67,584	102,566	20,244	14,460
Oregon	271,869	284,135	1,080,009	580,978	267,488
Pennsylvania	324,241	507,814	478,919	491,428	575,680
Rhode Island	556,474	933,053	521,490	957,743	767,507
South Carolina	297,874	218,045	369,448	335,617	263,905
South Dakota	(a)	....	....	(a)	(a)
Texas	190,055	173,271	66,909	70,488	67,613
Utah	5,229	7,525	6,783	5,209	8,975
Vermont	2,451,933	2,811,744	2,694,474	2,730,719	3,074,306
Virginia	321,530	488,250	503,106	420,611	470,657
Washington	870,944	742,878	642,992	1,345,551	809,201
Wisconsin	1,529,781	1,442,305	1,475,342	1,382,309	1,179,018
Wyoming	(a)	....	....	....	....
Other States	40,320	[d] 235,300	[e] 466,262	[f] 239,120	[g] 110,929
Total	18,420,080	19,581,597	20,541,967	21,194,228	20,234,041

[a] Included in "Other States."
[b] Basalt, included under trap rock.
[c] Includes a small value for trap rock in Michigan and Minnesota.
[d] Includes Arizona, Idaho, Montana, and New Mexico.
[e] Includes Arizona, Idaho, Montana, Nevada, and New Mexico.
[f] Includes Alabama, District of Columbia, Idaho, Nevada, New Mexico, and South Dakota.
[g] Includes Nevada, New Mexico, and South Dakota.

The following table shows the value of the granite, including small values for trap and other igneous rocks, produced in the United States in 1911 and 1912, by States and Territories and uses:

Value of granite and other igneous rocks in the United States in 1911 and 1912, by States and Territories and uses.

1911.

State or Territory.	Sold in the rough—					Dressed for—		Made into paving blocks.
	Building.	Monumental.	Rubble.	Riprap.	Other.	Building.	Monumental work.	
Alabama								
Arizona	$3,050	$6,000		$2,130	$1,825	$100		
Arkansas	3,000	50	$36,769	115,400	68	750		
California	19,450	37,181	12,994	261,653	210	393,504	$61,690	$78,978
Colorado	14,685	16,997	3,760		1,200	52,750	27,000	
Connecticut	24,177	33,312	1,310	144,679	2,278	175,287	60,139	49,498
Delaware	7,160		343	125,462	684	342		1,883
District of Columbia								
Georgia	113,708	91,924	44,381	3,500	10,220	27,329	28,000	91,893
Idaho								
Maine	263,105	44,181	12,500	1,967	10,467	1,274,048	68,399	467,398
Maryland	99,416	20,594	67,178	7,846		65,698	3,600	37,480
Massachusetts	365,464	373,764	93,170	105,753	104,865	607,358	4,600	432,600
Minnesota	4,543	86,813	29,131	23,742	3,160	251,353	261,913	63,045
Missouri	6,147	33,095		1,955	165	20,000	8,000	33,125
Montana	3,430	500	504			23,159	463	
Nevada								
New Hampshire	77,508	63,188	7,864	3,886	5,506	380,171	170,169	212,526
New Jersey	6,090	9,620	1,253	2,009	1,612	4,192		
New Mexico								
New York	11,619	10,770	1,496	43,737		43,190	10,419	
North Carolina	59,434	11,183	4,671	5,224	3,200	102,678	3,788	192,841
Oklahoma	2,120	11,570	490		1,000	3,500	1,064	
Oregon	1,030		10,121	6,000		8,400	19,368	12,000
Pennsylvania	265,343	14,224	18,081	12,052	23,106	83,158	94	17,842
Rhode Island	17,576	184,634	26		385	387,458	186,095	114,293
South Carolina	7,142	71,488	2,930	62,472		10,275	27,042	375
South Dakota								
Texas	10,951	29,835		3,994		2,450	8,500	
Utah	320	3,549				50	1,290	
Vermont	54,552	1,290,807	2,537	7,875	1,033	795,083	543,508	27,177
Virginia	9,580	8,990	27,870	7,975	765	11,948	2,000	32,458
Washington	60,216	4,153	23,590	814,457	2,000	165,700	27,613	49,798
Wisconsin	7,526	104,111	451	2,761	105	689	275,116	872,878
Other States [a]	2,325	300		23,375			1,500	
Total	1,520,667	2,562,833	403,420	1,789,904	173,854	4,890,620	1,801,370	2,788,088

[a] "Other States" includes Alabama, District of Columbia, Idaho, Nevada, New Mexico, and South Dakota.

Value of granite and other igneous rocks in the United States in 1911 and 1912, by States and Territories and uses—Continued.

1911—Continued.

State or Territory.	Curbing.	Flagging.	Crushed stone.			Other.	Total.
			Road making.	Railroad ballast.	Concrete.		
Alabama							(a)
Arizona							$13,105
Arkansas			$7,000	$145,004	$46,000		354,041
California	$89,969	$350	361,255	138,448	278,378	$4,034	1,738,094
Colorado	1,200		17,764		2,000		137,356
Connecticut	27,269	1,058	43,279		12,298	89	574,673
Delaware	3,129		12,465	31,125	35,609	32	218,234
District of Columbia							(a)
Georgia	223,131		31,366	36,615	143,841	1,115	847,023
Idaho							(a)
Maine	77,386	6,246	1,524	9,180	16,242	4,391	2,257,034
Maryland	850	266	273,928	136,661	115,466	16,953	845,936
Massachusetts	144,785	1,586	76,515	870	47,918	2,376	2,361,624
Minnesota	9,166		27,781	10,446	16,659	9,492	797,244
Missouri	1,348		11,945		23,290		139,070
Montana	1,614						29,670
Nevada							(a)
New Hampshire	62,043	90	1,350	1,306	14,312	17,353	1,017,272
New Jersey			86,175	53,020	2,803	338	167,112
New Mexico							(a)
New York	5,534	800	87,428		128,595	450	344,038
North Carolina	210,943	4,977	45,915	26,808	77,129	23,894	772,685
Oklahoma	500						20,244
Oregon			434,001		87,899	2,159	580,978
Pennsylvania	10,122	55	22,958		24,393		491,428
Rhode Island	13,164		33,616		20,496		957,743
South Carolina	4,636	60	18,039	1,045	129,950	163	335,617
South Dakota							(a)
Texas	1,200				13,558		70,488
Utah							5,209
Vermont	1,400		1,177		5,570		2,730,719
Virginia	24,149	3,330	39,379	145,722	104,945	1,500	420,611
Washington	46,310	3,223	138,183	1,874	2,378	8,056	1,345,551
Wisconsin	9,540	2,659	63,128		43,118	227	1,382,309
Other States [b]	2,970			158,650	50,000		239,120
Total	972,358	24,700	1,836,171	896,774	1,442,847	90,622	21,194,228

[a] Included in "Other States."
[b] "Other States" includes Alabama, District of Columbia, Idaho, Nevada, New Mexico, and South Dakota.

Value of granite and other igneous rocks in the United States in 1911 and 1912, by States and Territories and uses—Continued.

1912.

State or Territory.	Sold in the rough—					Dressed for—		Made into paving blocks.
	Building.	Monumental.	Rubble.	Riprap.	Other.	Building.	Monumental.	
Arizona	$325	$1,720				$1,000	$4,650	
Arkansas			$126,460					
California	32,935	53,929	6,919	$111,717	$2,904	307,997	90,825	$115,650
Colorado	10,300	35,260	900					
Connecticut	53,168	34,099	934	298,224	827	203,739	50,454	48,209
Delaware	5,243			109,699	15	419		8,617
Georgia	15,930	41,385	31,541	31,080	50	140,396	700	58,289
Idaho	700							
Maine	307,422	40,875	17,815	836	1,302	563,482	65,722	670,520
Maryland	95,570	14,826	76,336	83	888	39,210	17,797	60,853
Massachusetts	190,585	424,813	21,706	107,425	48,005	778,403	20,700	358,876
Minnesota	19,018	61,995	7,609	30,610	290	229,048	430,982	75,820
Missouri	5,629	35,273	1,816	2,518		700	9,900	5,927
Montana	809	500	500			15,164	7,242	1,695
Nevada								
New Hampshire	70,533	66,879	5,845	6,052	4,006	571,661	168,784	297,256
New Jersey	25,880	15,200	380	2,115	400	450		
New Mexico								
New York	25,329	5,541	23,731	32,071	1,890	160,959	10,265	
North Carolina	52,265	27,800	8,884	3,050	1,014	216,523	18,500	212,990
Oklahoma	2,000	8,450					2,610	
Oregon	505	1,700	1,201	3,520		2,480	12,791	300
Pennsylvania	243,506	10,560	7,840	93,729	29,399	64,211	44,300	13,442
Rhode Island	14,331	178,565	1,514	512	55	164,752	269,074	37,449
South Carolina	5,450	70,273	1,658	8,300		300	42,245	166
South Dakota								
Texas	8,058	30,880		9,445		800	5,000	
Utah	5,500	3,400					75	
Vermont	34,433	1,367,149	2,830		660	1,323,787	286,503	44,388
Virginia	28,617	8,820	32,554	59,575		3,852	7,526	79,046
Washington	741	1,628	13,180	575,029		30,822	10,501	7,877
Wisconsin	1,018	13,076	1,575	168	188	49,499	500,177	497,307
Other States[a]						1,300	12,000	
Total	1,255,800	2,554,596	393,728	1,485,758	91,893	4,870,954	2,089,323	2,594,677

[a] Includes Nevada, New Mexico, and South Dakota.

Value of granite and other igneous rocks in the United States in 1911 and 1912, by States and Territories and uses—Continued.

1912—Continued.

State or Territory.	Curbing.	Flagging.	Crushed stone.			Other.	Total.
			Road making.	Railroad ballast.	Concrete.		
Arizona					$18,806		$26,501
Arkansas			$101,917	$96,858	41,119		366,354
California	$109,810	$175	301,304	183,789	250,256	$15,373	1,583,583
Colorado			6,750		1,800		55,010
Connecticut	33,359	814	14,512		12,149	11,269	761,757
Delaware	2,435	179	27,861	14,070	24,536		193,074
Georgia	231,897	8,070	26,542	47,223	188,254	1,850	823,207
Idaho			9,000	16,000	4,600		30,300
Maine	105,649	4,860	5,062	14,000	5,075	1,059	1,803,679
Maryland	5,900	584	272,089	129,347	97,251	3,821	814,555
Massachusetts	108,304	2,750	94,555	3,985	51,629	8,543	2,220,279
Minnesota	23,470		33,607	15,000	22,400	184	940,033
Missouri	2,950				33,063		97,776
Montana	635				2,121		28,666
Nevada							(a)
New Hampshire	63,728	16,610	2,875	2,527	20,228	14,504	1,311,488
New Jersey			35,585	55,085	6,520	900	142,515
New Mexico							(a)
New York	3,111		41,553		127,220	240	431,910
North Carolina	130,506	4,510	60,691	33,254	206,579	7,049	983,615
Oklahoma					1,400		14,460
Oregon			128,272	14,636	102,013	70	267,488
Pennsylvania	3,941	100	16,522	17,573	28,867	1,690	575,680
Rhode Island	7,891		64,777		24,140	4,502	767,507
South Carolina	2,535		41,252	21,234	67,878	2,559	263,905
South Dakota							(a)
Texas	700				12,730		67,613
Utah							8,975
Vermont	912		100	2,000	11,544		3,074,306
Virginia	16,774	438	54,540	49,480	115,427	14,008	470,657
Washington	40,596	450	94,520	2,847	29,438	1,572	809,201
Wisconsin	2,106	1,900	49,038		62,936	30	1,179,018
Other States [b]	1,000	200		96,429			[b] 110,929
Total	898,209	41,640	1,482,924	815,337	1,569,979	89,223	20,234,041

[a] Included in "Other States." [b] Includes Nevada, New Mexico, and South Dakota.

Building stone.—Over 30 per cent of the value of granite output is represented by building stone, which, including rough and dressed stone, was valued at $6,126,754 in 1912. In 1911 this value was $6,411,287, or a decrease of $284,533 in 1912. The decrease was in the value of both rough and dressed stone and amounted to $264,867 for rough stone and $19,666 for dressed material.

Vermont furnished over 20 per cent of the building stone, mostly in the form of dressed stone. Massachusetts, Maine, and New Hampshire follow next in order, producing respectively about 16, 14, and 10 per cent of the granite used for building purposes, the stone in these States also being sold chiefly in the dressed state.

Monumental stone.—Including rough and dressed stone about 23 per cent of the granite output in 1912 was for monumental work, which increased in value from $4,364,203 in 1911 to $4,643,919 in 1912, a gain of $279,716, or about 6 per cent. The increase was in the stone sold as dressed stone, as the stone sold rough decreased somewhat in value.

Rubble.—Rubble decreased in value $9,692 in 1912, or from $403,420 in 1911 to $393,728 in 1912. Arkansas and Maryland reported the most stone sold for this purpose.

Riprap.—Stone for riprap decreased in value $162,146 in 1912, or to $1,485,758 from $1,647,904 in 1911. Nearly 40 per cent of the stone used for riprap in 1912 was quarried in Washington and consisted chiefly of basalt used at the mouth of Columbia River. Connecticut, California, Delaware, Massachusetts, and Pennsylvania also produced a considerable quantity of riprap.

Paving blocks.—Paving blocks represent over 12 per cent of the value of granite output. Maine, Wisconsin, Massachusetts, New Hampshire, North Carolina, and California, in the order named, report the largest outputs for this class of stone.

The following table shows the quantity and value of granite paving blocks produced in the United States in 1911 and 1912 by States:

Number and value of granite paving blocks produced in 1911 and 1912, by States and Territories.

State.	Paving blocks.			
	1911		1912	
	Number.	Value.	Number.	Value.
California	1,526,143	$78,978	2,228,835	$115,650
Connecticut	1,038,474	49,498	968,640	48,209
Delaware	40,393	1,883	211,180	8,617
Georgia	2,819,788	91,893	2,324,900	58,289
Maine	10,040,523	467,398	12,795,125	670,520
Maryland	664,666	37,480	1,030,331	60,853
Massachusetts	9,000,073	432,600	7,070,082	358,876
Minnesota	933,000	63,045	1,097,700	75,820
Missouri	722,650	33,125	95,400	5,927
Montana			17,472	1,695
New Hampshire	5,613,841	212,526	8,153,800	297,256
North Carolina	4,953,101	192,841	5,079,343	212,990
Oregon	300,000	12,000	10,000	300
Pennsylvania	427,238	17,842	280,205	13,442
Rhode Island	1,493,887	114,293	780,382	37,449
South Carolina	10,500	375	5,600	166
Vermont	915,766	27,177	1,837,360	44,388
Virginia	872,710	32,458	1,980,943	79,046
Washington	1,145,975	49,798	98,000	7,877
Wisconsin	15,610,875	872,878	9,974,076	497,307
Total	58,129,603	2,778,088	46,039,374	2,594,677
Average price per thousand		$47.79		$56.36
Percentage of decrease in 1912 as compared with 1911			20.80	6.60

This table shows a decrease in quantity of 12,090,229 blocks, or 20.8 per cent, and in value of $183,411, or 6.60 per cent. The average price per thousand at the original points of shipment was $56.36 in 1912, an increase of $8.67 per thousand compared with 1911, when the value was $47.79 per thousand. The value of a block varies with the size and dressing of the block and ranges from $20 to $100 per thousand. A large proportion of the output from Minnesota and Wisconsin supplies the Chicago market. The blocks for New York, Philadelphia, and other large eastern cities as well as for the central and southern cities are supplied by Massachusetts, Maine, North Carolina, New Hampshire, New Jersey, Georgia, Pennsylvania, and other granite-producing States of the Atlantic seaboard. The Pacific coast demand is met by the quarries in the States situated on that coast.

Curbing.—Granite for curbing decreased in value $74,149, or from $972,358 in 1911 to $898,209 in 1912. Georgia, North Carolina, California, Massachusetts, and Maine are the largest producers of this material.

Flagging.—But a small part of the total granite output is used for flagstone, and this was one of the three products in which the granite output showed an increase. The increase amounted to only $16,940, or from $24,700 in 1911 to $41,640 in 1912.

Crushed stone.—Granite in the form of crushed stone represents a little more than 14 per cent of the total granite output and nearly 14 per cent of the crushed stone in the United States.

There was a decrease in 1912 of 791,792 short tons in quantity and of $307,552 in value of the crushed granite, or from 6,025,017 short tons, valued at $4,175,792, in 1911, to 5,233,225 short tons, valued at $3,868,240, in 1912. About 80 per cent of this crushed stone is used for road making and concrete, nearly equally divided between the two, and the remaining 20 per cent for railroad ballast. The decrease was shown in quantity and value for road making and railroad ballast, while stone for concrete increased somewhat. The average value per short ton was 69 cents in 1911 and 74 cents in 1912, an increase of 5 cents per short ton.

Other purposes.—Rough stone sold for a variety of purposes not given on the statistical card decreased from $315,854 in 1911 to $91,893 in 1912, a loss of $223,961; and worked stone sold for a variety of purposes decreased $1,399, or from $90,622 in 1911 to $89,223 in 1912.

GRANITE PRODUCTION OF VERMONT.

A more detailed statement of the granite production of Vermont is of interest here, as Vermont at present produces more granite than any other State and as the granite industry is one of the principal sources of its wealth.

The following table shows the production of granite in Vermont in 1911 and 1912, by counties and uses:

Production of granite in Vermont in 1911 and 1912, by counties and uses.

County.	Number of active firms reporting.	Building.				Monumental.				Paving		Other uses.	Total value.
		Rough.		Dressed.		Rough.		Dressed.					
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (number of blocks).	Value.	Value.	
1911.													
Washington and Orange	29	32,463	$24,785	180,225 (Washington and Orange, and Windsor)	$783,518 (Washington and Orange, and Windsor)	1,282,582	$1,229,553	144,789	$513,548	777,266	$21,510	$19,200 (Washington and Orange, and Windsor)	$2,058,389
Windsor	3	5,500	7,400										541,125
Essex and Orleans	5	35,900	8,950	10,050	7,000	62,000	27,800	1,000	1,000			240	44,990
Windham	3	7,421	3,117	1,015	2,565	7,530	3,171			138,500	5,667	152	14,672
Caledonia	8	23,000	10,300	1,000	2,000	65,016	30,283	11,000	28,960				71,543
Total	48	104,284	54,552	192,290	795,083	1,417,128	1,290,807	156,789	543,508	915,766	27,177	19,592	2,730,719
Average price per cubic foot			$0.52		$4.13		$0.91		$3.47	Per M.	$29.68		
1912.													
Washington, Orange, and Windsor	25	29,388	$25,474	389,028	$1,322,567	1,320,744	$1,325,794	72,306	252,103	1,709,360	$39,392	$13,993	$2,979,323
Essex and Orleans	6	5,309	2,659	1,500	750	35,405	16,405	5,000	12,000			3,080	34,894
Windham	3	5,500	2,500	172	470					126,000	4,920	973	8,863
Caledonia	7	9,000	3,800			53,618	24,950	28,000	22,400	2,000	76		51,226
Total	41	49,197	34,433	390,700	1,323,787	1,409,767	1,367,149	105,306	286,503	1,837,360	44,388	18,046	3,074,306
Average price per cubic foot			$0.70		$3.39		$0.97		$2.72	Per M.	$24.15		

These figures show an increase of $343,587, or 12.58 per cent in 1912 when the total value of Vermont granite was $3,074,306, as compared with $2,730,719 in 1911. Vermont produces a little over 15 per cent of the total granite output for the United States. The most noteworthy changes in value are the lower average prices per cubic foot reported for dressed stone and higher average prices for rough stone in 1912 as compared with 1911.

As previously stated in this report, the values represent the value of the stone as sold by the quarrymen, the values being given for rough stone if sold rough, and for dressed stone if sold after cutting by the quarrying firm. In Vermont the greater part of the stone is sold to granite manufacturers in the rough and although some of the stone is shipped in the rough, the greater part is cut in the vicinity of Barre and other centers, and the manufacturing industry forms a distinct, though dependent, source of wealth to the State. In 1912 of 90 granite quarry owners in this State to whom requests for reports of their quarry operations were sent, 41 reported active operations. The remainder reported their quarries abandoned, idle, or sold to other quarrymen. Of the 41 active quarries only 9 dressed the stone that was sold, and this dressed stone, including monumental and building stone, amounted to only 496,006 cubic feet compared with 1,458,964 cubic feet sold rough. The dressed stone, however, was valued at $1,610,290, or an average price of $3.25 per cubic foot, while the rough stone value was reported at $1,401,582, or 96 cents per cubic foot.

If the rough stone be considered as sold in the manufactured state at the average price of dressed stone, after allowing 10 per cent for waste, the total value for Vermont, including stone sold for paving blocks, curbing, rubble, crushed stone, etc., would represent an industry amounting in 1912 to over $6,000,000.

GRANITE PRODUCTION OF MAINE.

A detailed statement of the granite production of Maine was presented for the first time in 1911. The granite industry is one of the principal sources of the wealth of the State.

The comparatively low price per cubic foot of the stone reported as sold for rough-building purposes is accounted for by the fact that the large stone quarries of Hancock and York counties are directly on the coast, which lessens the cost of stone at the shipping point. Large quantities of this stone are used for the construction of bridge masonry and other heavy construction work in New York City and vicinity.

The following table shows the output of granite in Maine in 1911 and 1912, by counties and uses:

Production of granite in Maine in 1911 and 1912, by counties and uses.

1911.

County.	Number of operators.	Building.				Monumental.				Paving.		Crushed stone.		Curbing and flagging.		Other.	Total value.
		Rough.		Dressed.		Rough.		Dressed.									
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (number of blocks).	Value.	Quantity (short tons).	Value.	Quantity (lineal feet).	Value.	Value.	
Cumberland	6	1,800	$1,352	300	$510	2,676	$2,676	175	$358	....	....	2,205	$2,445	5,000	$2,000	$130	$9,471
Franklin and Oxford	7	89,379	37,685	268,998	601,682	2,241	1,180	60	317	694,464	$29,038	29,273	23,033	8,406	1,685	7,354	701,974
Hancock	36	968,505	183,222	88,053	114,555	925	278	2,908	3,592	3,040,898	141,166	114	125	176,788	76,754	11,519	531,211
Kennebec and Waldo	4	57,637	20,901	228,918	509,441	8,905	5,725	9,240	33,000	369,000	14,760	....	....	....	....	1,052	584,879
Knox and Lincoln	9	8,755	3,700	13,194	35,564	29,289	18,854	5,061	15,039	5,580,965	267,726	....	....	2,190	721	4,196	345,800
Somerset	4	902	451	8,100	3,000	11,435	5,718	600	300	255,196	10,208	1,790	1,343	4,050	810	....	21,830
Washington and Aroostook	10	7,628	4,762	879	3,680	8,840	9,035	3,532	13,207	100,000	4,500	....	....	....	....	....	35,184
York	6	62,304	11,032	1,607	5,616	1,208	715	980	2,586	....	....	....	....	4,165	1,662	5,074	26,685
Total	82	1,196,910	263,105	609,049	1,274,048	65,519	44,181	22,556	68,399	10,040,523	467,398	33,382	26,946	200,599	83,632	29,325	2,257,034
Average price	....	....	$0.22	....	$2.09	....	$0.67	....	$3.03	Per M, $46.55		....	$0.81	....	$0.42	....	....

1912.

County.	Number of operators.	Building, rough: Quantity (cubic feet).	Building, rough: Value.	Building, dressed: Quantity (cubic feet).	Building, dressed: Value.	Monumental, rough: Quantity (cubic feet).	Monumental, rough: Value.	Monumental, dressed: Quantity (cubic feet).	Monumental, dressed: Value.	Paving: Quantity (number of blocks).	Paving: Value.	Crushed stone: Quantity (short tons).	Crushed stone: Value.	Curbing and flagging: Quantity (lineal feet).	Curbing and flagging: Value.	Other: Value.	Total value.
Cumberland, Franklin, Oxford, Somerset, and York	19	48,534	10,159	77,130	231,727	23,171	11,300	3,438	2,889	1,357,552	60,818	31,051	22,792	19,150	5,565	1,338	348,964
Hancock	32	858,083	280,237	27,727	46,553	3,130	1,085	6,050	8,700	2,002,879	97,834	1,007	995	192,136	101,118	2,607	539,129
Kenebec, Knox, Lincoln, and Waldo	17	18,243	10,245	110,246	283,652	42,291	22,635	10,877	44,766	9,369,694	508,643	325	350	1,616	1,450	17,067	888,808
Washington and Aroostook	9	7,305	6,781	475	1,550	4,885	5,855	4,851	9,367	65,000	3,225	....	....	5,621	2,376	....	26,778
Total	77	932,165	307,422	215,578	563,482	73,477	40,875	25,216	65,722	12,795,125	670,520	32,383	24,137	218,523	110,509	21,012	1,803,679
Average price	....	....	$0.33	....	$2.61	....	$0.56	....	$2.61	Per M, $52.40		....	$0.75	....	$0.51	....	....

This table exhibits a marked decrease in the granite output in Maine in 1912, the total value falling off from $2,257,034 in 1911 to $1,803,679 in 1912, a decrease of $453,355, or 20 per cent.

Of 146 quarry owners reporting to the United States Geological Survey, 77 reported active operations at their quarries during the year; the other 69 reported quarries either idle, abandoned, or absorbed by other firms.

Paving blocks and flagstone and curbing were the only two products showing increases in both quantity and value.

Stone sold rough for building purposes increased in value but decreased in quantity; dressed building stone decreased in both quantity and value, as did crushed stone; rough and dressed monumental stone increased in quantity, but decreased in value.

GRANITE PRODUCTION OF MINNESOTA.

Detailed statistics of the granite production of Minnesota, by counties and uses and showing the quantity and value of the stone as sold by the quarrymen, is herewith presented for the first time. To prevent publishing individual figures the productions of neighboring counties are combined, and for the same reason the rough stone and the dressed stone are given together. Minnesota has attained considerable importance as a granite-producing State; especially in the vicinity of St. Cloud the granite is a source of wealth to the State.

The stone quarried in Lake and St. Louis counties is trap rock rather than granite. The following table shows the quantity and value of the granite output of Minnesota in 1912 by counties and uses:

Quantity and value of granite produced in Minnesota in 1912, by counties and uses.

County.	Number of plants.	Building (rough and dressed).		Monumental (rough and dressed).		Paving blocks.		Crushed stone.		Other value.	Total value.
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Number of blocks.	Value.	Quantity (short tons).	Value.		
Lac qui Parle, Redwood, and Renville.	3	925	$595	5,175	$8,444	....	....	....	....	$107	$9,146
Benton and Kanabec.....	5	22,000	40,536	15,200	39,200	50,000	$3,500	....	....	7,950	91,186
Sherbourne....	5	41,250	37,127	3,862	3,189	913,700	62,545	13,462	$14,900	9,950	127,711
Stearns........	15	78,101	169,808	157,642	442,144	134,000	9,775	....	....	16,987	638,714
Lake and St. Louis[a]......	3	....	....	....	....	....	....	66,462	56,107	27,169	83,276
Total....	31	142,276	248,066	181,879	492,977	1,097,700	75,820	79,924	71,007	62,163	950,033
Average price..	......	....	$1.74	....	$2.71	Per M, $69.07		....	$0.89	......	......

[a] Trap rock.

TRAP ROCK.

Besides the trap rock reported in the following tables, there is a small quantity included in the figures for granite under those States in which trap rock does not form enough of an industry to warrant the separate publication of the figures. The trap-rock industry in the Pacific coast States is known as the basalt-quarrying industry.

In the value of trap rock produced in Massachusetts is included the value of slate quarried in the vicinity of Boston, which, on account of lack of fissility, is rendered unsuitable for any of the purposes for which slate is used; therefore it is crushed and used entirely for road making.

The total output of trap rock in 1912 was valued at $6,640,662 as compared with $6,739,141 in 1911, a decrease of $98,479, or 1.46 per cent. In Connecticut, Hawaii, Massachusetts, New Jersey, and Pennsylvania the value of the production increased. Stone for building (foundation work mostly), for paving, for concrete, and for other purposes, which includes riprap, rubble, etc., increased in value. The value of all other products decreased.

California, in 1912 as in 1911, showed the largest value of trap rock (basalt) products. New Jersey ranked second.

The following table shows the value of the trap-rock production in the United States in 1911 and 1912, by States and uses:

Value of trap rock produced in the United States in 1911 and 1912, by States and uses.

1911.

State.	Building.	Paving.	Crushed stone.			Other.	Total.
			Road making.	Railroad ballast.	Concrete.		
California	$4,077	$166,242	$699,543	$311,019	$688,926	$186,123	$2,055,930
Connecticut	8,402	2,695	220,180	50,346	187,234	3,604	472,461
Hawaii	1,500		47,577	8,625	134,503	147,314	339,519
Massachusetts	13,825		384,115	12,178	442,113	6,839	859,070
Northern Michigan			12,571		38,429		51,000
New Jersey	6,154	26,441	646,209	177,019	271,203	9,359	1,136,385
New York	22,250		704,566	63,500	133,650	36,000	959,966
Pennsylvania	27,122	2,100	353,573	321,333	159,740	942	864,810
Total	83,330	197,478	3,068,334	944,020	2,055,798	390,181	6,739,141

1912.

State.	Building.	Paving.	Road making.	Railroad ballast.	Concrete.	Other.	Total.
California	$500	$229,261	$591,036	$340,561	$543,254	$221,735	$1,926,347
Connecticut	15,683	3,081	274,036	89,645	180,370	18,255	581,070
Hawaii	2,707		128,854		94,140	5,650	231,351
Massachusetts	30,614		303,007	10,000	564,706	6,914	915,241
Michigan			18,366		9,340	8,500	36,206
New Jersey	9,213	31,646	616,674	189,641	342,079	13,144	1,202,397
New York	20,000		376,400	39,106	396,101		831,667
Pennsylvania	14,458	1,347	359,844	326,512	210,331	3,891	916,383
Total	93,175	265,335	2,668,277	995,465	2,340,321	278,089	6,640,662

The following table shows the quantity and value of trap paving blocks produced in the United States in 1911 and 1912, by States:

Number and value of trap paving blocks produced in the United States, 1911–12, by States.

State.	Paving blocks.			
	1911		1912	
	Number.	Value.	Number.	Value.
California	3,501,000	$166,242	4,906,889	$229,261
Connecticut	69,875	2,695	78,600	3,081
New Jersey	913,678	26,441	1,015,841	31,646
Pennsylvania	50,000	2,100	33,673	1,347
Total	4,534,553	197,478	6,035,003	265,335
Average price per thousand		$43.55		$43.97

SANDSTONE.

The value of sandstone, including bluestone, decreased from $7,730,868 in 1911 to $6,893,611 in 1912, a loss of $837,257, or 10.83 per cent.

This large decrease was chiefly caused by a decrease in the output of the sandstone known to the trade as "bluestone," quarried in eastern New York and northeastern Pennsylvania. The decrease in bluestone production in New York was especially noticeable and was occasioned by the curtailment or the finishing of work done by the State on public construction. New York, Pennsylvania, and Ohio in the order named are the most important sandstone producing States; of these Pennsylvania was the only one showing an increase for 1912, and the increase was not considerable. Arizona, California, Idaho, Iowa, Kansas, Oklahoma, and Virginia showed a noticeable decrease in sandstone output; Texas was the only State showing a marked increase.

Sandstone used as crushed stone for concrete showed the largest decrease in 1912, although all the other uses of this stone except ganister, riprap, and stone crushed for roadmaking decreased also. The decrease in crushed stone was in the stone used for concrete and railroad ballast, which showed a decline in value of $304,315 and $188,574, respectively, while crushed stone for road making increased $24,449.

The following table shows the value of the sandstone production in the United States from 1908 to 1912, inclusive, by States:

Value of sandstone (including quartzite and bluestone) production in the United States, 1908–1912, by States.

State.	1908	1909	1910	1911	1912
Alabama	$34,099	$77,327	$109,063	$73,195	$27,596
Arizona	396,358	298,335	131,716	*a* 57,100	21,524
Arkansas	42,463	67,956	71,641	85,529	80,538
California	330,214	290,034	113,488	176,213	70,724
Colorado	181,051	197,105	189,603	135,673	108,169
Connecticut	55,949	(*b*)	(*c*)	(*a*)	(*d*)
Florida	.....	.....	.....	(*a*)	(*d*)
Georgia	.....	.....	.....	.....	(*d*)
Idaho	33,394	29,263	34,070	40,097	13,883
Illinois	12,218	26,891	5,710	30,953	32,720
Indiana	3,342	4,119	4,141	7,078	(*d*)
Iowa	2,337	2,443	14,456	56,312	1,551
Kansas	67,950	19,560	25,691	13,774	6,031
Kentucky	78,732	90,835	90,729	97,439	114,650
Maryland	6,262	10,584	18,226	10,097	15,950
Massachusetts	241,462	*b* 457,962	*c* 424,485	*a* 406,072	307,838
Michigan	39,103	36,084	31,233	12,985	16,438
Minnesota	197,184	299,358	483,578	292,366	349,063
Missouri	17,954	28,763	39,398	19,748	15,004
Montana	51,564	73,443	59,019	34,437	33,280
Nebraska	*e* 15,815	.....	.....	(*a*)	(*d*)
Nevada	(*e*)	(*b*)	(*c*)	.....	.....
New Jersey	154,422	189,098	112,650	155,765	166,583
New Mexico	*e* 10,410	4,963	1,402	4,085	(*d*)
New York	*f* 1,774,843	*f* 1,430,830	*f* 1,810,770	*f* 2,353,995	*f* 1,651,317
North Carolina	*e* 12,266	.....	(*c*)	*a* 10,385	(*d*)
North Dakota	(*e*)	(*b*)	.....	.....	.....
Ohio	1,244,752	1,639,006	1,402,131	1,334,947	1,312,300
Oklahoma	57,124	59,855	19,801	90,971	5,334
Oregon	(*e*)	*b* 4,811	*c* 30,375	*a* 1,668	.....
Pennsylvania	*f* 1,368,784	*f* 1,637,794	*f* 1,595,070	*f* 1,333,309	*f* 1,367,601
South Dakota	128,554	*b* 118,029	156,576	141,615	139,167
Tennessee	(*e*)	(*b*)	(*c*)	(*a*)	(*d*)
Texas	154,948	61,600	40,471	28,000	82,501
Utah	25,097	71,235	43,589	41,953	32,562
Virginia	(*e*)	28,574	25,080	31,315	4,020
Washington	464,587	335,470	438,581	301,843	344,476
West Virginia	127,149	*b* 201,038	*c* 212,308	203,935	183,410
Wisconsin	219,130	204,959	189,654	144,430	179,352
Wyoming	44,574	13,130	5,314	3,584	3,730
Other States	.....	.....	.....	.....	*g* 206,299
Total	7,594,091	8,010,454	7,930,019	7,730,868	6,893,611

a Arizona includes Florida; Massachusetts includes Connecticut; Oregon includes Nebraska; North Carolina includes Tennessee.

b Massachusetts includes Connecticut; Oregon includes Nevada; South Dakota includes North Dakota; West Virginia includes Tennessee.

c Massachusetts includes Connecticut; Oregon includes Nevada; West Virginia includes Tennessee and North Carolina.

d Included in "Other States."

e Nebraska includes North Dakota and Oregon; New Mexico includes Nevada; North Carolina includes Tennessee and Virginia.

f Includes bluestone.

g Includes Connecticut, Florida, Georgia, Indiana, Nebraska, New Mexico, North Carolina, and Tennessee.

Value of production of sandstone (including quartzite and bluestone) in the United States in 1911 and 1912, by States and uses.

1911.

State.	Rough building.	Dressed building.	Ganister.	Paving.	Curbing.	Flagging.	Rubble.
Alabama			$12,700				$14,362
Arizona	$2,000	$1,300					
Arkansas	5,375	525		$80	$10,450	$253	1,958
California	25,534	613			39,518	52,610	33,480
Colorado	26,526	26,268	24,320	20,474	9,690	4,088	8,591
Idaho	32,015	6,260					1,802
Illinois	1,020	180	2,200	150			155
Indiana	500	5,390			210	90	
Iowa	875	162			19		27
Kansas	8,478	605		980	807	876	178
Kentucky	35,048	56,413				2,160	211
Maryland	3,751		398				
Massachusetts	185,336	42,940					20,657
Michigan	5,682	2,809					3,068
Minnesota	5,279	31,237		184,796	25,928		13,073
Missouri	2,800	9,804					1,792
Montana	500	25,745					3,597
New Jersey	60,716	45,900				750	
New Mexico	2,150	1,125					50
New York	158,564	273,978		297,670	474,345	274,125	17,210
North Carolina	375	7,700					1,985
Ohio	125,596	341,252	3,843	1,294	381,463	320,840	8,170
Oklahoma	4,766		36				7,654
Oregon	138			1,000			506
Pennsylvania	203,989	218,153	163,574	35,872	172,202	93,812	102,788
South Dakota	18,878	29,325		59,382			3,445
Texas	50	1,400			550		1,250
Utah	13,705	22,248		1,881	274		3,845
Virginia	1,000	4,500					2,550
Washington	154	77,472		78,706			73,968
West Virginia	11,601	79,988			9,304		35,128
Wisconsin	25,605	32,492	40,548	7,541			11,060
Wyoming	2,950	334					300
Total	970,956	1,346,118	247,619	689,826	1,124,760	749,604	372,860

State.	Riprap.	Road making.	Railroad ballast.	Concrete.	Other.	Total value.
Alabama	$16,133			$30,000		$73,195
Arizona		$5,670	$6,000	32,130		[a]57,100
Arkansas	33,172	9,627	8,086	15,482	$521	85,529
California	570	5,753	39	13,739	4,357	176,213
Colorado	1,107	3,000		11,466	143	135,673
Connecticut						([b])
Florida						([c])
Idaho	20					40,097
Illinois		27,238			10	30,953
Indiana	880	8				7,078
Iowa		86	52,525	2,613	5	56,312
Kansas	150	700		650	350	13,774
Kentucky	46			2,950	611	97,439
Maryland		230	100	3,000	2,618	10,097
Massachusetts	7,110	65,960		83,540	529	[d]406,072
Michigan	1,140				286	72,985
Minnesota	385	23,000	7,764	904		292,366
Missouri	4,010	17		350	975	19,748
Montana	2,631				1,964	34,437
Nebraska						([e])
New Jersey		16,736		31,663		155,765
New Mexico		725			35	4,085
New York	80,207	16,624	10,605	568,975	181,692	[f]2,353,995
North Carolina				25	300	[g]10,385
Ohio	90,317	4,598	150	38,801	18,623	1,334,947
Oklahoma	500		78,000		15	90,971
Oregon	18				6	[h]1,668
Pennsylvania	34,328	69,271	130,895	98,010	10,415	[f]1,333,309
South Dakota	8,139	1,200	100	20,746	400	141,615
Tennessee						([i])
Texas	750			24,000		28,000
Utah						41,953
Virginia		1,560	21,250	455		31,315
Washington	71,543					301,843
West Virginia	8,408	1,262	43,706	14,015	523	203,935
Wisconsin	8,459	3,700		14,375	650	144,430
Wyoming						3,584
Total	370,023	256,965	359,220	1,017,889	225,028	7,730,868

[a] Includes Florida.
[b] Included in Massachusetts.
[c] Included in Arizona.
[d] Includes Connecticut.
[e] Included in Oregon.
[f] Includes bluestone.
[g] Includes Tennessee.
[h] Includes Nebraska.
[i] Included in North Carolina.

Value of production of sandstone (including quartzite and bluestone) in the United States in 1911 and 1912, by States and uses—Continued.

1912.

State.	Rough building.	Dressed building.	Ganister.	Paving.	Curbing.	Flagging.	Rubble.
Alabama			$45				$4,866
Arizona	$924	$2,700				$200	300
Arkansas	1,205	350		$4,032	$5,905	2	4,770
California	34,338	3,668			2,845		500
Colorado	14,154	23,023	14,278	25,955	8,362	4,289	4,540
Connecticut							
Florida							
Georgia							
Idaho	11,630	2,063					40
Illinois	644	564	2,250				135
Indiana							
Iowa	818	14					104
Kansas	5,063				42	926	
Kentucky	23,071	59,492		140		1,118	5,350
Maryland	6,500		5,250	2,400			550
Massachusetts	70,038	76,725					
Michigan	4,844	9,985					1,132
Minnesota	7,591	52,695		180,894	17,074		6,339
Missouri	1,921	4,078			40	100	1,375
Montana	725	23,554				2,144	2,777
Nebraska							
New Jersey	55,609	49,665		925	7,670	450	2,884
New Mexico							
New York	74,392	300,098		226,581	530,980	325,577	18,259
North Carolina							
Ohio	122,248	389,899	4,000		337,110	278,887	28,432
Oklahoma	1,600	17					3,717
Oregon							
Pennsylvania	221,467	239,424	206,728	31,634	189,696	100,339	38,442
South Dakota	23,619	18,440		29,413			2,669
Tennessee							
Texas	147				994		
Utah	5,966	13,146		5,500		2,837	4,613
Virginia							500
Washington		67,532		40,201			1,828
West Virginia	76,034	20,620			6,577	1,400	20,169
Wisconsin	10,249	28,675	47,384	37,100			10,322
Wyoming	2,049						
Other States [a]	83,417	16,599	10,000	500	1,250	2,800	35,692
Total	860,263	1,403,026	289,935	585,275	1,108,545	721,069	200,305

[a] Includes Connecticut, Florida, Georgia, Indiana, Nebraska, New Mexico, North Carolina, and Tennessee.

Value of production of sandstone (including quartzite and bluestone) in the United States in 1911 and 1912, by States and uses—Continued.

1912—Continued.

State.	Riprap.	Crushed stone.			Other.	Total.
		Road making.	Railroad ballast.	Concrete.		
Alabama	$10,685			$12,000		$27,596
Arizona		$2,250	$13,000	2,150		21,524
Arkansas	26,500	2,341	18,867	16,486	$80	80,538
California	43	20,832	228	6,204	2,066	70,724
Colorado	3,619	8,600		1,349		108,169
Connecticut						(a)
Florida						(a)
Georgia						(a)
Idaho	150					13,883
Illinois		29,127				32,720
Indiana						(a)
Iowa	40			575		1,551
Kansas						6,031
Kentucky	2,014	21,000		2,465		114,650
Maryland	1,250					15,950
Massachusetts	1,975	33,600		125,500		307,838
Michigan	140				337	16,438
Minnesota	540	8,935		69,655	5,340	349,063
Missouri	4,280	2,240		125	845	15,004
Montana	2,015				2,065	33,280
Nebraska						(a)
New Jersey	792	8,000		37,529	3,059	166,583
New Mexico						(a)
New York	5,685	9,659	1,118	131,808	27,160	1,651,317
North Carolina						(a)
Ohio	90,189	3,310	5,000	36,252	16,973	1,312,300
Oklahoma						5,334
Oregon						(a)
Pennsylvania	34,200	81,656	94,079	107,588	22,348	1,367,601
South Dakota	10,491	3,600		50,935		139,167
Tennessee						(a)
Texas	9,360			72,000		82,501
Utah					500	32,562
Virginia		1,450	1,800	270		4,020
Washington	234,915					344,476
West Virginia	5,858	3,088	36,554	13,080	30	183,410
Wisconsin	25,241	11,370		9,006	5	179,352
Wyoming				1,681		3,730
Other States [b]	5,855	30,356		16,916	2,914	[b] 206,299
Total	475,837	281,414	170,646	713,574	83,722	6,893,611

[a] Included in "Other States."
[b] Includes Connecticut, Florida, Georgia, Indiana, Nebraska, New Mexico, North Carolina, and Tennessee.

Building stone.—Sandstone for building, including rough and dressed stone, decreased in value from $2,317,074 in 1911 to $2,263,289 in 1912, a decline of $53,785. Ohio, Pennsylvania, and New York produced the most building stone.

Ganister.—Ganister, reported from Pennsylvania, Wisconsin, Colorado, Georgia, Maryland, Ohio, Illinois, and Alabama, was valued at $289,935 in 1912, an increase of $42,316 over 1911.

Paving.—The total value of the paving stone decreased $104,551, from $689,826 in 1911 to $585,275 in 1912. New York and Minnesota were large producers.

Curbing.—Sandstone for curbing was valued at $1,124,769 in 1911; in 1912 its value was $1,108,545, a decrease of $16,215. New York, Ohio, and Pennsylvania were the principal producers.

Flagging.—New York, Ohio, and Pennsylvania were the chief States producing sandstone flagging. Ohio declined in production and New York and Pennsylvania increased; the total decrease in the

United States amounted to $28,535, from $749,604 in 1911 to $721,069 in 1912.

Rubble.—Rubble decreased in value $172,555, from $372,860 in 1911 to $200,305 in 1912.

Riprap.—Sandstone sold for riprap increased in value from $370,023 in 1911 to $475,837 in 1912, a gain of $105,814.

Crushed stone.—There was a decrease in value in crushed sandstone of $468,440, from $1,634,074 in 1911 to $1,165,634 in 1912. The quantity decreased from 2,299,341 short tons in 1911 to 1,568,020 tons in 1912, a loss of 731,321 tons. The average price per ton in 1911 was 71 cents, in 1912 it was 74 cents.

BLUESTONE.

The rock popularly known as "bluestone" in southern and eastern New York and northeastern Pennsylvania is a fine-grained, compact dark blue-gray argillaceous sandstone. Its production is included under sandstone in this report, but since the quarrying of this material in the locality mentioned forms a more or less distinct industry its value is given separately. Because of the peculiar method of quarrying bluestone, it has been found that the best figures of production are obtained from the dealers who buy the stone from the numerous small quarrymen, mostly farmers, who get out this stone at intervals. The dealers usually quarry for themselves also and are better able to give the entire quantity of stone bought and sold than are the small producers. The principal channels to market for this stone are the Erie Railroad, the New York, Ontario & Western Railway, and Hudson River. The output of bluestone decreased in value from $1,876,473 in 1911 to $1,505,763, a loss of $370,710, or 19.76 per cent. The stone used for flagging and curbing increased in value, building stone decreased slightly, but stone reported as disposed of for crushed stone and for unspecified purposes showed a large decrease.

The decrease in value of bluestone produced in New York in 1912 was the result of quarrying a much less quantity of bluestone in Ulster County than for that used in 1910 and 1911 as rubble and as crushed stone for concrete in the building of dams for the New York City water-supply system.

The following table shows the value and uses of the bluestone produced in New York and Pennsylvania in 1911 and 1912:

Value and uses of bluestone produced in New York and Pennsylvania in 1911 and 1912.

1911.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
New York	$336,157	$273,860	$336,779	$395,676	$249,110	$1,591,582
Pennsylvania	92,493	87,769	78,106	17,233	9,290	284,891
Total	428,650	361,629	414,885	412,909	258,400	1,876,473

1912.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
New York	$310,797	$325,210	$404,203	$102,905	$9,187	$1,152,302
Pennsylvania	114,296	95,223	116,647	9,593	17,702	353,461
Total	425,093	420,433	520,850	112,498	26,889	1,505,763

LIMESTONE.

This report does not include the value of stone burned into lime and used or sold as lime, except where the stone is quarried by manufacturing plants and ultimately burned into lime and used in the manufacturing process. This applies especially to stone quarried by alkali works and sugar factories, and in some slight degree by iron manufacturers where lime instead of stone is used as the flux. A certain amount of stone is also sold to persons or firms whose only connection with the production of limestone is the manufacture of lime, but notwithstanding this stone is included in these figures, for it is chiefly stone sold to farmers for burning into lime for farm use, whose record can not otherwise be obtained. The commercial output of lime is given in another chapter of Mineral Resources.

A large quantity of limestone used in the manufacture of Portland cement is also excluded from these figures; the value of this stone enters into and is included in the value of the cement, the statistics of which are also given in another chapter of Mineral Resources.

Limestone was one of the two varieties of stone which increased in value of output in 1912, and was the variety showing the greater increase. The total value of the limestone quarried in 1912 was $36,729,800, as compared with $33,897,612 in 1911, a gain of $2,832,188, or 8.36 per cent.

Crushed stone and furnace flux each increased in value more than $1,000,000 in 1912, as compared with 1911. Building stone, stone sold to sugar factories, and stone for miscellaneous purposes also increased in value, but limestone used as flagstone, curbstone, paving stone, rubble, and riprap decreased.

The chief States producing limestone in 1912, according to rank in value, were Pennsylvania, Indiana, Ohio, Illinois, New York, Missouri, Kentucky, and Michigan, the first six producing over $2,000,000 each, and the last two over $1,000,000. In 1911 the rank was Pennsylvania, Ohio, Indiana, Illinois, New York, Missouri, Kentucky, and Michigan. Indiana took second place from Ohio in 1912. Each of these leading States showed an increase in 1912.

The following table shows the value of limestone, by States, from 1908 to 1912, inclusive:

Value of limestone from 1908 to 1912, by States and Territories.

State or territory.	1908	1909	1910	1911	1912
Alabama	$479,730	$700,642	$714,516	$571,798	$531,085
Arizona	a 50,130	(b)	(c)	8,676	19,099
Arkansas	61,971	112,468	84,280	d 136,007	66,952
California	237,320	283,869	590,990	576,701	245,235
Colorado	378,822	355,136	415,523	341,798	365,004
Connecticut	a 3,727	b 5,023	c 9,062	d 21,040	17,924
Florida	41,910	b 49,856	c 84,457	97,520	60,524
Georgia	8,495	34,593	24,236	31,632	53,187
Hawaii	....	(b)	....	....	....
Idaho	36,000	(b)	19,423	d 19,497	19,791
Illinois	3,122,552	4,234,927	3,847,715	3,436,977	3,808,784
Indiana	3,643,261	3,749,239	4,472,241	4,406,577	5,066,337
Iowa	530,945	525,277	543,600	679,895	944,885
Kansas	403,176	892,335	768,739	789,448	757,197
Kentucky	810,190	903,874	978,809	1,124,170	1,160,148
Louisiana	....	(b)	(c)	(d)	(e)
Maine	(a)	(b)	(c)	(d)	(e)
Maryland	128,591	197,939	154,370	218,636	228,713
Massachusetts	1,950	....	(c)	(d)	(e)
Michigan	669,017	750,589	842,126	1,001,535	1,139,560
Minnesota	667,095	698,309	654,833	612,915	546,650
Missouri	2,130,136	2,111,283	2,360,604	2,179,767	2,373,725
Montana	134,595	154,064	169,836	148,126	154,133
Nebraska	330,570	293,830	338,731	263,459	335,369
Nevada	....	....	....	(d)	(e)
New Jersey	172,000	224,017	224,709	138,148	205,334
New Mexico	(a)	b 140,801	c 227,657	243,119	237,543
New York	2,584,559	2,622,353	2,813,476	2,857,797	3,208,911
North Carolina	(a)	(b)	(c)	30,278	39,864
Ohio	3,519,557	4,020,046	4,357,432	4,461,882	4,885,088
Oklahoma	257,066	450,055	509,344	594,664	409,994
Oregon	6,230	....	3,594	(d)	(e)
Pennsylvania	4,057,471	5,073,825	5,394,611	5,243,045	6,017,308
Rhode Island	(a)	(b)	(c)	(d)	(e)
South Carolina	....	....	(c)	(d)	....
South Dakota	(a)	b 49,328	17,150	6,250	10,628
Tennessee	a 535,882	b 589,949	c 747,162	d 798,369	673,329
Texas	314,571	341,528	447,239	490,289	530,251
Utah	253,088	169,700	389,603	168,145	208,245
Vermont	20,731	18,839	25,250	19,702	12,644
Virginia	280,542	342,656	471,903	369,872	403,069
Washington	31,660	38,269	86,186	32,478	20,370
West Virginia	645,385	864,392	841,064	902,077	981,467
Wisconsin	1,102,009	1,047,044	979,522	848,363	853,477
Wyoming	a 31,168	24,346	43,687	36,960	64,749
Other States	....	....	....	....	f 73,227
Total	27,682,002	32,070,401	34,603,678	33,897,612	36,729,800

a Arizona includes New Mexico; Connecticut includes Maine and Rhode Island; Tennessee includes North Carolina; Wyoming includes South Dakota.
b New Mexico includes Arizona; South Dakota includes Hawaii and Idaho; Connecticut includes Maine and Rhode Island; Florida includes Louisiana; Tennessee includes North Carolina.
c New Mexico includes Arizona; Connecticut includes Maine, Massachusetts, and Rhode Island; Florida includes Louisiana; Tennessee includes North Carolina and South Carolina.
d Arkansas includes Louisiana; Connecticut includes Maine, Massachusetts, and Rhode Island; Idaho includes Nevada and Oregon; Tennessee includes South Carolina.
e Included in "Other States."
f Includes Louisiana, Maine, Massachusetts, Oregon, South Carolina, and Rhode Island.

Value of the production of limestone in the United States in 1911 and 1912, by States and uses.

1911.

State.	Rough building.	Dressed building.	Paving.	Curbing.	Flagging.	Rubble.	Riprap.
Alabama	$2,115	$29,652	$170	$150			$10,459
Arizona	800						1,400
Arkansas	22,300	24,445					19,981
California	283		40				
Colorado							552
Connecticut							
Florida		2,000					
Georgia	1,404						
Idaho		535				$20	40
Illinois	34,252	16,775	81,935	5,071	$2,979	191,848	28,275
Indiana	1,082,154	1,972,903	965	76,039	5,207	19,369	12,108
Iowa	35,048	4,302	37,924	3,250	1,017	29,061	89,410
Kansas	61,147	30,991	47,754	4,202	250	20,167	35,515
Kentucky	98,234	77,819	582	13,825	760	1,845	46,418
Louisiana							
Maine							
Maryland	9,848		73	45	75		160
Massachusetts							
Michigan	7,526					165	380
Minnesota	74,531	130,637	9,650	4,600	3,493	29,035	72,718
Missouri	132,011	380,282	70,074	3,388	4,559	247,263	247,210
Montana	5,285						
Nebraska	2,763		16,929	4,000	500	1,645	24,536
Nevada							
New Jersey	341						
New Mexico							
New York	110,919	25,086	6,278	5,053	167	15,523	32,517
North Carolina							
Ohio	73,272	4,846	4,000	2,200		40,724	623,965
Oklahoma	15,590	1,500	53,492			3,750	48,735
Oregon							
Pennsylvania	89,798	4,545	120,835	5,960	1,200	6,595	4,201
Rhode Island							
South Carolina							
South Dakota						200	800
Tennessee	3,879	5,130	2,500	1,131		2,669	88,428
Texas	31,162	22	14,850	1,833	750	4,205	51,421
Utah	24,702	750	25			260	19,166
Vermont	1,610					2,500	
Virginia	701		226				
Washington							
West Virginia	4,320	40	1,536			2,500	650
Wisconsin	71,662	11,783	12,430	23,146	6,452	20,689	102,173
Wyoming	100					275	55
Total	1,997,757	2,724,043	482,268	153,893	27,409	640,308	1,561,273

Value of the production of limestone in the United States in 1911 and 1912, by States and uses—Continued.

1911—Continued.

State.	Crushed stone.			Flux.	Sugar factories.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Alabama	$37,511		$23,077	$458,356		$308	$561,798
Arizona				683	$3,793	2,000	8,676
Arkansas		$7,615	61,666				[a] 136,007
California	192,572	10,913	170,552	93,272	92,594	16,475	576,701
Colorado	250			284,142	54,219	2,635	341,798
Connecticut	323		1,110	7,166		12,441	[b] 21,040
Florida	72,500	16,945	3,000			3,075	97,520
Georgia		6,000	4,926	5,855		13,447	31,632
Idaho				49	17,853	1,000	[c] 19,497
Illinois	750,583	453,465	1,038,882	728,544	3,606	100,762	3,436,977
Indiana	783,328	118,486	103,858	165,250		66,910	4,406,577
Iowa	39,496	162,704	267,936	660	7,110	1,977	679,895
Kansas	142,895	275,373	164,518			6,636	789,448
Kentucky	374,010	349,714	138,462	6,243		16,258	1,124,170
Louisiana							(d)
Maine							(e)
Maryland	101,697	48,397	47,230	5,759		5,352	218,636
Massachusetts							(e)
Michigan	113,574	34,998	137,285	186,046	65,141	456,420	1,001,535
Minnesota	63,406	27,020	175,761	570	3,000	18,494	612,915
Missouri	399,869	176,101	435,679	24,593	11,861	46,877	2,179,767
Montana	10,265	245	751	120,401	11,179		148,126
Nebraska	9,610	1,950	200,318		1,108	100	263,459
Nevada							(f)
New Jersey	11,616	10,269	10,340	91,781		13,801	138,148
New Mexico		229,469	13,650				243,119
New York	856,279	679,861	463,758	443,522		218,834	2,857,797
North Carolina	15,578			5,000		9,700	30,278
Ohio	1,505,154	520,645	398,224	1,089,236	9,051	190,565	4,461,882
Oklahoma	16,850	305,550	146,637			2,560	594,664
Oregon							(f)
Pennsylvania	560,212	390,938	510,297	3,396,304		152,160	5,243,045
Rhode Island							(e)
South Carolina							(g)
South Dakota	250		5,000				6,250
Tennessee	406,448	90,444	80,904	109,633		7,203	[h] 798,369
Texas	91,171	175,386	114,075	467		4,947	490,289
Utah	1,680		5	114,307	6,250	1,000	168,145
Vermont	7,775		3,450	736		3,631	19,702
Virginia	42,643	126,884	40,677	143,099		15,642	369,872
Washington				26,179		6,299	32,478
West Virginia	9,365	356,457	49,962	422,902		54,345	902,077
Wisconsin	269,945	44,143	211,157	56,453		18,330	848,363
Wyoming			18,383		13,952	4,195	36,960
Total	6,886,855	4,619,972	5,041,530	7,987,208	300,717	1,474,379	33,897,612

[a] Includes Louisiana.
[b] Includes Maine, Massachusetts, and Rhode Island.
[c] Includes Nevada and Oregon.
[d] Included with Arkansas.
[e] Included with Connecticut.
[f] Included with Idaho.
[g] Included with Tennessee.
[h] Includes South Carolina.

Value of the production of limestone in the United States in 1911 and 1912, by States and uses—Continued.

1912.

State.	Rough building.	Dressed building.	Paving.	Curbing.	Flagging.	Rubble.	Riprap.
Alabama			$15,900				$81,361
Arizona							
Arkansas	$5,887	$9,936				$963	166
California	136						
Colorado							
Connecticut							
Florida							
Georgia	828					414	2,518
Idaho	12					250	
Illinois	15,413	19,293	53,169	$33,063	$356	187,478	58,545
Indiana	1,329,620	2,173,267	230	75,697	1,481	21,335	11,407
Iowa	44,979	9,830	4,600	580	50	43,247	112,698
Kansas	46,222	29,219	15,062	1,032	982	29,188	20,997
Kentucky	86,977	101,224	198	17,660	397	13,186	32,511
Louisiana							
Maine							
Maryland	10,719						
Massachusetts							
Michigan	9,997					380	75
Minnesota	65,216	145,354		245	1,971	35,096	43,751
Missouri	139,416	310,276	26,601	6,170	2,928	203,672	289,999
Montana	2,653					70	6
Nebraska	448					4,088	64,824
Nevada							
New Jersey	625						
New Mexico							
New York	112,736	27,013		2,877	912	13,798	5,769
North Carolina							
Ohio	59,842	12,475	5,560	550		37,822	242,742
Oklahoma	8,692	27,731	360			1,325	22,374
Oregon							
Pennsylvania	144,424	1,258	149,079	1,465		8,730	1,745
Rhode Island							
South Dakota						600	621
Tennessee	5,965	1,685	150	275	11	910	53,726
Texas	13,144	7	6,000	1,111		2,624	20,650
Utah	23,961	1,100		200		150	8,932
Vermont	2,760					50	
Virginia	6,457					197	
Washington							
West Virginia	354					4,000	5,445
Wisconsin	40,497	3,358	2,021	12,090	5,305	30,101	101,383
Wyoming	740						
Other States [a]	150						206
Total	2,178,870	2,873,026	278,930	153,015	14,393	639,674	1,182,451

[a] Includes Louisiana, Maine, Massachusetts, Nevada, Oregon, and Rhode Island.

Value of the production of limestone in the United States in 1911 and 1912, by States and uses—Continued.

1912.

State.	Crushed stone.			Flux.	Sugar factories.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Alabama	$54,270	$14,093	$26,235	$339,166		$60	$531,085
Arizona				6,400	$12,450	249	19,099
Arkansas			50,000				66,952
California	51,128	24,000	9,133	62,210	73,834	24,794	245,235
Colorado		376		313,237	46,189	5,202	365,004
Connecticut			1,600	1,524		14,800	17,924
Florida	27,500	15,000	8,750			9,274	60,524
Georgia	7,385	6,000	11,500	6,636		17,906	53,187
Idaho	1,131				18,398		19,791
Illinois	1,054,676	368,349	963,617	951,733	6,441	96,651	3,808,784
Indiana	1,033,673	102,841	45,197	216,275	3,152	52,162	5,066,337
Iowa	30,821	235,326	404,302	2,928	8,128	47,396	944,885
Kansas	95,642	274,176	234,261	178		10,238	757,197
Kentucky	298,057	473,023	106,890	9,670		20,355	1,160,148
Louisiana							(a)
Maine							(a)
Maryland	88,637	83,532	36,423	8,364		1,038	228,713
Massachusetts							(a)
Michigan	295,449	28,368	97,298	137,812	36,944	533,237	1,139,560
Minnesota	23,410	25,642	195,545	1,235	4,400	4,785	546,650
Missouri	260,198	387,449	641,798	38,937	7,270	59,011	2,373,725
Montana	1,365	101	15,994	99,896	34,048		154,133
Nebraska		5,985	252,043		7,308	673	335,369
Nevada							(a)
New Jersey	19,509	21,410	9,014	122,943		31,833	205,334
New Mexico		229,593	7,950				237,543
New York	828,682	701,932	811,187	535,159		168,846	3,208,911
North Carolina	10,294					29,570	39,864
Ohio	1,671,990	782,486	269,015	1,698,237	12,562	91,807	4,885,088
Oklahoma	60,862	178,440	110,035	150		25	409,994
Oregon							(a)
Pennsylvania	490,342	285,312	407,445	4,361,677		165,831	6,017,308
Rhode Island							(a)
South Dakota	560		3,663		5,184		10,628
Tennessee	268,509	114,011	127,076	88,789		12,222	673,329
Texas	52,753	49,956	349,602	33,094		1,310	530,251
Utah				170,642		3,260	208,245
Vermont	1,875		3,463	665		3,831	12,644
Virginia	56,506	115,576	41,192	130,916		52,225	403,069
Washington	2,255		153	10,718		7,244	20,370
West Virginia	24,352	292,317	87,775	546,511		20,713	981,467
Wisconsin	310,151	26,726	263,626	36,219		22,000	853,477
Wyoming	703		4,452		58,800	54	64,749
Other States	8,158	12,281	38,221	5,851		8,360	(b) 73,227
Total	7,130,843	4,854,301	5,634,455	9,937,772	335,108	1,516,962	36,729,800

(a) Included in "Other States."
(b) Includes Louisiana, Maine, Massachusetts, Nevada, Oregon, and Rhode Island.

Building stone.—Limestone for building purposes, including rough and dressed stone, increased in value $330,096, or from $4,721,800 in 1911 to $5,051,896 in 1912. Both the rough and the dressed stone increased in value in 1912, the former $181,113 and the latter $148,983.

Indiana and Missouri produce the greater part of the building stone, that from Indiana representing a little over 69 per cent of the total for the United States, and therefore, more than the proportion produced in 1911, which was 64 per cent. The Indiana limestone which represents most of this product is quarried in Lawrence and Monroe counties and is well known to the trade as Bedford oolitic limestone, from the town of Bedford, Lawrence County, which, with Bloomington, Monroe County, forms the shipping center of this stone. This Bedford stone is chiefly used for building stone, although some is sold for flagstone, curbstone, monumental stone, crushed stone, ground limestone, furnace flux, and some—not included in this report—is used for lime and cement.

As this stone is so large a factor in the building limestone trade, the following table showing the details of the production of Bedford oolitic limestone in Lawrence and Monroe counties, Indiana, from 1901 to 1912 is given.

Quantity and value of Bedford oolitic limestone quarried in Lawrence and Monroe counties, Ind., 1901–1912.

Year.	Lawrence County.		Monroe County.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901		$1,365,875		$421,599		$1,787,474
1902		1,207,497		439,902		1,637,399
1903		1,088,477		487,662		1,576,139
1904		1,054,302		589,672		1,643,974
1905		1,550,076		843,399		2,393,475
1906		1,460,743		1,162,062	[a] 9,282,004	2,622,805
1907		1,413,280		908,612	[a] 7,849,027 [b] 256,960	2,321,892 110,525
1908	[a] 5,199,996 [b] 93,085	1,498,822 42,150	[a] 3,147,097 [b] 8,260	880,218 1,719	[a] 8,347,093 [b] 101,705	2,379,040 43,869
1909	[a] 6,441,483 [b] 145,672	1,678,195 71,637	[a] 2,970,388 [b] 106,600	801,436 56,925	[a] 9,411,871 [b] 252,272	2,479,631 128,562
1910	[a] 5,778,660 [b] 131,590	1,841,233 75,906	[a] 3,960,148 [b] 70,655	1,265,287 44,224	[a] 9,738,808 [b] 202,245	3,106,520 120,130
1911	[a] 6,612,988 [b] 53,242	2,171,148 27,842	[a] 2,915,444 [b] 50,914	859,580 45,112	[a] 9,528,442 [b] 104,156	3,030,728 72,954
1912	[a] 7,066,496 [b] 71,124	2,622,648 37,894	[a] 3,375,808 [b] 76,532	824,594 60,629	[a] 10,442,304 [b] 147,656	3,447,242 98,523

[a] Cubic feet. [b] Short tons.

The following table shows the production of Bedford oolitic limestone in Lawrence and Monroe counties, Ind., in 1911 and 1912, by uses:

Production of Bedford oolitic limestone in Lawrence and Monroe counties, Ind., in 1911 and 1912, by uses.

1911.

County.	Building.						Other uses.[a]		Total value.
	Rough.		Dressed.		Total.				
	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (short tons).	Value.	
Lawrence	3,786,538	$829,865	2,826,460	$1,341,283	6,612,998	$2,171,148	53,242	$27,842	$2,198,990
Monroe	1,602,975	255,841	1,312,469	603,739	2,915,444	859,580	50,914	45,112	904,692
Total	5,389,513	1,085,706	4,138,929	1,945,022	9,528,442	3,030,728	104,156	72,954	3,103,682
Average price	....	$0.20	....	$0.47	....	$0.32	....	$0.70	....

1912.

County.	Rough quantity (cubic feet).	Rough value.	Dressed quantity (cubic feet).	Dressed value.	Total quantity (cubic feet).	Total value.	Other uses quantity (short tons).	Other uses value.	Total value.
Lawrence	4,024,487	$942,180	3,042,009	$1,680,468	7,066,496	$2,622,648	71,124	$37,894	$2,660,542
Monroe	2,182,862	361,942	1,192,946	462,652	3,375,808	824,594	76,532	60,629	885,223
Total	6,207,349	1,304,122	4,234,955	2,143,120	10,442,304	3,447,242	147,656	98,523	3,545,765
Average price	....	$0.21	....	$0.50	....	$0.33	....	$0.67	....
Percentage of increase (+) or decrease (−) as compared with 1911	+15.17	+20.12	+2.32	+10.18	+9.59	+13.74	+41.76	+35.05	+14.24

[a] Includes stone used for rubble, riprap, curbstone, flagstone, glass making, sugar factories, ground limestone, etc.

From these tables it will be seen that the stone industry for these counties is in a very thriving condition. The total increase in value in 1912 as compared with 1911 was 14.24 per cent, or $442,083; the building stone increased in quantity 913,862 cubic feet, or 9.59 per cent, and in value $416,514, or 13.74 per cent.

Monroe County, however, while showing an increase in quantity decreased slightly in total value of output in 1912. This decrease was in the quantity and value of dressed stone sold.

Lawrence County showed an increase both in quantity and in value for all products. The average prices for this stone remained practically unchanged, increasing 1 cent per cubic foot for rough building stone, 3 cents for dressed building stone, and decreasing 3 cents per ton for stone sold for miscellaneous purposes.

Missouri ranked next to Indiana in the output of building limestone, the value of the output in 1912 being $449,692, in comparison with $512,293 for 1911, a decrease in 1912 of $62,601.

About 60 per cent of the Missouri building stone is a strong, light-gray crystalline limestone from Carthage, Jasper County, and the following table shows the details of production in this district:

Production of limestone at Carthage, Jasper County, Mo., in 1908–1912, by uses.

Year.	Number of producers.	Building stone.		Curbing.	Flagging.	Rubble.	Other.[a]	Total value.
		Quantity.	Value.	Value.	Value.	Value.	Value.	
		Cubic feet.						
1908	8	431,576	$280,249	$5,238	$3,602	$2,682	$17,826	$309,597
1909	8	481,274	334,715	1,263	6,232	3,791	24,001	370,002
1910	10	502,161	347,244	1,767	7,229	2,945	23,571	382,756
1911	9	427,974	293,470	2,427	2,431	2,596	23,865	324,789
1912	8	404,685	268,930	670	2,878	4,885	28,087	305,450

[a] Includes stone used for monumental work, crushed stone, stone sold to glass factories, blast furnaces, sugar factories, etc.

From this table it will be seen that the limestone production in 1912 for this district decreased $19,339, or nearly 6 per cent. Building stone and curbing showed decreased production; stone for flagging, rubble, and miscellaneous uses increased.

The building stone decreased from 427,974 cubic feet, valued at $293,470, in 1911 to 404,685 cubic feet, valued at $268,930, in 1912, a loss of 23,289 cubic feet in quantity and of $24,540 in value. The average price per cubic foot was 68.6 cents in 1911 and 66.5 cents in 1912.

Another limestone of increasing importance to the building trade in the Central States is the oolitic limestone quarried near Bowling Green, Ky. The production of this district was published separately for the first time in the report for 1910. The following table shows the quantity and value of this limestone produced in 1909, 1910, 1911, and 1912.

Production of limestone in Warren County, Ky., by uses, 1909–1912.

	Rough building.		Dressed building.		Crushed stone.		Other.[a]	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Value.	
	Cubic feet.		*Cubic feet.*		*Short tons.*			
1909	203,120	$60,936	74,482	$62,989	46,725	$22,013	$33,704	$179,642
1910	204,602	56,141	90,100	57,350	108,183	47,532	5,584	166,607
1911	134,291	45,792	103,220	76,589	57,720	25,921	250	148,552
1912	148,711	51,638	114,308	100,774	38,495	17,563	1,890	171,965

[a] Curbing, flagging, fluxing, and monumental stone.

Building stone as shown in this table was about 81 per cent of the total production of limestone for building in Kentucky. Although the total quantity of the stone quarried in Warren County in 1912 was not so large as in 1909 and 1910, the total value was larger for 1912 than for either of these years; the production also exceeded in both quantity and value the building stone produced in 1911.

Stone sold as crushed stone, however, decreased in both quantity and value of output, as did also stone sold for miscellaneous purposes.

Paving.—Limestone for paving decreased in value from $482,268 in 1911 to $278,930 in 1912, or $203,338. Pennsylvania, Illinois, Missouri, Kansas, and Alabama produced most of the limestone used for paving in 1912.

Curbing.—There was a decrease of $878 in the value of the output of limestone for curbing, from $153,893 in 1911 to $153,015 in 1912. Indiana, Illinois, Kentucky, and Wisconsin furnished most of the material in 1912.

Flagging.—A decrease of $13,016 marked the limestone output of flagging in 1912, from $27,409 in 1911 to $14,393. Most of the stone was from Wisconsin, Missouri, Minnesota, and Indiana.

Rubble.—Rubble decreased in value $634, from $640,308 in 1911 to $639,674 in 1912. Missouri, Illinois, Iowa, and Ohio reported the largest production.

Riprap.—Riprap decreased in value $378,822, from $1,561,273 in 1911 to $1,182,451 in 1912. Missouri, Ohio, Iowa, and Wisconsin produced most of this stone in 1912.

Crushed stone.—Crushed limestone used in road making, railroad ballast, concrete, etc., had a larger value than any other limestone product. In 1912 this output was 33,122,642 short tons, valued at $17,619,599, an increase of 2,674,201 short tons in quantity and of $1,071,242 in value for 1912, as compared with 1911, when the figures were 30,448,441 short tons, valued at $16,548,357. This was a notable increase and the largest increase in quantity was shown in the stone sold for road making, while the greatest increase in value was for the stone sold for concrete.

In 1912 the total output was divided into 13,292,935 short tons, valued at $7,130,843, for road making; 10,560,779 short tons, valued at $4,854,301, for railroad ballast; and 9,268,928 short tons, valued at $5,634,455, for concrete, which compared with the itemized output for 1911—road making, 12,075,515 tons, valued at $6,886,555; railroad ballast, 9,708,418 tons, valued at $4,619,972; concrete, 8,664,508 tons, valued at $5,041,530—was an increase of 1,217,420 tons in quantity and $243,988 in value for road making, of 852,361 tons in quantity and $234,329 in value for railroad ballast, and of 604,420 tons in quantity and $592,925 in value for concrete. It is possible that the stone for road making includes some stone used for concrete, some of the operators reporting that they were unable to subdivide, except approximately, their total output of crushed stone, not knowing the exact use which was to be made of the stone. The average price per short ton was 53 cents in 1912, compared with 54 cents in 1911.

Ohio, Illinois, New York, Indiana, Pennsylvania, and Missouri were ranking States in 1912 according to quantity of crushed limestone sold, and the rank according to value was Ohio, Illinois, New York, Missouri, Pennsylvania, and Indiana.

Furnace flux—Next to crushed stone, limestone sold for furnace flux showed the largest value and a larger increase in production in 1912 than any other limestone product. The production in 1912 was 20,190,554 long tons, valued at $9,937,772; in 1911 it was 16,126,650 long tons, valued at $7,987,208, an increase in 1912 of 4,063,904 tons in quantity and of $1,950,564 in value. The average price per ton was 49 cents in 1912 and 50 cents in 1911. Pennsylvania, Ohio, Illinois, West Virginia, New York, Alabama, and Colorado were the principal producers. This large increase in the production of furnace flux in 1912 is fully accounted for by the large increase in pig iron manufactured in 1912.

The following table shows the production of limestone for smelter, open hearth, and blast-furnace flux in 1911 and 1912, by States, in long tons:

Production of furnace flux, etc., in 1911 and 1912, by States, in long tons.

State.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Alabama	831,864	$458,356	582,904	$339,166
Arizona	692	683	7,035	6,400
California	84,247	93,272	54,868	62,210
Colorado	518,643	284,142	534,224	313,237
Connecticut	a 5,364	a 7,166	2,774	1,524
Georgia	9,838	5,855	11,622	6,636
Illinois	1,927,785	728,544	2,747,284	951,733
Indiana	334,471	165,250	481,950	216,275
Iowa	1,071	660	5,500	2,928
Kansas			177	178
Kentucky	11,088	6,243	14,527	9,670
Maryland	10,284	5,759	14,978	8,364
Massachusetts	(b)	(b)	(c)	(c)
Michigan	341,027	186,046	295,941	137,812
Minnesota	842	570	1,257	1,235
Missouri	27,618	24,593	42,533	38,937
Montana	228,147	120,401	259,193	99,896
New Jersey	183,267	91,781	230,822	122,943
New York	781,247	443,522	981,670	535,159
North Carolina	10,000	5,000		
Ohio	2,335,048	1,089,236	3,334,126	1,698,237
Oklahoma			100	150
Oregon	84	49	(c)	(c)
Pennsylvania	6,769,949	3,396,304	8,540,211	4,361,677
Rhode Island	(b)	(b)	(c)	(c)
South Carolina	(d)	(d)		
Tennessee	e 198,050	e 109,633	156,732	88,789
Texas	504	467	48,161	33,094
Utah	194,659	114,307	295,670	170,642
Vermont	536	736	604	665
Virginia	281,968	143,099	254,108	130,916
Washington	28,396	26,179	17,484	10,718
West Virginia	886,268	422,902	1,179,708	546,511
Wisconsin	123,693	56,453	83,840	36,219
Other States			f 10,551	f 5,851
Total	16,126,650	7,987,208	20,190,554	9,937,772
Average price per ton		$0.50		$0.49
Per cent of increase			25.20	24.42

a Includes Massachusetts and Rhode Island.
b Included with Connecticut.
c Included in "Other States."
d Included in Tennessee.
e Includes South Carolina.
f Includes Massachusetts, Oregon, and Rhode Island.

Other uses.—Limestone reported as sold to sugar refiners increased in value from $300,717 in 1911 to $335,108 in 1912, a gain of $34,391. Stone for other uses included stone quarried and used by alkali works in New York and Michigan; stone sold to glass factories, to paper mills, and to carbonic-acid plants; stone for making whiting and mineral wool; and also a small quantity sold to farmers for burning into lime to be used as a fertilizer, it being impossible to get the lime value for this stone; also about 200,000 tons of ground limestone, valued at $311,702, used chiefly for fertilizing the ground. The total output of stone for these various uses increased in value $42,583, from $1,474,379 in 1911 to $1,516,962 in 1912.

MARBLE.

The figures for marble production here presented include, for some of the States, the value of serpentine (verde antique marble) and "onyx" marble. The serpentine included is that form which, from its use as ornamental stone for interior decorative work in buildings, answers the purpose of marble. The Georgia and Pennsylvania figures in this report include this stone. Onyx marble, or cave onyx, is included in the production of Kentucky and New Mexico.

In 1912 the commercial output of marble came from Vermont, Georgia, Tennessee, Colorado, New York, Alabama, Pennsylvania, Massachusetts, Alaska, California, Maryland, North Carolina, Kentucky, Utah, New Mexico, and Virginia, named in order of value of output. The small totals for Utah and Virginia are, however, included with the value of the limestone.

The marble output in the United States was valued in 1911 at $7,546,718, and in 1912 at $7,786,458, a gain of $239,740, or 3.18 per cent.

The chief uses of marble are as building stone, for exterior and interior work, and for monuments. Building stone used for interior work was the only one of these products that showed an increase in value.

Owing to the small number of producers in many of the marble-producing States, it is difficult to compile a satisfactory table showing the marble production by States. The figures are given, however, as far as they are available.

The following table shows the value of the marble produced in the United States from 1908 to 1912, by States:

Value of marble produced in the United States, 1908–1912, by States and Territories.

State or Territory.	1908	1909	1910	1911	1912
Alabama	(a) $118,580	(b) $212,462	(c) $255,664	(d) $335,005	(e)
Alaska	(a) 103,888	(b) 46,900	(c)	(d)	(e)
Arizona		(b)		(d)	
California	60,408	89,392	(c) 112,339	29,964	$76,424
Colorado	(a)	(b) 488,311	(c) 488,173	(d) 1,010,840	(e)
Georgia	916,281	766,449	953,917	1,088,422	1,096,622
Kentucky	(a)	(b)	(c)	(d)	(e)
Maryland	(a) 79,317	(b)	(c)	(d) 73,300	(e)
Massachusetts	175,648	243,711	224,088	219,445	213,939
Missouri	(a)				
New Mexico	(a)	(b) 5,390	(c)	(d)	(e)
New York	706,858	402,729	484,732	379,670	291,210
North Carolina	(a)	(b)	(c)	(d)	(e)
Oklahoma				(d)	
Oregon		(b)			
Pennsylvania	102,747	186,037	(c) 182,514	214,913	267,242
South Carolina				(d)	
Tennessee	790,233	613,741	728,502	700,229	974,733
Texas		(b)	(c)		
Utah	(a)	(b)	(c)	(d)	(f)
Vermont	4,679,960	3,493,783	3,562,850	3,394,930	3,494,253
Virginia					(f)
Washington		(b)	(c)		
West Virginia		(b)	(c)		
Other States					1,372,035
Total	7,733,920	6,548,905	6,992,779	7,546,718	7,786,458

(a) Alabama includes Kentucky and Missouri; Alaska includes Colorado, New Mexico, and Utah; Maryland includes North Carolina.

(b) Alabama includes Kentucky, Maryland, North Carolina and West Virginia; Alaska includes Washington; New Mexico includes Arizona and Texas; Colorado includes Oregon and Utah.

(c) Alabama includes Kentucky, North Carolina, and West Virginia; California includes Alaska and Washington; Colorado includes Arizona and New Mexico; Pennsylvania includes Maryland.

(d) Alabama includes Kentucky and Oklahoma; Colorado includes Alaska, Arizona, New Mexico, Oregon, and Utah; Maryland includes North Carolina and South Carolina.

(e) Included in "Other States."

(f) Included in limestone.

The following table shows the value of marble quarried from 1907 to 1912, according to uses:

Distribution and value of the output of marble, 1907–1912, among various uses.

Use.	1907	1908	1909	1910	1911	1912
Sold by producers in rough state....	$1,697,891	$1,455,980	$2,330,336	$2,098,480	$3,182,620	$3,358,536
Dressed for—						
Building..........................	1,905,145	2,329,438	1,293,019	1,463,749	1,220,635	1,396,254
Ornamental purposes...........	25,050	25,506	24,695	37,950	71,000	134,826
Monumental work...............	2,044,000	1,843,426	1,184,672	1,279,985	1,368,430	720,464
Interior decoration in buildings..	1,900,952	1,943,750	1,557,783	2,001,646	1,545,963	1,944,161
Other uses.......................	264,647	135,820	158,400	110,969	158,070	232,217
Total..........................	7,837,685	7,733,920	6,548,505	6,992,729	7,546,718	7,786,458

Building stone.—The value of marble produced in 1912 for exterior building purposes (including rough and dressed stone) and either sold or used by the producer, was $2,771,645, a decrease of $138,622, compared with 1911, when this value was $2,910,267. The total for 1912 included $1,375,391 for rough and $1,396,254 for dressed building stone; in 1911 the rough building marble sold was valued at $1,689,632 and the dressed building stone at $1,220,635, a decrease in 1912 of $314,241 for rough stock and a gain of $175,619 for dressed marble.

The quantity of marble sold in 1912 for rough building stone was 945,728 cubic feet, valued at $1,369,213, or $1.45 per cubic foot; 5,009 square feet, valued at $4,828; and 450 tons, valued at $1,350. There was 478,361 cubic feet of dressed building stone quarried, with an average price of $2.91.

Monumental stone.—Monumental marble (including rough and dressed stone), was valued at $2,115,200 in 1912 and at $2,621,213 in 1911, a decrease of $506,013 in 1912. In 1911 the value of rough stock was $1,252,783 and of dressed monumental stone, $1,368,430; the corresponding figures for 1912 are $1,394,736 for rough monumental stock, and $720,464 for dressed monumental stone, an increase in 1912 of $141,953 in value of rough stock and a decrease of $647,966 for dressed stone.

In 1912 the quantity of stone sold rough for monumental work was 867,716 cubic feet, at $1.61 per cubic foot; and that for dressed monumental work was 214,326 cubic feet, at $3.36 per cubic foot.

Interior work.—The total value of marble for interior work in buildings in 1912 was $1,944,161, a gain of $398,198 when compared with the value $1,545,963 in 1911. The stone sold for this work was 364,769 cubic feet, valued at $1,863,561, or $5.11 a cubic foot, and 110,009 square feet, valued at $80,600, or 73 cents a square foot.

Other marble.—Rough stone for other uses includes waste marble sold to lime burners, to carbonic-acid factories, to pulp mills, to iron furnaces for flux, and that used for road making, etc.; the dressed stone includes stone for mosaics, electrical work, etc.

As the requests to the producers for the report of their marble output in 1911 and 1912 were in different forms, it is impossible to compare the uses of the marble as sold in the different States according to uses. The following statement of the marble output in the United States shows the quantity and value of this material and the form in which it was sold by the producer in 1911 and 1912.

Total quantity and value of marble produced in the United States in 1911 and 1912, according to form in which it was sold by the producer.

1911.

Form in which sold by producer.		Quantity.	Value.
In rough blocks:			
To manufacturers	short tons	1,384	$3,600
	cubic feet	1,351,137	2,129,708
To dealers	do	33,450	48,313
Direct for—			
Monumental work	do	376,925	542,877
Buildings	short tons	35,475	26,997
	square feet	4,650	3,689
Rough sawed:			
To manufacturers	cubic feet	361,546	567,584
	square feet	93,596	29,798
To dealers	cubic feet	25,500	51,275
Direct for—			
Monumental work	do	55,095	86,264
Buildings	do	16,752	17,163
Finished:			
To manufacturers	short tons	720	96,000
	cubic feet	404,636	1,653,309
	square feet	2,000	1,000
To dealers	cubic feet	81,549	306,820
Direct for—			
Monumental work	short tons	25	962
	cubic feet	31,247	75,308
	square feet	3,000	4,500
Ornamental purposes	cubic feet	27,000	70,000
	square feet	2,000	1,000
Interior decoration	short tons	600	40,000
	cubic feet	435,138	1,502,610
	square feet	4,353	3,353
As crushed stone	short tons	39,686	56,762
As ground limestone	do	3,866	14,637
Other purposes	do	67,958	53,189
	cubic feet	1,510,000	160,000
Total	do	4,714,625	7,214,920
	square feet	104,949	39,651
	short tons	149,714	292,147
			7,546,718

1912.

Form in which sold by producer.		Quantity.	Value.
In rough blocks or rough sawed:			
To dealers or manufacturers	cubic feet	1,603,617	$2,671,244
Direct for—			
Monumental work	do	358,737	573,393
Buildings	do	253,930	211,487
	square feet	5,009	4,828
	short tons	450	1,350
As finished work:			
Direct for—			
Monumental work	cubic feet	84,326	270,464
Buildings (exterior)	do	498,969	1,333,099
Interior decoration	do	344,345	1,822,950
	square feet	110,009	80,600
Ornamental purposes	cubic feet	76,013	134,826
As crushed stone	short tons	44,250	29,068
As ground limestone	do	8,085	26,542
For other purposes	do	105,220	84,496
	cubic feet	150,689	542,111
Total	do	3,370,626	7,559,574
	square feet	115,018	85,428
	short tons	158,005	141,456
			7,786,458

A comparison of these figures shows that although the total value increased for 1912, the number of cubic feet of marble quarried decreased, and as all but a very small quantity is sold by the cubic foot, for all practical purposes the value increased while the output declined.

It will be noted that in the table for 1912 a very large proportion of the marble was sold by the quarrymen to dealers and manufacturers, and correspondence with the principal quarrymen, most of whom knew for what purpose the stone was to be used, resulted in the following table:

Total quantity and value of marble produced in the United States in 1912, according to the use for which the stone was intended.

Form in which sold by producer.		Quantity.	Value.
In rough blocks or rough sawed:			
To dealers or manufacturers	cubic feet	403,025	$588,409
Rough:			
Direct for—			
Monumental work	do	867,716	1,394,736
Buildings	do	945,728	1,369,213
	square feet	5,009	4,828
	short tons	450	1,350
As finished work:			
Direct for—			
Monumental work	cubic feet	214,326	720,464
Buildings (exterior)	do	478,361	1,396,254
Interior decoration	do	364,769	1,863,561
	square feet	110,009	80,600
Ornamental purposes	cubic feet	76,013	134,826
As crushed stone	short tons	32,789	23,156
As ground limestone	do	8,085	26,542
For other purposes	do	116,681	90,408
	cubic feet	20,688	92,111
Total	do	3,370,626	7,559,574
	square feet	115,018	85,428
	short tons	158,005	141,456
			7,786,458

The following table shows the quantity and value of the marble sold by the producers in the most prominent marble States:

Quantity and value of marble produced in California, Georgia, Massachusetts, New York, Tennessee, and Vermont in 1911 and 1912.

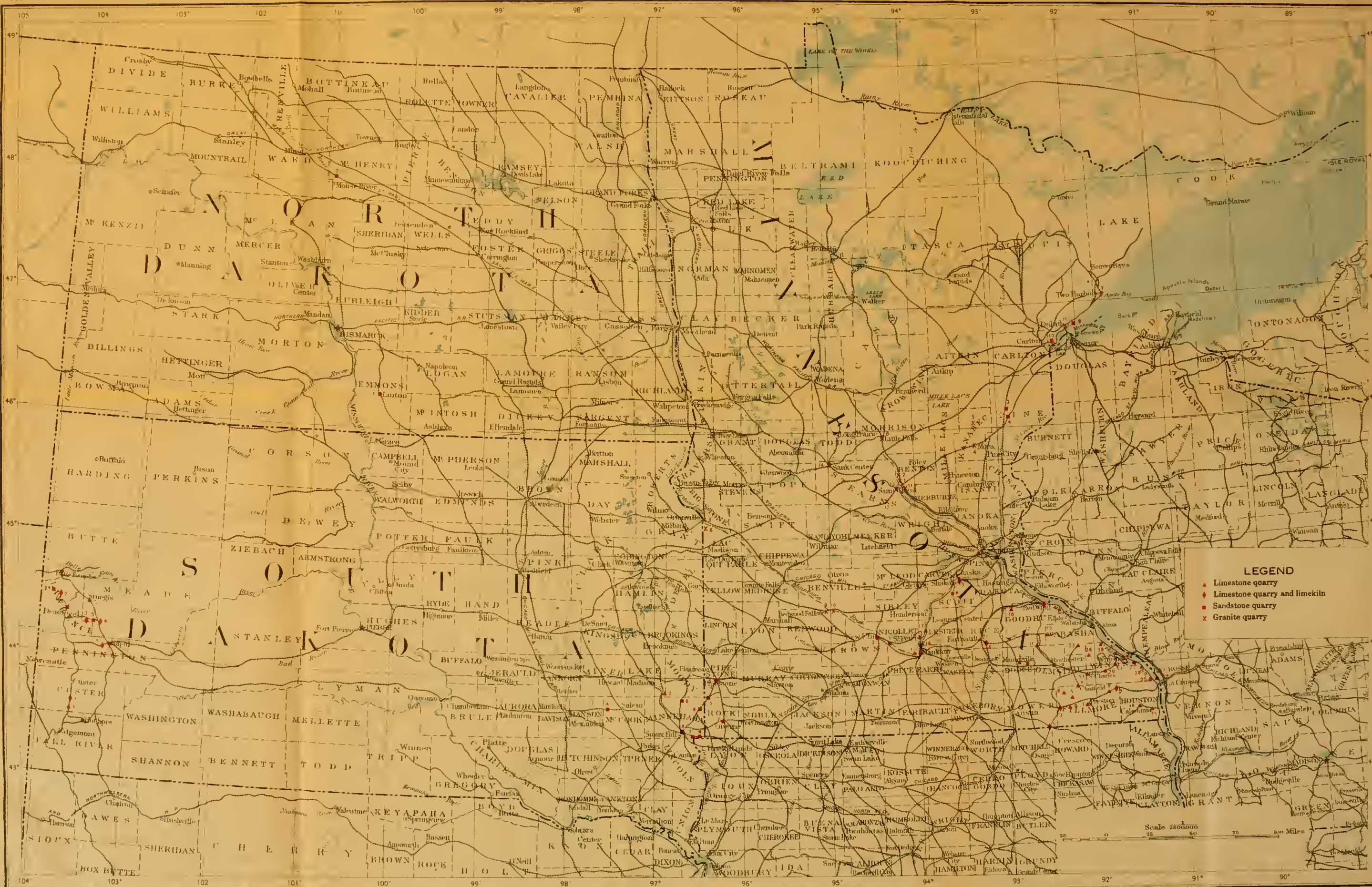
State.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
California:				
Short tons	2,202	$102,964	479	$2,874
Square feet	79,000	27,000		
Cubic feet			28,429	73,550
Total		129,964		76,424
Georgia:				
Short tons	10,979	26,547	17,676	29,286
Cubic feet	935,950	1,061,875	928,191	1,067,336
Total		1,088,422		1,096,622
Massachusetts:				
Short tons	8,688	21,071	9,217	12,360
Cubic feet	103,086	194,223	104,228	197,175
Square feet	5,949	4,151	28,615	4,404
Total		219,445		213,939
New York:				
Short tons	66,736	54,178	62,219	57,243
Cubic feet	149,756	250,492	144,105	233,967
Cubic yards	50,000	75,000		
Total		379,670		291,210
Tennessee:				
Short tons			16,478	6,315
Cubic feet	414,128	700,229	605,198	968,418
Total		700,229		974,733
Vermont:				
Short tons	5,100	5,100	600	295
Cubic feet	1,186,015	3,385,830	1,105,022	3,464,534
Square feet	17,000	4,000	54,203	29,424
Total		3,394,930		3,494,253

STONE RESOURCES IN GREAT PLAINS AND ROCKY MOUNTAIN STATES.

GENERAL FEATURES.

Within the last few years the United States Geological Survey has received many requests for maps showing areas of stone suitable for building and other purposes in the United States. Such a set of maps is doubtless very desirable, and their preparation may be considered a goal to be attained at some future time, but not under present conditions, as the preparation of such a publication would entail an expense not compatible with the funds at present available. The compilation of a reconnaissance geologic map of the United States, recently issued, occupied the time of a geologist for many years. This geologic map shows, for the most part, the rocks subdivided on the basis of age—not on a lithologic basis—and therefore, in order to make it a serviceable stone map, it would be necessary so to resubdivide and reclassify all the cartographic units that the character and accessibility of the rock might be indicated, a task which would require years of additional field and office work. This reconnaissance geologic map of the United States is now available; it is contained in the geologic map of North America, issued as part of Survey Professional Paper 71,[1] in 1912, and may be obtained free of charge from the Director of the United States Geological Survey, Washington, D. C. This map shows on a scale of approximately 80 miles to 1 inch the main subdivisions of rocks by geologic systems, and in some places by series, but it does not show the rock formations, such as limestones, sandstones, granites, etc., that are suitable and available for quarry products. The Survey has been issuing, from time to time, special reports on certain types of stone within limited areas, as, for instance, on granite in certain States, on marble or limestone, or structural materials in general in certain districts; and occasionally a note on stones suitable for building purposes is included in a geologic folio text; but, taken altogether, the work done on this subject is hardly more than begun. In most of the States, especially those east of Mississippi River, the locations of the stone quarries already opened outline in a general way the areas underlain by suitable stone, although, of course, suitable stone may extend far beyond the areas actually developed. Markets and transportation are the two factors that exert the greatest influence on the development of stone, even though the stone may be admittedly of an excellent quality and may be in a convenient position for quarrying. With all these limitations in mind, it was decided that the most practicable maps bearing on the stone industry that could be prepared by the Survey in the short time available for the work should indicate the locations of quarries by classes of stone. Accordingly a set of maps showing quarries throughout the United States by classes of stone is in preparation, and maps comprising the States east of Mississippi River were published in the report on stone in Mineral Resources for 1911, and maps of the States west of Mississippi River to and including the Rocky Mountain States are issued as an accompaniment of the present report on Stone for Mineral Resources for 1912. The statements in this chapter with regard to the ages of the rocks under discussion have been made

[1] Willis, Bailey, Index to stratigraphy of North America: Prof. Paper U. S. Geol. Survey No. 71, 1912, 894 pp., 1 wall map.



MAP OF MINNESOTA, NORTH DAKOTA, AND SOUTH DAKOTA

Showing location of limekilns and quarries of limestone, sandstone, and granite

Prepared under the direction of E. F. Burchard

with reference to the classification and geologic mapping in Professional Paper 71. Many facts are also drawn from State reports and other sources credited in the footnotes, and notes made by the writer in the course of visits to many quarries in the Middle West during the last four years have also contributed to the data. If these stone-quarry maps are studied in connection with the geologic map of the United States mentioned above, many interesting, economic, and scientific relations between the stone industry and areal geology may be observed.

A few notes in general explanation of the maps should be included here. It was the aim in the preparation of these maps to present an outline of quarry areas in so far as practicable without special reference to the output of stone from any given area. For instance, although there may be many quarries at or near one place it is impracticable on account of the scale of the maps to represent each quarry by a separate symbol, and only one symbol is given; on the other hand, in an isolated place there may be but one quarry and that a small one, yet the fact that quarriable stone occurs at that place has been regarded as the important point to be brought out by these maps, and the isolated quarry is therefore indicated by the appropriate symbol. Naturally, where the quarry industry predominates in a county or a district, these maps readily indicate that fact, as inspection of Plates II and VII shows at a glance that there are several granite quarries near St. Cloud, Minn., many limestone quarries in the vicinity of Kansas City, Mo., and several sandstone quarries near Fort Collins, Colo.; but equally interesting and possibly of even more importance to the matter of distribution of stone resources is the demonstration that there is also quarriable granite in Grant County, S. Dak., limestone in Hamilton County, Kans., and sandstone in Valencia County, N. Mex. A provision has been made in the directories accompanying the maps which shows the number of quarries represented by a single symbol. For instance, with regard to granite symbol No. 1, on Plate II, the directory gives "1–East St. Cloud (4) and Sauk Rapids (5)"—indicating that 9 granite quarries are represented by the single granite symbol near St. Cloud, Minn. The limestone quarrying industry and the manufacture of lime are so intimately associated, practically every lime manufacturer at times selling some crushed stone or other form of stone not burned and many stone producers making lime as an adjunct to their stone business, that the locations of lime kilns have also been given on these maps, by simply modifying the triangular limestone symbol into a double triangle which indicates "limestone and lime." On the other hand, limestone quarries operated as a source of material for the manufacture of cement have not been included, because as a rule they are operated solely for cement material, the sale of stone from them being negligible. Besides this, the location of cement plants has been shown on maps accompanying the chapters on the cement industry in Mineral Resources for both 1910 and 1911.

The advisability of giving a complete tabulation of such chemical analyses of stones as are available has been considered; but, since analyses of stones other than limestones are of rather doubtful value, this matter has been disposed of by giving in the chapter in Mineral

Resources on the production of lime in 1911,[1] an extensive tabulation of chemical analyses of both limestone and limes from all parts of the country, including both high calcium and high magnesian materials. In a few instances, however, both chemical and physical data with regard to rocks of particular interest have been included in the present report.

Under marbles no distinction has been made in the quarry symbols between true metamorphic marbles and crystalline limestones susceptible of a high polish, since the latter class includes some very valuable marbles of commerce.

The preparation of these quarry maps was begun in 1911 by Miss Olive Zeph, of the United States Geological Survey, who used as a basis the Survey's list of stone producers in 1910. Before they went to press some revision was made by the writer in order to bring the maps up to date, but it has been unavoidable to include some quarries now inactive, and probably it has been impossible to include every place in which stone is quarried. However, the first fault is not a disadvantage, because, although a quarry may have been abandoned temporarily, it by no means follows that the quarriable stone has been exhausted, and the symbol stands not wholly to show the location of a quarry but the existence of a certain type of stone at that place.

There are certain limitations to the accuracy of these maps which should be mentioned here. The scale of the maps is approximately 40 miles to 1 inch. On this scale the quarry symbols, which have been made as small as is compatible with convenient reading and interpretation, are still so large that each one covers much more area than an average-sized quarry. Where quarry areas are close together, it has therefore been necessary to place the symbol as near the determined locality as possible, without running the symbols together or superimposing one upon another. In the great majority of counties the only town shown on the base map is the county seat. Therefore the location of all other places where quarries are situated has been of necessity interpolated from other Government maps, commercial atlases, and railroad maps. Not all these maps are agreed in all details, and many of the locations resulting from comparisons of these various sources of information are to some extent compromises. One other unavoidable source of error is that the exact location of a quarry may not have been given by the stone producer in his reports to the Survey. All quarries have therefore been plotted with reference to the nearest railroad station or post office, according to the reports of the producer, unless, as in many cases, special information in the possession of the writer has been drawn upon to determine doubtful locations. In view of the small scale of the map and the purposes which it is intended to fulfill it is not believed that these errors will detract seriously from its value.

The treatment of the subject in the following discussions has, on account of limitations of time and space, been very much generalized. In the case of the directories locations only have been given, without reference to ownership of quarries, since it is planned to treat this subject in an entirely impersonal way, and also because the ownership of quarries changes more or less frequently.

Readers who are interested in further details concerning the stone resources of the country will find much local information in the

[1] Mineral Resources U. S. for 1911, pt. 2, U. S. Geol. Survey, 1912, pp. 658-707.

Survey reports listed in the bibliography at the end of this report, especially the works of Dale and Watson, and in a textbook by G. P. Merrill, "Stones for building and decoration," published by John Wiley & Sons, New York.

MINNESOTA, NORTH DAKOTA, AND SOUTH DAKOTA.

The group of States comprising Minnesota, North Dakota, and South Dakota will be treated together since they are grouped together on the map (Pl. II). Limestone, sandstone, and granite (including gabbro) are quarried, and lime is manufactured. The available rocks in this group of States include formations of pre-Cambrian, Cambrian, Ordovician, Devonian, Carboniferous, Jurassic and Triassic, Cretaceous, and Tertiary age. In the greater part of North Dakota and South Dakota, and the western one-third of Minnesota the surface rocks are of Cretaceous age, and these formations together with those of Tertiary age which form the western one-third of North Dakota and a small area in the southern part of South Dakota do not yield much hard rock of uniform texture. The rocks suitable for quarrying must, therefore, be sought in the areas underlain by Paleozoic and pre-Paleozoic formations. In Minnesota and in that portion of the Dakotas east of Missouri River glacial drift covers much of the surface, and in consequence rock available for quarrying is exposed best along the streams and in the Black Hills uplift.

The lack of available stone in northern Minnesota and in North Dakota is in part compensated for by the abundance of large glacial bowlders that are scattered over the surface. In many places these bowlders are utilized, either in the natural state or dressed, in foundations, and even in the walls of buildings.

MINNESOTA.

The stone resources of Minnesota comprise limestone, sandstone, granite, and other varieties of granitic rock. As at present developed there are more quarries of limestone than of any other rock, but the value of the production of granite exceeds that of limestone. When, however, the value of the output of lime is considered, the industry based on limestone quarrying yields more wealth than the granite-quarrying industry.

The distribution of the stone quarries in Minnesota is shown in Plate II. The limestone areas are mainly in the southeastern part of the State along Mississippi River and westward to the middle of the southern part of the State. Sandstone occurs on the western border of the limestone area, also in the southwest corner and in the eastern part of the State, near Lake Superior. Granite has the most varied distribution of all the rocks, being found in eastern, central, northern, and western Minnesota, although much of its outcrop areas are drift-covered and are not all quarried.

A considerable portion of Minnesota is thickly covered by glacial deposits of clay, gravel, and sand. Probably this cover retards the development of quarries to some extent, first, by obscuring outcrops of good rock, and second, by the expense which its removal entails in quarry operations. As will be noted by reference to the map, the majority of the stone quarries are near the streams, where erosion has cut sections through the glacial drift and exposed the hard rock generally in terraces or bluffs.

Granite.[1]—Granite, including gabbro in Lake and St. Louis counties, is quarried in 11 counties in Minnesota. The area near St. Cloud, in Stearns, Benton, and Sherburne counties, is one of the most important in the State. This granite is considered to be of Keweenawan age, as are also several small, isolated areas, including those quarried at Sauk Center, Stearns County, Little Falls, Morrison, County, and Mora and Warman, Kanabec County.

In the vicinity of St. Cloud several types of granitic rock are quarried, including pinkish-gray granite and gray and red syenite. The new Federal building at St. Paul has been constructed from the pinkish-gray medium-grained stone. The coarse-grained pinkish-gray granite in the basement of the new capitol building at St. Paul is reported to have been obtained at St. Cloud. The former Minnesota Geological Survey reports that the gray quartzose syenite from East St. Cloud showed a crushing strength of 26,250 pounds per square inch on "bed" and of 25,750 pounds per square inch on "edge." The ratio of absorption was 1 : 208. The fine-grained gray syenite showed crushing strengths of 28,000 pounds and 26,250 pounds per square inch, respectively on "bed" and on "edge." The red syenite showed practically the same results. The red stone is used almost exclusively for polished monumental work, pillars, and columns. The gray stone is used extensively for the same purposes as well as for building stone, curbing, and paving blocks. At Rockville, in Stearns County, the granite is coarser grained and is used entirely for building purposes. It is well adapted for this purpose and the supply is unlimited.

Another gray granite well adapted for monumental work and probably of the same age as the granite near St. Cloud, is quarried in Kanabec County, south of Mille Lacs Lake.

In western Minnesota, near Ortonville, is a dark-red granite that has been used to considerable extent for structural and ornamental purposes in both Minneapolis and St. Paul. There are several columns of polished granite from Ortonville in the capitol at St. Paul, and the exterior of the handsome city hall and county courthouse building at Minneapolis, erected at a cost reported to have been $2,250,000, is faced with this dark-red granite. This stone is rather coarse-grained and is capable of being quarried in massive blocks. Much stone of good quality for monumental purposes is available here. Quarries have been opened in a banded gneiss at North Redwood, Redwood County, and Morton, Renville County, in the Minnesota River valley.

The granite area which has been mapped as extending down the valley of Minnesota River from Ortonville into Brown County is considered to be of Laurentian age.

In the vicinity of Duluth and northeastward along the shore of Lake Superior is a large area of Keweenawan rocks. At Duluth quarries are operated in a bluish-gray to grayish-green gabbro. The

[1] The writer is indebted to Mr. Oliver Bowles, of the department of geology, University of Minnesota, for certain notes on granite and other building stones which have been incorporated in the following pages on Minnesota stone.

product is mostly crushed for road making, and to a less extent for concrete, but rough blocks of this stone are quarried for riprap. The gabbro is very hard, difficult to crush, and shows great resistance to wear, especially on roads. At Two Harbors Keweenawan gabbro is also quarried.

Sandstone.—The sandstone quarried in Minnesota is found in widely separated areas and ranges in age from early Huronian to Ordovician. The Huronian sandstone which outcrops in the extreme southwest corner of the State has been metamorphosed to quartzite and is known as the Sioux quartzite, on account of typical exposures on Big Sioux River in eastern South Dakota. This quartzite is often locally called granite, on account of its great hardness, and the production of some of it has been reported to the Survey as granite, but as the rock is clearly of a sedimentary origin the commercial classification of building stones adopted by the division of mineral resources of the Survey, loose though it may be, can not be stretched so as to admit the Sioux quartzite among the granitic rocks. The quartzite is quarried in Rock County, near Luverne, and in Pipestone County, near Pipestone and Jasper. Other outcrops of the Sioux quartzite occur in Watonwan and Cottonwood counties and in Nicollet County, where it is quarried at Courtland and New Ulm. The rock at New Ulm is reported to be a very hard, practically indestructible quartzite.

The Sioux quartzite has been used for building within a radius of 100 miles or more from the area in which it is quarried, but probably its largest use in Minnesota at present is as crushed stone for road construction. It is a pink and red to bluish and purple stone that breaks with a vitreous fracture that cuts across the original sandstone grains as sharply as through the siliceous cement between them. This rock will be described in more detail in the section on South Dakota.

A large sandstone-quarrying industry flourishes at the town of Sandstone, Pine County, on Kettle River, on the Great Northern Railway, 87 miles north-northeast of Minneapolis. The rock quarried is a fine-grained light-pink or salmon-colored stone, generally very hard and durable. The sand grains are sharp, and many of them sparkle and show recrystallized faces. The relative size of the grains may be indicated by the following sieve tests, which were made on sand derived by crushing the rock until it had been reduced to its individual grains: Remained on 20-mesh, none; on 40-mesh, 30 per cent; passed through 40-mesh, 70 per cent. The cementing material is mainly silica. There are some beds, especially toward the top of the quarry, in which the rock is of a darker shade, varying in color from yellow to brownish-red. The face of the largest quarry in the autumn of 1909 was about 80 feet high and about 2,200 feet long. Only about 20 feet of stone is selected as the choicest building stone, much of the upper courses being utilized for paving blocks and for heavy masonry. The rock lies in massive beds, 1 to 3 feet thick, and there are three thin zones of shaly sandstone, 16 to 20 feet apart, that divide the quarry face vertically into four divisions. The beds dip 2 to 4° SE. and are jointed in places by well-marked vertical joints that facilitate quarrying but do not prevent blocks 5 to 10 feet long from being easily obtained. This quarry is operated on a large scale and is equipped with all the facilities necessary for a large output of stone, such as electric power, compressed-air drills, large loading derricks, locomotives, cars, and several miles of standard track connecting with the Great Northern Railway at Sandstone. There is a large sawmill and cutting shed where dimension stone is cut to order, and the stone, although hard, has been found to be adapted to the highest grade of carved work. For this purpose it rivals granite and is in some respects superior, particularly with reference to its fineness of grains. The rock has a very high crushing strength, tests having been made at the Watertown Arsenal that showed 12,295 and 12,799 pounds per square inch. A chemical analysis made at the same laboratory shows silica, 97.10 per cent; alumina, 2.20 per cent; lime, 0.60 per cent; and magnesia, 0.10 per cent. The stone works very freely, although it shows stratification very faintly, if at all, and contains no fossils. Although there is considerable stripping, such as soil and disintegrated or shaly sandstone, the quarry floor is kept free of rubbish. Nearly all the waste material is utilized in one way or another. Even the sand screened from the crusher is saved. The principal products made from this sandstone are building stone, sawed stone, crushed rock, rubble, paving blocks, curbing, cross walks, bridge stone, coping, and monument bases.

The library building at the University of Illinois was built of this sandstone in 1896. After 14 years of exposure the stone in this building shows, except for smoke stains, almost the same brightness that it did when first laid in the wall. The stone is chemically so inactive that artificial gases, cements, and other agents that discolor most stones seem to have little or no deleterious effect on it. Other buildings in which the stone is reported to have been used are the United Presbyterian Church (interior) at Worcester, Mass.; Spokane Club Building, Spokane, Wash.; Des Moines (Iowa) public library; courthouses at Elk Point, S. Dak., Crookston, Grand Rapids, and Benson, Minn., etc. A school building constructed of the stone at Sandstone, Minn., was once burned out, and the outer walls showed very little effects of the fire. The spalling that occurred was mostly in the window caps and along the coping.

Another important sandstone is the brownish-red stone quarried in St. Louis County at Fond du Lac and near Duluth. This rock is of medium grain and resembles the Connecticut "brownstone," but is much harder, although not so hard as the quartzite mentioned above. It occurs in the area of rocks mapped as of Keweenawan age.

A light-colored sandstone of Cambrian or Lower Ordovician age is quarried near Minnesota River at Jordan, Scott County.

Limestone.—Much of the limestone quarried along Mississippi River and its tributaries in Houston, Winona, Wabasha, Goodhue, and Washington counties is of Cambrian and Lower Ordovician age. The beds are generally highly magnesian and received the name "Magnesian" limestones in early geological reports. They are blue where fresh, but weather to a buff color. They lie horizontal and in beds from a few inches to a foot or two in thickness. This belt of rock extends up Mississippi River nearly to St. Cloud and up Minnesota River to beyond Mankato; it is quarried extensively near Kasota and Mankato both for building stone and for natural cement and at other places for crushed stone and for the manufacture of lime. Along Mississippi River the limestone is used extensively for riprap.

The quarries at Kasota and Mankato are in a high-grade magnesian limestone that can be tool faced, carved, polished, etc. Although the stone at both places belongs to the same formation, that at Kasota is more worked for cut stone. The Mankato stone is of a buff color, and that at Kasota is of a light-pink shade, banded faintly in places. The Mankato stone is used largely for massive masonry and as crushed stone, whereas that at Kasota is used for flagging and for building purposes, including polished wainscoting and other interior work. The stone is a fine-grained, highly magnesian limestone. At Kasota the beds range from a few inches thick at the top (the thinness is due to weathering) to about 4 feet thick below. Massive blocks 12 feet long may be quarried if desired. The stone is quarried to a depth of about 12 feet below the stripping, which amounts to 3 to 5 feet of sand and gravel. In winter the quarries are closed and the beds covered with straw so as to prevent the stone from being disintegrated by frost. The quarry companies have cutting shops at Kasota, at which the stone is sawed, tooled, turned, and polished. The supply of stone here is ample and the facilities for its production are larger than the demand.

The United States post-office building at Aberdeen, S. Dak., is faced with Kasota cut stone, and much of the "marble" wainscoting in the Minnesota State capitol building at St. Paul is of polished Kasota stone.

Tests made by Maj. Q. A. Gillmore before 1875 showed this stone to have a crushing strength of 10,700 pounds per square inch on "bed"; specific gravity, 2.63; weight per cubic foot, 164.4 pounds; and ratio of absorption, 1.56.

Overlying the Cambrian and Lower Ordovician rocks in southeastern Minnesota, between Mississippi and St. Peter rivers, are rocks of Middle and Upper Ordovician age, including the "Trenton" limestone. Quarries have been opened in these beds near Rochester, Mantorville, Faribault, and Minneapolis. The color and bedding of these rocks are similar to those of the earlier Ordovician rocks. Near Faribault certain of the limestone beds consist of so nearly pure calcium carbonate that the stone has been shipped to beet-sugar factories for the manufacture of lime. Most of the material for structural purposes produced from the "Trenton" limestone is used in the form of rubble and crushed rock. Notes on some of the operations at Minneapolis are as follows:

The local surface rock at Minneapolis is the "Trenton" limestone. This rock consists of beds of high-calcium, fine-grained, dense, light-gray rock, beds of bluish to greenish argillaceous magnesian limestone, and beds that approach shale in texture. The first-mentioned beds are the most desirable for all purposes, but most of the quarries are obliged to move considerable of the inferior stone and more or less of it is worked into the product. In the vicinity of Fifteenth Avenue NE., between Central Street and Johnson Street, about 1¾ miles northeast of the new post-office site, is an area comprising about 60 acres which supports a large quarrying industry. There are three large quarries operating here, the output of which is mostly crushed stone. These crusher quarries will be described further on. At the east side of this area rubble, heavy blocks, and riprap are quarried. The best material lies at a depth of 18 or 20 feet from the top of the rock and is 8 to 10 feet thick above the base of the quarry. The rock is a hard fine-grained to subcrystalline wavy-bedded blue-gray limestone. Stone 6 to 15 inches thick and 5 to 6 feet in length is commonly obtained and blocks 3 feet thick are available. This rock is sold mostly for footings in large structures, such as grain elevators.

Very high-grade limestone rubble is produced from a quarry at Second Avenue NE. and the Great Northern Railway tracks. About 10 feet of glacial sand and clay overlie the stone, which is a fresh light-gray fine-grained to subcrystalline high-calcium limestone. It is sold principally for footings, but the demand is small and much rock that would make good rubble must be run through the crusher.

On the southwest bluff of Mississippi River at two places, near the Minneapolis, St. Paul & Sault Ste. Marie Railway Bridge and near Twenty-ninth Avenue S., the "Trenton" limestone is quarried for rubble. The stone is nearly the same at the three river quarries. The upper half is of argillaceous magnesian limestone, which is very soft in places and is termed "soapstone" by the quarrymen. The lower half, generally 12 to 14 feet thick, consists of hard dense fine-grained bluish limestone with wavy laminations. Both rubble and ordinary range stone can be produced from the lower beds in these quarries. Range rock looks well at first, but in a few years the blue color fades to a buff and the laminations become prominent. This is shown in many old buildings in Minneapolis. In these river quarries there is only two or three years' supply of stone (autumn of 1909), because the park board has acquired the river front and has set a limit beyond which the stone may not be quarried into the bluff.

The "Trenton" limestone that is quarried in the vicinity of Fifteenth Avenue NE., between Central Street and Johnson Street, is converted into crushed stone by three large crushers. The beds quarried here dip gently to the southeast, so that the beds which are quarried at the west lie in the bottom of the quarry at the east. The lowest beds (stratigraphically) quarried (on the west side of the area) consist of a bluish-gray fine-grained thin wavy-bedded limestone, much broken by joints and containing some argillaceous shaly material on the bedding planes. The rock weathers to a grayish-buff color. The surface material is so badly broken by nature that it is adapted only to being crushed. When it is crushed and well screened a product of excellent grade is obtained. The crushed stone from these wavy limestone beds runs high in calcium carbonate and is the strongest and most durable of the rock exploited here. These beds are about 15 feet thick, and because they dip to the southeast they occupy only the lower two-thirds of the face in the next quarry toward the east. They are overlain by a thicker-bedded argillaceous magnesian limestone. The rock in these upper beds is apparently good and sound, but on account of its composition it does not prove as strong or as durable as the blue limestone. Still farther east the blue limestone beds are covered by a greater thickness of argillaceous magnesian limestone. This quarry farthest east is deeper than the others, so that the blue limestone is obtainable to the extent of perhaps 40 per cent of the product. All these quarries are operated on a large scale and are equipped for handling the stone by the most improved methods for crushing and screening it thoroughly and for shipping by rail. The product is used for concrete and macadam. The stone is screened to the following sizes: $\frac{3}{8}$ to $\frac{5}{8}$ inch, $\frac{5}{8}$ inch to $1\frac{1}{4}$ inches; and $1\frac{1}{4}$ to 2 inches; and the dust is screened through the $\frac{3}{8}$-inch screen.

One other quarry, at Second Avenue and the Great Northern Railway tracks, produces crushed stone. As mentioned above, the rock quarried here is of the best quality of high-calcium limestone, hard, fine grained, and unweathered.

There is abundance of well-prepared crushed stone in the Minneapolis district, but the principal caution that deserves emphasis here is that specifications should call for hard fine-grained blue pure limestone, free from argillaceous or magnesian limestone. Physically and chemically, the purer limestone is the superior material.

Lime is burned from local stone in the following Minnesota counties: Blue Earth, Fillmore, Goodhue, Mower, Rice, and Scott. As noted above, the limestone in most of these counties is magnesian, but that in Rice and Mower counties is high in calcium carbonate. Analyses of certain of these limestones and limes are given in Mineral Resources for 1911, pages 673 and 701. The magnesian stone is of Ordovician age, earlier than the "Trenton," and the high-calcium stone belongs to the "Trenton" and later formations. The quarry at Le Roy, Mower County, is in an area of Devonian rock.

Limestone is quarried in 16 counties in Minnesota, 6 of which produce lime, and in addition lime is burned near Duluth from stone quarried in Ohio and shipped by boat through the Lakes.

Production.—The total output of stone in Minnesota in 1912 was valued at $1,845,746, compared with $1,702,525 in 1911. The rank of this State as a stone producer in 1912 was twelfth; it was thirteenth in 1911. The value of the output in 1912 was apportioned as follows: Granite, $950,033; limestone, $546,650; and sandstone, $349,063.

Directory.—Quarries of all the kinds of rock produced in Minnesota are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Minnesota.

GRANITE.

Benton County:
1. East St. Cloud (4) and Sauk Rapids (5).
2. Watab.

Bigstone County:
3. Ortonville (5).

Houston County:
4. Caledonia.

Kanabec County:
5. Mora (2).
6. Warman (2).

Lac Qui Parle County:
6a. Near Ortonville, Bigstone County.

Lake County:
7. Two Harbors.

Morrison County:
8. Little Falls (2).

Redwood County:
9. North Redwood.

Renville County:
10. Morton.

St. Louis County:
11. Duluth (3).

Sherburne County:
11a. Near East St. Cloud (5).

Stearns County:
12. Rockville (2).
13. St. Cloud (29).
14. Sauk Center.

SANDSTONE.

Nicollet County:
1. Courtland.
2. New Ulm (near) (2).

Pine County:
3. Banning.
4. Sandstone (2).

Pipestone County:
5. Jasper (3).
6. Pipestone (4).

Rock County:
7. Luverne (2).

Scott County:
8. Jordan.

St. Louis County:
9. Duluth.
10. Fond du Lac.

Directory of stone quarries in Minnesota—Continued.

LIMESTONE AND LIMEKILNS.

Blue Earth County:
- 1. Mankato (9).

Fillmore County:
- 2. Rushford (5).
- 3. Spring Valley (3).

Goodhue County:
- 4. Red Wing and E. Red Wing (6).

Mower County:
- 5. Le Roy.

Rice County:
- 6. Faribault.

Scott County:
- 7. Shakopee.

LIMESTONE.

Blue Earth County:
- 1. North Mankato (5).

Dodge County:
- 2. Mantorville.
- 3. Wasioja (2).

Fillmore County:
- 4. Chatfield (2). (Also 2 nearby in Olmsted County).
- 5. Fillmore.
- 6. Peterson (2).
- 7. Preston (3).
- 8. Washington.
- 9. Wykoff.

Goodhue County:
- 10. Cannon Falls.
- 10a. Frontenac.
- 11. Pine Island (2).
- 12. Wanamingo.

Hennepin County.
- 13. Minneapolis (23).

Houston County:
- 14. Caledonia (4).
- 15. Freeburg.

Le Sueur County:
- 16. Kasota (3).
- 17. Ottawa (4).

Nicollet County:
- 18. St. Peter (2).

Olmsted County:
- 19. Rochester (6).
  See also Chatfield, Fillmore County.

Ramsey County:
- 20. St. Paul (7).

Rice County.
- 21. Faribault (7).

Wabasha County:
- 22. Mazeppa (3).
- 23. Plainview.

Washington County:
- 24. Stillwater (5).

Winona County:
- 25. Dresbach.
- 26. Elba (3) and Fairwater.
- 27. Homer.
- 28. Lamoille.
- 29. Lewiston (3).
- 30. Minneiska.
- 31. Minnesota City (2) and Rolling Stone.
- 32. St. Charles (3).
- 33. Stockton (4).
- 34. Winona (3).

NORTH DAKOTA.

The stone resources of North Dakota have been very little developed, and there are very few data at hand concerning the undeveloped resources of the State. About two-thirds of the area of the State, viz, the portion north and east of Missouri River, is generally deeply covered by glacial drift, and rock exposures are scarce. Except in the valley of Red River, where there may be granite, the rocks below the drift are sedimentary beds of Cretaceous and Tertiary age which consist mostly of soft sandstone and limestone, shale, and clay, thus affording but little suitable rock for quarrying.

Sandstone.—In places sandstone beds are sufficiently indurated so that they can be quarried for local use. One sandstone quarry at Linton, Emmons County, has reported production and one at Velva, McHenry County. The former is in Cretaceous rock, the latter in the Tertiary. The location of these quarries is shown in Plate II.

Glacial bowlders.—In the autumn of 1909 the writer investigated the resources in local structural materials of several of the larger towns in North Dakota. Little suitable building stone was found in the bedded rocks where exposed in the stream cuttings, but a substitute was suggested by the abundance in which glacial bowlders occur in some localities. The following notes on this resource in the vicinity of Minot, from a report made by the writer to the Supervising Architect of the Treasury Department, may be of interest here as indicating the character of most of the bowlder deposits:

About 2 miles east of Minot there is an area of 40 acres or more over which bowlders are strewn very thickly, even forming a morainal ridge in one place. Considering the whole tract the bowlders would average one to about every 2 square yards of area. The bowlders range in size from 6 to 8 inches to 4 or 5 feet in diameter. They are mostly of red granite, but there are also the following types of rock represented: Cream-colored dolomite, gray and pink granite, gray gneiss and schist, diorite, quartzite, and sandstone. Many of the bowlders are moss covered and show spalling to a shallow depth on the surface, but they are practically all sound to within a fraction of an inch of the surface. The quantity of bowlders available is sufficient to build the walls of several Federal buildings, and in this country of practically no other building stone they are of very great importance. Many foundations in Minot have been built of bowlders trimmed into dimension stone and so laid as to present a handsome variety of colors.

Another fine example of a foundation constructed from glacial bowlders cut into dimension stones was afforded by the new Masonic Temple at Bismarck. The cost of these bowlders compares favorably with other stone shipped in from outside States.

Production.—No stone production was reported to the Survey from North Dakota in 1911 or 1912.

Directory.—Quarries of all the kinds of rock quarried in North Dakota are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in North Dakota.

SANDSTONE.

Emmons County: 1. Linton.

McHenry County: 2. Velva.

SOUTH DAKOTA.

The greater part of the area of South Dakota is underlain by sandstone, shale, clay, and chalky limestone of Cretaceous and Tertiary age, none of which formations contain much good quarry stone. Glacial drift overlies much of the area of the State east of Missouri River. Aside from the Cretaceous and Tertiary areas there are three small but important areas in South Dakota where hard rocks of several varieties are available for quarrying, viz, in the Black Hills uplift, in the southwestern part of the State, where granite and sedimentary rocks both occur; the Sioux quartzite area, in the southeastern part; and a granite area in Grant County, in the northeast. Granite, sandstone (including quartzite), and limestone are quarried in South Dakota, the production in sandstone predominating. Marble also occurs, but is not quarried at present. The location of the quarries in this State is shown in Plate II.

Granite.—The granite of the Black Hills, according to Todd,[1] is mostly composed of quartz and mica, the latter locally developed into valuable veins. In places, as at the Etta mine, the feldspar, albite, is remarkably developed. The granite is generally coarse grained. It has not been developed, and on accont of its character does not seem generally well adapted for working. The granite of the Black Hills uplift is considered to be of pre-Cambrian age.

[1] Todd, J. E., Mineral resources of South Dakota: Bull. South Dakota Geol. Survey No. 3, 1902, p. 83.

In the northern Black Hills various kinds of fine-grained eruptive rocks occur, which, were they quarried, would fall in the general commercial classification as granite. They include several varieties of rhyolite, trachyte, and andesite. Some are light colored and suitable for building purposes, others are dark and might be suitable for monumental and ornamental work.

In Grant County, near the lower end of Big Stone Lake, the mass of granite is exposed which is quarried at Ortonville, Minn. (See p. 49 for description.) This rock is quarried near Milbank, S. Dak.

Sandstone (including quartzite).—One of the oldest rocks of this class is the Sioux quartzite, of Huronian age, which underlies portions of Minnehaha, Lincoln, Moody, Lake, McCook, Turner, and Hanson counties. It also extends a few miles into Iowa and Minnesota. This rock is one of the best-known quartzites used for building purposes in the United States. In color the quartzite varies from light pink to red, and to a bluish or purple shade. Much of the material is banded parallel to the bedding, and there is a little mottling in some places, due to the absence of iron oxide in the coloring matter. Rarely the stone is nearly white, and such portions seem to be much less firmly cemented than the tinted portions. The rock is a sedimentary, fine-grained, bedded sandstone that has become so firmly indurated by siliceous cement that when fractured it breaks across the original sand grains as readily as between them. The quartzite splits easily parallel to the bedding planes and trims readily at right angles to them, although it is an exceedingly hard material. The surface rock is broken by bedding and joint planes into slabs varying from 4 to 18 inches thick and from 1 to 12 or 14 feet long. Generally it is possible to obtain stone of any size desired for structural purposes, but where the joints are closely spaced there is necessarily much waste, consequently the cutting of paving blocks and the crushing of the stone have become important phases of the quarrying industry. Quartzite from the South Dakota quarries is shipped into all the surrounding States and even as far east as Detroit, Mich. Paving blocks are sent chiefly to Chicago and St. Louis. The Federal building, State penitentiary, and many public buildings at Sioux Falls, S. Dak., as well as many handsome structures in Sioux City and other Iowa cities are constructed of the Sioux quartzite. It is also a popular stone for retaining walls, terraces, etc. Todd [1] reports that typical Sioux quartzite has shown a crushing strength of 25,000 pounds per square inch. The stone does not change color, and soot and dirt do not adhere to it readily. Samples exposed to fire have withstood heat up to that of redness without cracking or scaling, although if quenched suddenly the result would doubtless have been different, owing to the brittleness of the rock.

Twenty-two quarries in three counties reported production of Sioux quartzite in South Dakota in 1912.

Other quartzites of Huronian and Cambrian age occur in the Black Hills region, but they are reported to be so interstratified with schists as not likely to be quarried to a great extent. Some of this material has, however, been used for building purposes and flagging. Some strata in both the Cretaceous and the Tertiary have been locally silicified so that they may be classed as quartzite, but the extent of such deposits is limited.

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[1] Op. cit., p. 87.

Enormous supplies of choice varieties of sandstone are found in the Black Hills, and material suitable for rough building purposes is found widely distributed through most of the State, in Cretaceous and Tertiary beds. In the Black Hills region Cambrian sandstone is commonly exposed more or less at the base of the main escarpment which faces the interior dome of crystalline rocks. Outside of this belt lie Carboniferous rocks, including the Minnelusa sandstone, a rock much variegated in both color and hardness. It is quarried at Doyle, where some of it is very hard, and has shown crushing strengths ranging from 4,285 pounds to 20,575 pounds per square inch. In the Jurassic area the Unkpapa sandstone consisting of soft, brightly colored beds has been quarried. The Dakota sandstone, of Cretaceous age, is probably the most important of the sources of sandstone in the Black Hills. It is quarried at several openings—about 5 miles southeast of Hot Springs, about 3½ miles north of Edgemont, 1 mile southwest of Rapid City and near Spearfish. It is well exposed in the canyons cut through the main hogback surrounding the uplift, and also on the outer slopes of this ridge.

The Edgemont quarry, which has been inactive in recent years, is in a grayish-buff, not very hard, sandstone. Several of the larger buildings in Edgemont were built of this stone. Certain strata yield excellent rock for grindstones. The rock quarried near Hot Springs is a fine to medium grained quartz sandstone, generally gray when fresh and weathering to buff and brown shades. Some beds are pinkish gray. The beds are massive, but in places, especially near the top of an exposure, they weather into thin layers. The rock is not generally very hard when freshly quarried, but seems to case-harden on exposure in walls. Dimension stone is cut from the select material, and the darker-colored varieties are used for rubble, riprap, and railroad ballast. The sandstone obtained 5 miles southeast of Hot Springs has been used in several of the larger buildings and in the United States Army sanitarium in that city, as well as in Deadwood and other places. Crushing tests are reported to have shown strengths ranging from 3,000 pounds to 7,500 pounds per square inch. The quarries in the Dakota sandstone at Rapid City yield brownish-gray to reddish-brown, medium-grained quartz sandstone, rather soft, porous, and loosely cemented. The beds are faintly laminated, and the rock splits easiest parallel to the bedding. The impurities are mainly iron oxide in specks and lumps, also hollow pockets of limonite and clay. The upper beds, which are soft and shaly, are rejected. The product is used locally for business blocks, churches, foundations, porch columns, etc., the stone cutting being done on the job.

Limestone and lime.—Except for beds of chalky limestone in the Cretaceous of eastern South Dakota (which are of value for cement-making rather than for structural purposes), the limestone beds of importance occur in the Black Hills. The limestone beds in the Black Hills are mostly of Carboniferous age, but there are also Silurian, Triassic, and Cretaceous limestones in this locality. One of the most important limestones is the Pahasapa, of Carboniferous age. It is reported to be about 500 feet thick in the northwestern part and about 225 feet in the southeastern part of the Hills. The lower part is massive, and above there are cherty beds. This stone has been used mainly for smelter flux and for making lime. It has been quarried near Doyle, Pringle, and Deadwood. The Minnekahta limestone, also of Carboniferous age, has been used for lime burning and for building stone. It averages less than 50 feet thick. It has been quarried at Spearfish. One limestone quarry is located in Cretaceous rocks at Chester, Lake County.

Limestone, including that quarried for lime and flux, is obtained in five counties in South Dakota, 12 quarries having reported production in 1912.

Marble.—According to Todd,[1] an extensive deposit of white, crystalline dolomite marble occurs 4 or 5 miles northeast of Custer. It grades from a pure white fine-grained crystalline rock to coarse mottled stone with thinner layers of white, attractively spotted and banded with light and dark green serpentine. The marble is in distinct layers from 1 to 3 feet or more thick, the upper layers being the thinner. The total thickness is 30 to 40 feet. The deposit is embedded in and interstratified with pre-Cambrian schists. The deposit has been prospected by means of strip pits at several points in a distance of 1½ miles.

A deposit of grayish schistose marble, 20 feet thick, occurs on Box Elder Creek, but no development is reported.

Production.—The total output of stone in South Dakota in 1912 was valued at the quarries at $162,295, compared with $147,865 in 1911. The rank of the State as a stone producer was 41 in 1912 and 42 in 1911. The value of sandstone formed the greater part of the total value, with granite and limestone yielding minor values.

Directory.—Quarries of all the kinds of rock quarried in South Dakota are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in South Dakota.

GRANITE.

Grant County: 1. Milbank.

SANDSTONE.

Butte County: 1. Bellefourche (2).
Fall River County: 2. Hot Springs (2).
Lawrence County:
3. Deadwood (2).
3a. Spearfish.
McCook County: 4. Spencer.
Meade County: 5. Doyle.
Minnehaha County:
6. Dell Rapids (3).
7. East Sioux Falls (3).
8. Garretson (6).
9. Rowena (2).
10. Sioux Falls (5) and West Sioux Falls.
Pennington County: 11. Rapid City.

LIMESTONE AND LIMEKILNS.

Custer County: 1. Pringle (2).
Lawrence County: 2. Spearfish (2).
Meade County:
3. Doyle.
4. Piedmont.
Pennington County: 5. Rapid City (2).

LIMESTONE.

Custer County: 1. Loring.
Lake County: 2. Chester.
Meade County: 3. Sturgis (2).

[1] Op. cit., p. 88.

IOWA, NEBRASKA, MISSOURI, AND KANSAS.

Granite, sandstone, and limestone constitute the stone resources of this group of States. Granite is found only in southeastern Missouri; sandstone and limestone are common to all the States. In the foregoing discussion of the rocks of Minnesota and the Dakotas the relation of the Paleozoic rocks and the Cretaceous and Tertiary formations to the stone-quarrying industry has been outlined, and similar relations hold for the States farther south. A glance at the map (Pl. III) shows that stone quarries are fairly abundant in the eastern two-thirds of Iowa, the southeastern corner of Nebraska, nearly the whole of Missouri, and in the eastern one-third of Kansas. The distribution of these quarries indicates the areas underlain by rocks of Paleozoic age belonging to the Ordovician, Devonian, and Carboniferous systems, rocks that are generally fairly pure representatives of their type and sufficiently indurated to make good building or crushed stone. Northwestern Iowa, the western four-fifths of Nebraska, and the western two-thirds of Kansas are underlain by either Cretaceous or Tertiary rocks, and these areas contain but few stone quarries because the rocks are generally rather soft.

IOWA.

Although considerable of the surface of Iowa is composed of Glacial drift, streams have so dissected the drift mantle as to produce many good exposures of the underlying beds of hard rock. The Paleozoic rocks underlie the eastern two-thirds of the area as well as the southwest corner of the State. Cretaceous rocks underlie the remaining northwestern portion, with the exception of a few square miles in the northwest corner of the State which are underlain by Huronian quartzite. The Paleozoic rocks, beginning with the Cambrian and Lower Ordovician along Mississippi River in the northeast corner of the State, outcrop in successive northwest-southeast belts and include rocks of Middle and Upper Ordovician, Silurian, Devonian, and Carboniferous age. The Carboniferous rocks include large areas of Mississippian and Pennsylvanian rocks, and a very small area of Permian beds in Webster County. The Cambrian and Ordovician systems comprise beds of magnesian limestone, soft, friable sandstone, and some fairly high-calcium limestone; the Silurian and Devonian systems carry magnesian limestone and high-calcium limestone, respectively; the Mississippian series is composed mostly of high-calcium limestone, but contains some magnesian and some cherty beds and some sandstone; and the Pennsylvanian series contains much sandstone and a smaller proportion of shaly limestone. Most of these systems also contain shale, but no account is taken of that material in this connection.

The distribution of stone quarries indicated on Plate III is shown to follow closely that of the streams and incidentally that of the railroads, and also to fall almost entirely within the area of Paleozoic rocks. With possibly the exception of limestone quarries in Montgomery County, apparently there are no working quarries in the Cretaceous areas, although doubtless there are a few local pits that produce limited quantities of Cretaceous limestone or sandstone for use on the farms.

Sandstone.—Sandstone is produced from about 27 quarries in 16 counties in Iowa. The majority of these sandstone quarries are in the areas of Pennsylvanian rocks. A small area of Pennsylvanian rocks occurs in the southern part of Scott County, west of Rock Island, Ill. This area is separated from the main Pennsylvanian area by areas of Devonian and Mississippian rocks. Classed as sandstone there is probably some dolomite composed of friable, granular dolomite. There is much of such rock in eastern Iowa and in adjoining parts of Wisconsin and Illinois. On weathering it yields a dolomite sand that in the absence of close inspection is often mistaken for silica sand. The sandstone resources of Iowa are extensive, but at present the greater part of the sandstone output is crushed for railroad ballast.

Limestone.—The limestone quarries of Iowa are distributed over the eastern two-thirds of the State and have been opened in each of the Paleozoic limestones mentioned above. Probably the greater number of quarries are in limestone of Mississippian age, although there are numerous quarries in the Cambrian and Ordovician areas. There are about 243 limestone quarries in Iowa in 42 counties. Twenty-three of these quarries in 7 counties produce stone for making lime. High-calcium lime is burned from formations of Mississippian and Devonian age, and magnesian lime is produced from Mississippian and Ordovician rocks.

Production.—The total output of stone in Iowa in 1912 was valued at the quarries at $946,436, compared with $736,207 in 1911. Iowa ranked twenty-fifth in 1912 as compared with thirtieth in 1911 as a stone-producing State. In 1912 limestone was valued at $944,885, and sandstone at $1,551.

Directory.—Quarries of all the kinds of rock quarried in Iowa are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Iowa.

SANDSTONE.

Black Hawk County: 1. Laporte City.
Clayton County: 2. Garnavillo (2).
Decatur County: 3. Davis City.
Des Moines County:
 4. Burlington.
 5. Danville.
Fayette County: 6. Brainard.
Hardin County:
 7. Eldora (3).
 8. Steamboat Rock.
Jasper County: 9. Newton.
Jones County: 10. Olin (2).
Keokuk County: 11. Delta.
Lee County:
 12. Vincennes.
 13. West Point (3).
Mahaska County: 14. Eveland.
Marion County: 15. Tracy.
Marshall County: 16. Quarry.
Scott County:
 17. Buffalo.
 18. McCausland.
Tama County: 19. Butlerville.
Webster County:
 20. Evanston.
 21. Fort Dodge.

LIMESTONE AND LIMEKILNS.

Cerro Gordo County: 1. Mason City (7).
Clayton County: 2. Guttenberg (3).
Clinton County: 3. Brown.
Dubuque County: 4. Dubuque (8).
Henry County: 5. Mount Pleasant.
Jackson County: 6. Maquoketa and Hurstville (2).
Wapello County: 7. Eldon.

MAP OF NEBRASKA, IOWA, KANSAS, AND MISSOURI
Showing location of limekilns and quarries of limestone, sandstone, and granite

Prepared under the direction of E. F. Burchard

Directory of stone quarries in Iowa—Continued.

LIMESTONE.

Allamakee County:
1. Church.
2. Lansing (4).
3. Waukon.

Appanoose County: 4. Plano.

Benton County:
5. Garrison (4).
6. Mt. Auburn.
7. Shellsburg.
8. Vinton (3).

Blackhawk County:
9. Cedar Falls (2).
10. Laporte City (3).
11. Waterloo (2).

Buchanan County: 12. Hazelton.

Cedar County:
13. Cedar Valley.
14. Plato.

Bremer County: 15. Waverly.

Clark County: 16. Osceola (3).

Clayton County:
17. Elkader (3).
18. Garnaville (2).
19. McGregor.
20. Volga (2).

Clinton County:
21. Charlotte.
22. Grand Mound (3).
23. Lyons.

Decatur County: 24. Davis City (2).

Delaware County: 25. Hopkinton (4).

Des Moines County:
26. Burlington (6).
26a. Middletown.

Dubuque County:
27. Cascade (2).
28. Farley.
28b. Julian.
29. Sherrill.

Fayette County:
30. Arlington (3).
31. Brainard (3).
32. Elgin (2).
33. Postville (nr).
34. West Union.

Floyd County:
35. Charles City (5).
36. Marble Rock (4).
37. Rockford.

Hardin County:
38. Alden.
39. Iowa Falls (4).

Harrison County: 39a. Logan.

Howard County:
40. Cresco (2).
41. Elma (2).

Humboldt County: 42. Humboldt.

Jackson County:
43. Bellevue (2).
43a. Gordons Ferry.

Johnson County:
44. Iowa City.
45. Solon.

Jones County:
46. Anamosa (3).
47. Hale (4).
48. Olin (2).
49. Stone City (5).

Keokuk County:
50. Delta.
51. Hedrick (4).
52. Rickland.
53. Sigourney (2).

Lee County:
54. Ballinger Station.
55. Belfast.
56. Denmark.
57. Franklin (3).
58. Keokuk (7).
59. Montrose (2).
60. Wever.
61. Westpoint (4).

Linn County:
62. Cedar Rapids (4).
63. Marion.
64. Mount Vernon (2).

Louisa County:
65. Columbus City.
66. Columbus Junction.
67. Morning Sun and Newport (3).
68. Oakville.

Madison County:
69. Earlham (6).
70. East Peru.
71. Winterset (6).

Mahaska County:
72. Givin (4).
73. Oskaloosa.
74. Peoria.
75. Rose Hill.

Marion County: 76. Tracy.

Marshall County: 77. Quarry and Legrand (2).

Mitchell County:
78. Orchard (2).
79. Osage (3).

Montgomery County: 80. Stennett (4).

Pocahontas County: 80a. Gilmore City.

Scott County:
81. Bettendorf (2).
82. Big Rock (3).
83. Buffalo (3).
84. Gambril.
85. Le Claire.

Tama County: 86. Montour (2).

Van Buren County:
87. Douds Leando (4).
88. Keosauqua and Chequest Creek (2).
89. Selma (4).

Wapello County:
90. Chillicothe (2) and Dudley.
91. Eddyville.
92. Ottumwa (2).

Washington County:
93. Washington.
94. Westchester (3).

Winneshiek County: 95. Decorah (2).

NEBRASKA.

The stone industry in Nebraska can hardly be considered to be developed to the extent that would be required by a State of its size and population. The relatively local distribution of hard rock as compared with the general distribution of clay and shale suitable for brick manufacture and of sand and gravel for concrete has led to the use of brick and concrete to a considerable extent in lieu of stone.

Sandstone.—Only two sandstone quarries have reported production in Nebraska recently. One of these quarries is apparently in the area of Pennsylvanian sandstone at Springfield, Sarpy County, although it may be Dakota sandstone of Cretaceous age, the other is in the area of later Tertiary rocks at Scotia, Greeley County. As in the Dakotas, there is much sandstone in the Cretaceous and Tertiary area that is indurated in places and is suitable for local use. In Franklin County an attractive coarse-grained green quartzite occurs. It is known locally as "green granite" and "Nebraska granite."

Limestone.—With three exceptions—quarries at Sydney, Cheyenne County, and at Scotia, Greeley County, in limestone of late Tertiary age, and quarries at Roca, Lancaster County, in Cretaceous beds—the limestone quarries in Nebraska are in rocks of Carboniferous age, and are confined to the southeastern portion of the State south of Omaha and east of Lincoln. Most of these quarries are in Pennsylvanian areas, but some are in the Permian. A fossiliferous limestone containing great numbers of Fusulina, a fossil resembling a grain of wheat, is very common. The greater part of the output of limestone in Nebraska is sold as crushed stone, mostly for concrete, and the next largest item, comprising nearly 10 per cent of the total value is the production for riprap on Missouri River.

Lime production is reported from only one locality, Weeping Water, Cass County. The total number of limestone quarries is 32, distributed among 9 counties in Nebraska.

There is little literature available on the quarrying industry in Nebraska, but fortunately a report has been published on the geology of Cass County,[1] one of the most important stone-producing counties in the State, and also a report on a special phase of the industry, viz, the production of flint ballast.[2]

Woodruff [3] states that the stone producing area is in three localities, one along the Platte, another on the Weeping Water, and between these two a small triangular section facing Missouri River. The overburden is generally loess ranging in thickness from a few feet to 20 or more feet. The State capitol at Lincoln is built of native Carboniferous limestone quarried at Louisville, Cass County.

In Gage County cherty limestone, apparently in the area of Permian rocks, is crushed and screened at several quarries and marketed for railroad ballast and concrete. The markets for this material are by no means local but extend well beyond the borders of Nebraska.

Production.—The total value of the stone production in Nebraska in 1912 was $336,189, compared with $268,971 in 1911. As a pro-

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[1] Woodruff, E. G., The geology of Cass County, Nebr.: Nebraska Geol. Survey, vol. 2, pt. 2, 1906.
[2] Barbour, E. H., The flint ballast industry of Gage County, Nebr.: Nebraska Geol. Survey, vol. 3, pt. 5, 1909.
[3] Op. cit., p. 211.

ducer of stone Nebraska ranked thirty-third in 1912 and thirty-seventh in 1911.

Directory.—Quarries of all the kinds of rock quarried in Nebraska are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Nebraska.

SANDSTONE.

Greeley County: 1. Scotia.

Sarpy County: 2. Springfield.

LIMESTONE AND LIMEKILNS.

Cass Connty: 1. Weeping Water.

LIMESTONE.

Cass County:
1. Cedar Creek.
2. Louisville, and Meadow, Sarpy County (2).
3. Nehawka (2).

Cheyenne County: 4. Sidney (4).

Gage County:
5. Blue Springs (2).
6. Holmesville (2).
7. Wymore (3).

Greeley County: 8. Scotia.

Johnson County:
9. Elk Creek (2).
10. Graf.
11. Tecumseh.

Lancaster County: 12. Roca (4).

Nemaha County:
13. Auburn.
14. Brock (2).
15. Johnson.

Pawnee County: 16. Table Rock.

Sarpy County:
17. Richfield.
18. Springfield.

MISSOURI.[1]

The southeastern part of Missouri, comprising over one-fourth of the area of the State, is underlain by rocks of Cambrian and Ordovician age consisting chiefly of interstratified magnesian limestone and sandstone. In a few of the southeastern counties such as Carter, Iron, Madison, St. Francois, and Wayne, granite of pre-Cambrian age outcrops from below the magnesian limestones. Bordering the Ordovician rocks on the east, north, and west is a belt of Mississippian rocks. These rocks form the inner valley and bluffs of Mississippi River except for part of its course north of the mouth of the Missouri in Pike and Lincoln counties, where Silurian rocks outcrop. The Mississippian rocks extend westward from the Mississippi north of the Missouri, crossing the Missouri in Boone County, and in Pettis County they make an abrupt bend to the south and southwest, extending beyond the southwest corner of the State into Arkansas and Oklahoma. They consist largely of limestone, some of which is cherty. A narrow belt of Devonian rocks lies between the Ordovician and the Mississippian area north of Missouri River in Callaway, Montgomery, Warren, and St. Charles counties. The Devonian and Silurian rocks consist largely of limestone. North and west of the Mississippian area Pennsylvanian rocks occupy the remainder, or nearly one-half the area of the State. The Pennsylvanian rocks consist of sandstone, shale, and limestone.

Granite.—In southeastern Missouri there are very large quantities of granite of pre-Cambrian age. The granite underlies areas approximating 60 square miles in both Madison and St. Francois counties

[1] One of the best State reports on the quarrying industry that has come to the notice of the writer is that published by the Missouri Bureau of Geology and Mines as vol. 2, Second Series, 1904. Details are given as to the quarries active at that date.

and smaller areas in Iron, St. Genevieve, Carter, Wayne, Reynolds, and Washington counties. Still larger areas of rhyolite (or porphyry) surround the main body of granite on the northwest, west, and south. One of the most attractive of the Missouri granites is a coarse red variety, quarried at Graniteville, Iron County, and at Syenite, St. Francois County. This deposit yields blocks of almost any size desired. It has been extensively used in St. Louis and Chicago structures. In the latter city in a building in the wholesale district the window sills consist of single rough blocks of this granite 3 feet square by 17⅓ feet long, weighing about 10 tons each. An office building in San Francisco is embellished with 12 polished columns, 16 feet high, by 2⅙ feet in diameter, of the same stones. The Allen monument in Pittsfield, Mass., built from this granite, is 42 feet in height and 4½ feet square at the base and weighs 42 tons. Several buildings of the Washington University and many large business buildings in St. Louis are built wholly or in part of this red granite. The prevailing color of the granite is some shade of red, but the color of the granite in southeastern Missouri varies from light gray through different shades of pink and red to brownish red. The color of the rhyolite varies from many shades of dark red and wine color to dark brown and black.

The granite of Missouri is popular for monumental work, more being sold for such purposes than for building stone. Large quantities are made into paving blocks and also are crushed for concrete and for macadam. So well known is the Missouri red granite that it may be found in stone yards in large cities in all parts of the United States.

Sandstone.—The greater part of the sandstone quarried in Missouri for building stone, concrete, or other structural purposes or road-making is obtained from the area of Pennsylvania rocks in the northwestern half of the State. The principal exceptions are quarries in St. Genevieve, Franklin, and Hickory counties, where sandstone of Cambrian or Lower Ordovician age is obtained. Dressed building stone and stone for riprap are the principal products of the sandstone quarries. Among the quarries that have furnished the most sandstone for local building purposes, and even for distant places, are those near Warrensburg and Carrollton.

The sandstone quarries near Warrensburg are about 2¼ miles northwest of town. The stone that occurs here is massive calcareous sandstone of bluish-gray and light-gray shades. The blue rock lies nearest the surface. The stone is composed of fine, subangular silica grains, held together by calcareous cement and iron oxide. There is a notable quantity of mica present in thin flakes, and in places in the blue stone there is considerable carbonaceous matter in fine grains and in leaf and stem impressions parallel to the bedding. Such rock is called "reedy" stone. In places the blue stone is stained by iron oxide in kidney-shaped masses up to several feet in length. In both shades of stone there are concretionary structures called "hardheads" varying in size up to 3 or 4 feet in diameter. The bedding planes often extend through these concretions, yet they can be separated from the rest of the rock without difficulty. These "hardheads" have an unusually large percentage of lime in their cement. Fine particles of iron rusts, resulting from the oxidation of iron pyrites, are occasionally seen in the blue stone, but they are scarcer in the light-gray stone. In the quarries the joints are not closely spaced. The rock shows bedding planes, coated with coaly matter in places, but little attention is paid to them in quarrying, and blocks 5 feet wide, 7½ feet thick, and 10 feet or more in length are cut by channeling machines and wedges. The rock is tough, but not very hard or brittle when freshly quarried, although it grows harder with age. It holds its color well, remaining nearly its original shade for five to ten years. Gradually, however, the bluish stone becomes buff-colored and the lighter stone becomes darker gray. Sawed stone where used close to the ground is apt to disintegrate and spall off in thin crusts after many years' exposure, but where well above ground the stone stands satisfactorily.

The quarries near Carrollton are 15 miles east of town, or 1½ miles west of Miami, Carroll County. The stone is light gray in color, and consists principally of fine rounded grains of quartz, cemented chiefly with calcium carbonate. Small flakes of mica, grains of iron oxide, and nodules of iron pyrites are minor constituents of the sandstone. Some beds of the stone contain carbonaceous material in the form of thin black layers, shaped like long narrow leaves or stems. These impressions generally occur parallel to the bedding planes and show only as a dark line on faces cut at right angles to the bed. Occasionally these carbonaceous layers are found slightly inclined to the bedding, in which case they show as dark irregular spots on the sawed faces of the stone. When first quarried the rock is rather soft, but it hardens on exposure. The rock is massive, and the size of mill blocks obtainable is limited only by the carrying capacity of the derricks. "Hardheads" are present as in the stone near Warrensburg, and as both deposits are of practically the same age their character is very similar. This sandstone is said to be adaptable to very intricate carved work, stone for carving having been furnished to the Iowa State Capitol. A handsome courthouse at Carrollton has been built of this stone.

The State geologist of Missouri reports the following chemical and physical data with regard to the two sandstones described above: [1]

Chemical analyses of Missouri sandstones.

	Insoluble.	Iron and aluminum oxides (Fe_2O_3 $+Al_2O_3$).	Calcium carbonate ($CaCO_3$).	Magnesium carbonate ($MgCO_3$.
Warrensburg	76.53	11.37	9.56	0.41
Carrollton	77.19	12.19	8.41	0.76

Physical test data.

	Warrensburg.	Carrollton.
Crushing strength on bed, per square inch ... pounds	5,910.6	7,477.6
Crushing strength on edge, per square inch ... do	4,869.	9,203.
Crushing strength of sample after freezing, per square inch ... do	5,097.5	8,670.5
Transverse strength, per square inch ... do	777.97	1,321.76
Specific gravity ... do	2.6485	2.637
Weight per cubic foot ... do	137.7	141.3
Porosity ... per cent	16.765	14.31
Ratio of absorption	7.644	6.33

[1] Buckley, E. R., and Buehler, H. A., The quarrying industry of Missouri: Missouri Bureau of Geology and Mines, vol. 2, 2d ser., pp. 270, 276, 308, and 313.

Sandstone for structural purposes is produced at 23 quarries in 12 counties in Missouri. In addition to these purposes enormous quantities of St. Peter (Ordovician) sandstone, a very pure silica sandstone generally too friable for structural work, are quarried and crushed for glass sand. Quarries are located near Meramec and Missouri rivers at Pacific, Grays Summit, and Klondyke, and near Mississippi River at Crystal City.

Limestone.—The wide distribution of limestone in Missouri, which has already been outlined, insures a large production of this valuable material. Most of the limestone is suitable for crushed stone, and much of it is also suitable for building stone, for the manufacture of lime, and for flux, so that each of these branches of the industry contributes largely to the output of limestone. Limestone of Cambrian and Lower Ordovician age is quarried in Missouri in the following counties: Bollinger, Cape Girardeau, Cole, Dallas, Franklin, Madison, Miller, Moniteau, Osage, Perry, St. Francois, and Wright; Middle and Upper Ordovician limestone in Cape Girardeau and Jefferson counties; Silurian limestone in Lincoln and Pike counties; Devonian (probably) limestone in Jefferson County; Mississippian limestone in Barry, Boone, Callaway, Clark, Cooper, Greene, Jasper, Jefferson, Knox, Lawrence, Lewis, McDonald, Marion, Monroe, Montgomery, Pettis, Pike, Platte, Ralls, St. Charles, St. Clair, St. Louis, Saline, and Shelby counties; and limestone of Pennsylvanian age in Andrew, Atchison, Audrain, Bates, Buchanan, Caldwell, Carroll, Cass, Clark, Clay, Clinton, Daviess, Dekalb, Grundy, Harrison, Holt, Jackson, Knox, Lafayette, Linn, Livingston, Mercer, Montgomery, Platte, Ray, St. Clair, Saline, and Sullivan counties.

A total of 283 quarries have produced limestone in the last two or three years of which 80 quarries furnished stone for making lime. Out of the total of 283 quarries, 41 were in Cambrian and Lower Ordovician limestone, 8 in Middle or Upper Ordovician, 5 in Silurian, 4 in Devonian, 105 in Mississippian, and 120 in Pennsylvanian limestone. Of the quarries producing stone for lime 12 were in Cambrian and lower Ordovician limestone, 5 in Middle or Upper Ordovician, 1 in Devonian, 59 in Mississippian, and 3 in Pennsylvanian limestone. It is thus evident that the Mississippian and Pennsylvanian series contain the most extensive limestone formations, and that for the manufacture of lime the rock of Mississippian age has proved most suitable. The Mississippian limestone is mostly high-calcium stone; the beds of Cambrian and Lower Ordovician age are highly magnesian; and certain of the limestone beds of the Middle and Upper Ordovician are high in calcium carbonate. Analyses of many Missouri limestones are given in Mineral Resources for 1911, part 2, pages 673–674.

A well-known representative of the Mississippian rocks is the limestone quarried at Carthage, Jasper County, at Phenix, Springfield, and Ash Grove, Greene County, and near Hannibal, Marion County. The largest limestone-quarrying center in the State is at Carthage. Here the stone is of a remarkably uniform color, a faint bluish gray in the quarry, and nearly pure white when cut and dressed. The rock is composed of medium-sized, irregular grains of calcite, closely interlocked, cemented by a calcite matrix. Analyses show more than 98.5 per cent of calcium carbonate and less than 0.25 per cent of iron oxide and alumina. The rock occurs in thick beds. Some chert is present near the base, but can easily be separated in quarrying. This limestone shows stylolitic jointing along the stratification planes, but these joints are generally so tight that the rock does not break readily along them. To avoid showing these stylolites on a sawed face the stone is generally sawed parallel to the bedding and laid on edge in the wall. Few limestones will admit of this practice, but in the case of the Carthage stone the results appear to be satisfactory. The stone is considerably harder and consequently more difficult to saw and dress than limestones of the type quarried near Bedford, Ind., and it is also considerably stronger and less affected by the weather and by soot, gases, etc., than most other limestones.

The limestone quarried at Carthage is used principally for building purposes, either rock-faced, tooled, or hammered, and some is polished for interior decoration. Some producers term the rock a marble. Some is sold for curbing, terracing, and flagging, and the use of the white rock in this manner in connection with its use in buildings produces in truth a "spotless town." The city of Carthage itself is a beautiful example of what the use of a stone of this type can contribute to the attractiveness of a residential city. Much stone from Carthage is used in St. Louis, Kansas City, and in many of the other cities of Missouri, Kansas, Arkansas, and Oklahoma.

The limestone quarried at Phenix is more coarsely crystalline than that at Carthage. It has a bluish-gray color and uniform texture and occurs in thick beds. It is becoming a very popular building material, a beautiful church building having recently been constructed from it at Thirty-first Street and Troost Avenue, Kansas City.

Production.—The total value at the quarries of the stone output of Missouri in 1912 was $2,486,505, compared with $2,338,585 in 1911. Missouri ranked ninth in 1912 and tenth in 1911 as a stone-producing State. The 1912 value was divided as follows: Limestone, $2,373,725; granite, $97,776; and sandstone, $15,004.

Directory.—Quarries of all the kinds of rock quarried in Missouri are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Missouri.

GRANITE.

Carter County: 1a. Van Buren.
Iron County: 1. Graniteville (3).
Madison County: 2. Cornwall.
St. Francois County:
  3. Doe Run (2).
  4. Farmington (2).
St. Francois County—Continued.
  5. Knob Lick (4).
  6. Syenite
Wayne County: 7. Granite Bend (mail Kerrigan).

SANDSTONE.

Bates County:
  1. Rich Hill (2).
  2. Rockville.
Calloway County: 3. Fulton.
Clark County: 4. Kahoka.
Franklin County: 5. Union.
Henry County:
  6. Clinton (4).
  7. Montrose.
  8. Urich (2).
Hickory County: 9. Weaubleau.
Howard County: 10. Glasgow.
Johnson County: 11. Warrensburg (2).
Putnam County: 11a. Worthington.
Ste. Genevieve County: 12. Jonca.
Saline County:
  13. Miami Station (nr).
  14. Sweet Springs.
Schuyler County: 15. Queen City (2).

Directory of stone quarries in Missouri—Continued.

LIMESTONE AND LIMEKILNS.

Barry County: 1. Cassville.
Calloway County: 2. Fulton.
Cape Girardeau County: 3. Cape Girardeau (3).
Cole County: 4. Taos.
Cooper County:
5. Boonville (2).
6. Woolridge.
Dade County:
6a. Everton.
6b. Lockwood.
Franklin County:
7. Gerald.
7a. Pillman and Port Royal (2).
8. Washington.
Greene County:
9. Ash Grove.
10. Galloway.
11. Phenix.
12. Springfield (8).
13. Walnut Grove.
14. Wilson Creek.
Jasper County:
15. Carthage.
16. Sarcoxie.
Jefferson County:
17. Byers (mail Barnhart).
Jefferson County—Continued.
18. Glen Park (mail Pevely).
19. Kimmswick.
Lawrence County: 20. Peirce City.
Marion County:
21. Bear Creek.
22. Hannibal (7).
Mercer County: 23. Princeton.
Miller County: 24. Spring Garden.
Osage County:
25. Koeltztown (2).
26. Loose Creek.
27. Westphalia (2).
Pettis County: 28. Georgetown.
Pike County: 29. Louisiana.
Platte County: 30. Parkville.
St. Clair County: 31. Osceola.
Ste. Genevieve County:
32. Brickeys.
33. Ste. Genevieve (3).
St. Louis County:
34. Centaur.
35. Glencoe (2).
36. Mincke (mail Crescent).
St. Louis City County: 37. St. Louis (17).
Wright County: 38. Mountain Grove.

LIMESTONE.

Andrew County:
1. Amazonia.
2. Cosby.
3. Nodaway.
4. Savannah (3).
Atchison County: 5. Rockport.
Audrain County: 6. Mexico (2).
Bates County: 7. Butler (2).
Bollinger County: 8. Lutesville (2).
Boone County:
9a. Ashland.
9. Columbia (5).
9b. Easley (Rutland).
9c. Wilton.
Buchanan County:
10. Easton.
11. St. Joseph (4).
Caldwell County: 12. Breckenridge (2).
Cape Girardeau County:
13. Egypt Mills.
14. Jackson (3).
15. Neely's Landing (4).
Carroll County: 15a. Tina.
Cass County:
16a. Belton.
16. Garden City.
17. Harrisonville (5).
Clark County:
18. Alexandria.
19. Kahoka.
20. St. Francisville (3).
21. Wayland.
Clay County:
22. Birmingham.
22a. Excelsior Springs.
22b. Missouri City.
22c. Miltondale.
22d. South Liberty.
Clinton County: 23. Plattsburg (5).
Cole County:
24. Elston.
25. Jefferson City (7).
Cooper County: 26. Sweeney (mail Clifton City).
Dallas County: 27. Buffalo.
Daviess County:
28. Gallatin (5).
28a. Jameson.
29. Pattonsburg.
De Kalb County: 30. Maysville.
Grundy County:
31. Spickard.
32. Trenton (3).
Harrison County:
33a. Bethany.
33. Gilman City.
33b. Ridgeway.
Holt County:
34. Forest City.
34a. Oregon.
Jackson County:
35. Courtney (2).
35a. Grand View.
36. Greenwood.

Directory of stone quarries in Missouri—Continued.

LIMESTONE—continued.

Jackson County—Continued.
- 37. Independence (4).
- 38. Kansas City (33).
- 39. Leeds (2).
- 40. Sheffield.
- 41. Westport.

Jasper County: 41a. Carthage.

Jefferson County:
- 42a. Barnhart.
- 42. De Sota.
- 43. Rush Tower.
- 44. Wickes.

Knox County: 45. Edina.

Lafayette County:
- 46. Corder.
- 47. Higginsville (3).
- 48. Lexington.

Lewis County: 49. Lagrange (3).

Lincoln County: 50. Elsberry.

Linn County: 51. Marceline.

Livingston County: 52. Wheeling.

McDonald County: 53. Noel.

Madison County: 54. Fredericktown.

Marion County: 55. Palmyra (2).

Mercer County: 55a. Millgrove.

Moniteau County:
- 56. California.
- 56a. Tipton.

Monroe County: 57. Paris (4).

Montgomery County:
- 58. McKittrick.
- 59. Montgomery City (2).
- 60. New Florence.
- 61. Wellsville (2).

Osage County:
- 61a. Argyle (2).
- 61b. Rich Fountain.

Perry County:
- 62. Perryville (3).
- 62a. Across river from Grand Tower, Illinois.

Pettis County: 63. Sedalia (3).

Pike County:
- 64. Bowling Green (2).
- 65. Busch.
- 66. Clarksville (3).

Platte County:
- 66a. Dearborn.
- 66b. Platte City.

Ralls County: 67c. New London.

Ray County: 67d. Richmond.

St. Charles County:
- 67. Foristell.
- 68. St. Charles.
- 69. St. Peters.

St. Francois County: 70. Farmington (5).

St. Louis County:
- 71. Chesterfield.
- 72. Creve Coeur and Fernridge (2).
- 73. Florisant.
- 74. Fort Bellefontaine.
- 75. Jefferson Barracks.
- 76. Manchester.
- 77. Mattese.
- 77a. Mentor.
- 78. Vigus (2).

Saline County:
- 79. Napton (2).
- 80. Sweet Springs.

Scott County: 81. Grays Point.

Shelby County:
- 82. Shelbina.
- 83. Shelbyville.

Sullivan County: 84. Milan (3).

KANSAS.

Kansas is underlain by practically the same formations as Nebraska, in addition to a few square miles of Mississippian rocks in the extreme southeastern corner of the State, but the Pennsylvanian and Permian rocks extend farther west and occupy a larger proportion of the area of the State, consequently the quarries have a wider areal distribution and the stone output is much the greater in Kansas. The map (Pl. III) shows that the relation between the Paleozoic rocks and the later rocks and the stone quarries that has obtained for the rest of the Great Plains holds equally well for Kansas. Outside of the Paleozoic areas there are six localities in which limestone is quarried and one locality producing sandstone—all in the Cretaceous.

Sandstone.—The most important sandstones in Kansas are in the area of Pennsylvanian rocks in the eastern fourth of the State, but in the Cretaceous area and possibly in the Tertiary are beds of sand stone suitable for local use. Sandstone is at present produced from 22 quarries in 13 counties, but the output is small compared with that of limestone, the principal markets being for rough stone for local building and flagging.

Notes made by the writer in December, 1909, on quarries in southeastern Kansas may be of interest here. About 2 miles northwest of Independence a quarry in brownish-buff fine-grained sandstone exhibits a face of rock 7 or 8 feet high and 150 feet long. The stripping consists of 5 to 7 feet of soil and brown clay, grading into shaly sandstone. The beds are horizontal and show very even courses of stone 4 to 12 inches thick. In one place several layers of stone are compactly bedded, making a stratum 20 inches or more in thickness. Generally the maximum thickness in which the stone can be obtained in blocks is about 10 inches. Blocks 10 feet or more in length can be obtained, and one slab 16 feet by 24 feet by 10 inches is reported to have been quarried. Above water level the stone is yellowish buff in color; below water level it is grayish buff. On exposure the stone all darkens to brownish buff. The stone is apparently durable, as shown in foundations, retaining walls, and buildings that have been built 20 years or more. It is used for rubble, range, dimension stone, trimmings, curbs, sidewalks, and posts. The Roman Catholic Church at Independence is built of this sandstone, and the trimmings of the Montgomery County courthouse and high-school building are cut from it.

Four miles south of Parsons, on Bachelor Creek, sandstone is quarried. This deposit is about 20 feet thick, the upper 14 feet being above water level and weathered to a brownish-buff color, while the lower 6 feet are below creek level and are of a bluish-gray color. The rock is fine grained, but gritty, contains a small percentage of calcium carbonate and fine grains of iron oxide. It contains some seams of carbonaceous and micaceous material along which it splits easily. This sandstone is sold both for rubble and range. When dressed for range it generally comes in blocks about 8 inches thick. When exposed in a wall for five years the bluish-gray stone generally changes to a buff color.

In the vicinity of Columbus, Cherokee County, sandstone of fair quality for dimension stone and for foundations and bridge building has been quarried from time to time.

One of the principal uses to which the Pennsylvanian sandstones of Kansas are suited is the production of flagging, but owing to the large increase in the use of concrete for sidewalks in recent years, the output of flagstone has shown a relative decrease.

Limestone.—Limestone beds belonging to four geologic divisions are abundant in Kansas. Beginning with the lowest these are as follows: Mississippian series, Pennsylvanian series ("Coal Measures"), Permian series, and Cretaceous system.

Mississippian rocks occur only in one small area in the extreme southeast corner of Kansas, about 30 square miles in Cherokee County being covered by rocks of this age. This series is composed of limestone with interbedded chert and a few beds of shale. The limestone is usually heavy bedded and low in magnesia. It is said to be the rock that is extensively quarried at Carthage and other points in Missouri. Pennsylvanian rocks outcrop in the three eastern tiers of counties, and in part of the counties in the fourth tier. Although made up mostly of shale and sandstone, the series includes many beds of limestone. Permian rocks occur west of the Pennsylvanian rocks and include a few beds of limestone. The chalk and chalky limestones of the Cretaceous occur in western Kansas. The principal outcrops are in Jewell, Smith, Phillips, Rooks, Osborne, Graham, Ellis, Trego, Gove, Logan, Ness, Lane, and Finney counties, and the same rocks are exposed in southern Nebraska and along Republican River.

A brief outline of the stone resources and industry of Kansas has been published by the University Geological Survey of Kansas[1] from which the following quotation is taken:

Years ago * * * Mississippian stone was quarried at Galena, at Lowell, and elsewhere for the production of lime. It is so abundant in quantity and so easily accessible along the hillsides that it is a great wonder more limekilns are not in operation. The same rock is quarried at different places in Missouri and burnt into lime, producing lime of a good quality, but no better than might be obtained from Kansas quarries.

To the northwest of Cherokee County many local quarries in heavy limestone formations have been operated, some of which are still operated in an irregular manner. The most extensive of these is the quarry at Iola, which has produced large quantities of dimension stone and sawed flagstone for local trade and for shipment to other points. The limestone at Iola exists in a layer nearly 40 feet thick, from which dimension blocks of any size or proportion desirable can be obtained.

Still farther to the northwest the next quarries are those along the banks of the Kansas River west of Kansas City, from which large quantities of stone are taken for ballast and for macadamizing streets. Near Kansas City a deposit of fragmentary material exists from which large quantities have been shipped for making sidewalks and for macadamizing streets and for similar purposes.

Other places furnish quantities of stone, the output of which would be greatly increased if the demand were sufficient to justify the extensive operation of quarries. Generally, however, it is principally a local demand, for which no statistics can be gathered, but which in the aggregate amounts to many thousands of dollars.

Still farther west a limestone exists which is remarkable in many of its properties, permitting it to be successfully quarried for all kinds of dimension stone wherever it comes to the surface. It is known commercially as the Cottonwood Falls limestone, because such large quantities have been shipped from Cottonwood Falls and Strong City to so many points within and without the State. The same rock has been quarried at a dozen or more places to the north of Cottonwood Falls, such as Eskridge, Alma, Manhattan, Beattie, and a number of other places. This limestone is not very thick, averaging from 5 to 8 feet, and generally consists of two individual layers, known in the markets as the "upper" and the "lower." The rock from the two layers differ slightly in quality, the lower one generally producing the best stone. Its most valuable properties are two—almost perfect uniformity of texture throughout and the absence of vertical fissures. It is white or light cream in color, fine and noncrystalline in texture, and well filled with the little rice-grain-like invertebrate fossil, *Fusulina cylindrica*. The color is so uniform that when the stone is placed in a building the general color effect is very pleasing and satisfactory. The absence of vertical fissures and the uniformity of texture throughout make it possible to obtain dimension blocks of any size desired, which can be worked with perfect uniformity. These qualities make it by all odds the most desirable and therefore the most extensively used stone in the State. Large buildings are erected from it entirely, and many others partly constructed from the same rock. The different quarries so widely separated make it possible for a large community to use it without paying excessive freight.

From this Cottonwood Falls limestone the following important buildings are constructed: Snow Hall, and the stone trimmings of the main building, University of Kansas, Lawrence; the M. E. Church, Lawrence; the Rock Island depot, Topeka; the Santa Fe depots at Ottawa, Wellington, and elsewhere; and a number of other depot buildings along the lines of the different railways in Kansas.

In addition to the above-mentioned uses, the different railroads in the State use the Cottonwood Falls limestone for bridge building and other construction purposes. This is true to so great an extent that many thousands of dollars' worth of dimension stone are annually supplied the different Kansas lines for use in this State and elsewhere, much of it being shipped outside of the State.

A few hundred feet above the Cottonwood Falls limestone are heavy beds of the Permian limestone, which are unusually filled with flint nodules. These soft Permian limestones, carrying so much flint, are very serviceable for railroad ballast, and are

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[1] Haworth, Erasmus, Mineral resources of Kansas for 1897: University Geol. Survey Kansas, 1898, pp. 74–76.

extensively quarried and crushed for this purpose at different places. The quarry near Strong City has probably yielded more ballast of this kind than any other one in the State, but extensive quarries are operated farther west along the Santa Fe at Florence and near Marion, and along the Rock Island at different points, all of which produce practically the same kind of stone.

In the central and west-central part of the State, the Cretaceous limestones have been quarried to a great extent. On account of their soft, chalky character they are generally spoken of locally as a magnesian limestone, although such a term is entirely misapplied. A belt of country stretches across the State, by way of Beloit and Russell, throughout which a fine layer of limestone is quarried and broken into pieces suitable for fence posts. Travelers passing from east to west along almost any railroad line in the State can notice large fields and pastures fenced entirely by fastening the wire fencing to these stone posts, which are set in the ground similar to the way common wooden posts are used in ordinary fencing. The Cretaceous limestones also serve many structural purposes in all of the cities and villages within the Cretaceous area. The rock is so soft it can easily be sawed into blocks, and worked with chisel and hammer much more rapidly than ordinary limestone. This, added to its property of materially hardening after being quarried, greatly increases its value. None of it is what would be called a first-class building material, yet it is capable of being used in many ways to a great extent, and furnishes a convenient and durable structural material for that part of the State, which tolerably effectually prevents other stone from being shipped in. Here, as elsewhere, local demands are not so great now as they formerly were, but every year thousands of dollars' worth of the rock are quarried and used for various purposes, principally for supplying fence posts.

A large amount of work, in systematically examining the Kansas building stone, has been performed by members of the university faculty. This was particularly true during the years 1892 and 1893, at which time a large collection was made from almost all over the State, by Prof. Williston, and many chemical analyses made by Prof. Bailey and his assistants, in the chemical department, and crushing tests made by Prof. Marvin and his assistants in the engineering department. This work was done especially for the exhibit of Kansas building stone at the World's Fair. The results of the investigation have not yet been published. A synopsis of it, however, was published in the Sixteenth Annual Report of the Director of the United States Geological Survey, Part III, page 504.

More than 200 quarries report recent production of limestone in Kansas, including 22 quarries which supply stone for lime burning. The total number of limestone-producing counties in Kansas at present is 41, in 7 of which lime is burned. The largest item among the limestone products is crushed stone, although building stone and stone for paving are produced also in large quantities.

Production.—The value of the production of all kinds of stone in Kansas in 1912 was $763,228, of which the value of limestone was $757,197 and that of sandstone, $6,031. The 1912 production showed a reduction as compared with that of 1911, which was valued at $803,222 and the rank of Kansas as a stone producer among the rest of the States changed from twenty-eighth in 1911 to twenty-ninth in 1912.

Directory.—Quarries of all the kinds of rock quarried in Kansas are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Kansas.

SANDSTONE.

Bourbon County:
1. Hiattville.
2. Redfield.

Chautauqua County: 3. Chautauqua.
Cherokee County: 4. Galena.
Crawford County:
5. Farlington.
6. Pittsburg.

Elk County: 7. Howard.
Greenwood County: 8. Madison.
Labette County: 9. Parsons (2).
Linn County: 10. Pleasanton (3).
Montgomery County: 11. Independence (3).
Pawnee County: 12. Larned.
Pottawatomie County: 13. Onaga.
Wilson County: 14. Neodesha (2).
Woodson County: 15. Yates Center (2).

Directory of stone quarries in Kansas—Continued.

LIMESTONE AND LIMEKILNS.

Bourbon County: 1. Fort Scott (4).
Chautauqua County: 2. Sedan.
Elk County: 3. Moline.
Leavenworth County: 4. Lansing.
Marshall County: 4a. Frankfort (6).
Shawnee County: 5. Topeka (8).
Wilson County: 6. Vilas.

LIMESTONE.

Allen County: 1. Gas and Iola (2).
Anderson County: 2. Garnett.
Atchison County: 3. Atchison (5).
Brown County:
- 4. Fairview (3).
- 5. Hiawatha (2).

Butler County:
- 6. Augusta (2).
- 7. Eldorado (2).

Chase County:
- 8. Cottonwood Falls (3).
- 9. Strong City.

Coffey County: 10. Waverly.
Cowley County:
- 11. Silverdale.
- 12. Winfield (4).

Douglas County:
- 13. Baldwin (2).
- 14. Lawrence (4).
- 14a. Lecompton.

Franklin County:
- 15. Ottawa (3).
- 16. Wellsville.

Geary County: 16a. Junction City (2).
Greenwood County:
- 17. Hilltop.
- 18. Madison (2).

Jackson County: 18a. Delia.
Hamilton County: 19. Syracuse.
Jewell County:
- 20. Formoso (6).
- 21. Randall (7).

Johnson County: 22. Olathe.
Labette County: 23. Parsons (2).
Leavenworth County: 24. Leavenworth.
Lyon County:
- 25. Admire.
- 26. Allen (5).
- 27. Americus (2).
- 28. Emporia (5).

Marion County:
- 29. Aulne.
- 30. Florence (4).
- 31. Marion (2).

Marshall County:
- 32. Barrett.
- 33. Beattie (2).

Marshall County—Continued:
- 34. Bigelow (3).
- 35. Florena.
- 36. Marysville (3).
- 37. Oketo.

Miami County: 38. Paola.
Montgomery County:
- 39. Coffeyville (4).
- 40. Independence (3).

Morris County:
- 41. Helmick.
- 42. Dunlap.
- 43. Dwight.

Nemaha County:
- 44. America City.
- 45. Sabetha.

Neosho County:
- 46. Chanute (3).
- 47. Erie (3).

Ness County: 48. Bazine (3).
Pottawatomie County:
- 49. Belvue.
- 50. Emmett.
- 51. Onaga (2).
- 52. St. Mary's (2).
- 53. Wamego.

Riley County:
- 54. Keats.
- 55. Manhattan (11).

Rush County: 56. Alexander (8).
Russell County: 57. Russell (3).
Saline County: 57a. Salina.
Shawnee County: 58. Richland and Tevis (2).
Sumner County: 59. Caldwell (2).
Wabaunsee County:
- 60. Alma.
- 61. Alta Vista.

Washington County: 62. Hanover
Wilson County:
- 63. Fredonia.
- 63a. Benedict.
- 64. Neodesha.

Wyandotte County:
- 65. Kansas City (10) and Quindaro (8).
- 66. Loring.
- 67. Rosedale (2).

ARKANSAS AND LOUISIANA.

Granite, slate, marble, sandstone, and limestone—practically all the commercial classes of rock except trap rock—are to be found in this group of States. Most of these have been developed only in Arkansas, as is shown in Plate IV. This is a natural consequence of the distribution of the geologic formations, since the Paleozoic formations, which generally carry the hard, quarriable rocks, underlie only the northwestern half of Arkansas, as the southeastern half of Arkansas and the whole of Louisiana belong to the Coastal Plain and are underlain by formations of Tertiary age, consisting principally of clay, sand, and soft limestone. Locally there are hard beds of limestone and sandstone in these Tertiary deposits, and if situated convenient to transportation lines they may be quarried.

ARKANSAS.

As already stated, the Paleozoic rocks of Arkansas are confined to the northwestern half of the State. The line of demarkation between the Paleozoic rocks and the deposits of the Coastal Plain is fairly sharp and on a small-scale map shows as a nearly straight northeast-southwest line passing through Little Rock. The Paleozoic rocks consist principally of magnesian limestone and sandstone of Cambrian and Lower Ordovician age, sandstone, shale, and chert of Middle and Upper Ordovician age, limestone of Silurian age, sandstone of Devonian age, limestone of Mississippian age, and sandstone and shale of Pennsylvanian age. The Ozark uplift at the north, the Boston Mountains to the south of the Ozarks, and the Ouachita Mountains still farther south, afford ample exposures of the various rocks, and advantage has been taken of many favorable quarry sites along the railroad lines. In addition to the rocks mentioned above there are slates of undetermined age in the Ouachita Range, and granite (syenite) is exposed in small areas near Little Rock and other points farther up Arkansas River. The marbles of Arkansas are really nonmetamorphosed crystalline limestone beds in the Silurian and Carboniferous formations.

Granite.—The production of granite in Arkansas has been reported recently from Perry, Pope, and Pulaski counties, by a total of nine quarries. The occurrence of granite is reported also in Saline County, and at Magnet Cove, and Potash Sulphur Springs. This rock is rather to be classed as syenite than as true granite. The rock of the Fourche Mountain area in Perry and Pulaski counties is known as "blue granite" or Pulaskite. It is very strong, and has shown one of the highest crushing strengths yet recorded for granite, viz, 34,950 pounds per square inch, with an average of 30,900 pounds. This rock is used extensively for structural purposes, monumental work, and as crushed stone for macadam, railroad ballast, and concrete.

Slate.[1]—In the region of highly folded rocks in the Ouachita Mountains of central-western Arkansas, beds that were originally shale have in places been metamorphosed into slate. This area extends from the vicinity of Little Rock westward nearly to Mena and is about 100 miles in length by an average width of 15 miles. It lies mainly in Saline, Garland, Montgomery, and Polk counties. The St. Louis, Iron Mountain & Southern Railway passes near the eastern border, and the Kansas City Southern Railway near the western extremity. The slate deposits are associated with shale, chert, novaculite, and thin beds of limestone, and within and not

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[1] For details as to geology, character, occurrence, and tests of these slates, see Purdue, A. H., The slates of Arkansas: Bull. U. S. Geol. Survey No. 430, 1910, pp. 317-334.

MAP OF ARKANSAS AND LOUISIANA

Showing location of limekilns and quarries of limestone, sandstone, marble, slate, and granite

Prepared under the direction of
E. F. Burchard

far beyond the eastern edge of the area are the small areas of igneous rocks referred to under granite. Five of the formations of the Ouachita Mountains contain slate, viz., the "Ouachita" shale, the Polk Creek shale, the Missouri Mountain slate, the Fork Mountain slate, and the Stanley shale. Only the last three have been prospected to any extent, and most of the prospecting and development work has been done in the Missouri Mountain slate. This formation produces both red and green slate, the red variety predominating. The material is a clay slate, remarkably homogeneous and free from sandy or other impure layers. Generally this slate is intersected by numerous joints that extend in all directions, but in favorable places these are not so common as to prevent the quarrying of large blocks. The slate cleaves with fairly even surfaces and can readily be split into sheets a quarter of an inch or less thick. This slate is reported to be well adapted for inside fittings, such as laundry tubs, wainscoting, lavatories, and switchboards. The Fork Mountain slate is a hard, generally gray slate, although portions of it may weather green or chocolate in color. Thin sandy or quartzitic layers are numerous. The cleavage is generally well developed. The slate has great strength and toughness and is highly sonorous. In most places joints are so numerous as to render the slate worthless, yet there may be areas of sufficient size free from joints to permit of quarrying. This slate is considered suitable for roofing. A few quarries have been opened in the Stanley shale which yields blue to black thin-splitting smooth material, but the formation is not generally suitable for quarrying. The other two formations mentioned above do not give promise of becoming of great commercial value.

According to the Survey records there are 17 slate quarries in Arkansas, in 4 counties. Not all of these quarries are continuous producers.

Sandstone.—The Paleozoic area of Arkansas abounds in sandstone, most of which is undeveloped. In the large area of Pennsylvanian rocks, especially in the Boston Mountains, there is much excellent light-brown sandstone, easily quarried, and there is considerable quartzite near Hot Springs. The quarry map (Pl. IV) shows the wide distribution of sandstone quarries in the northwestern half of the State. The quarries naturally have been opened along the railway lines where favorably exposed in the bluffs of streams. Twenty-four sandstone quarries in 11 counties report production in this State. The largest use is for riprap, with concrete, road-making, railroad-ballast, and building stone following in order.

Limestone and marble.[1]—The Ozark region of northern Arkansas is underlain by several formations containing limestone, some of which are of great beauty and value. Certain of the limestone beds are composed of crystalline calcite and take a fine polish, and they are therefore commercially classed as marble beds, although they do not fulfill all the requirements of the scientific definition of marble. In this description the term "marble" will be used in its broad and popular sense. In the Ozark region hundreds of miles of outcrop

[1] See the exceptionally full and detailed report by T. C. Hopkins, entitled Marbles and other limestone: Arkansas Geol. Survey Ann. Rept. for 1890, vol. 4, 1893, 443 pp. and atlas.

of limestone and marble are afforded by the dendritic drainage of White River and its tributaries. The rocks lie nearly horizontal and are generally finely exposed in the stream bluffs. The principal limestone and marble formations are the following: Magnesian limestone of Cambrian and Lower Ordovician age, several beds, including "cotton rock"; Izard limestone, a blue, dense, amorphous stone, about 280 feet thick, of Ordovician age; the St. Clair marble (Silurian), a fine-grained fossiliferous crystalline rock, about 150 feet thick, varying in color from light-gray to dark chocolate-brown; the St. Joe limestone member of the Boone limestone (Mississippian), a fine to medium grained crystalline fossiliferous limestone, showing in some places an abundance of crinoid stems, and varying in color from light pink to dark chocolate-brown, also mottled with gray and green, having generally a thickness of 25 to 40 feet, but in places reaching 100 feet; gray crystalline limestone of the Boone limestone (Mississippian), in places oolitic, as near Batesville; the Pitkin ("Archimedes") limestone, of Mississippian age; and the Brentwood ("Pentremital") limestone, of Pennsylvanian age. These limestones and marbles, with the exception of those of Cambrian and Lower Ordovician age, which are highly magnesian, are all high in calcium carbonate. Relatively the great limestone and marble resources of northern Arkansas have been little developed, partly because of the lack of transportation lines and partly on account of the lack of large markets. Two railroads have been recently built in a northwest-southeast direction across the Ozarks, connecting the Frisco lines on the west with the Iron Mountain route on the east, and this has led to the opening of a number of quarries near the new railroads. The limestone near Batesville is a grayish-white, hard, crystalline rock, and will take a good polish. It occurs in layers 3 to 5 feet thick, is comparatively free from seams or flaws, and can be quarried in as large pieces as can be handled. It makes an excellent building stone, and the new State capitol at Little Rock is being constructed from this material. The high degree of purity of many of the northern Arkansas limestones renders them suitable for the manufacture of lime, and a thriving lime industry has been built up in this part of the State.

Twelve quarries in Arkansas have recently reported the production of limestone, besides 13 quarries which produced stone for lime, and 7 quarries have reported the production of marble. Thirteen counties comprise the area from which these three products are obtained. The principal uses for the limestone appear to be as crushed stone for concrete and as stone for building purposes.

Production.—The stone production of Arkansas in 1912 was valued at $513,844. Of this total, the value of granite was $366,354, sandstone was $80,538, and limestone was $66,952. The production for 1911 was about the same as in 1912, but no direct comparison can be made, since in the report for 1911 the figures for Arkansas included those for certain other States.

Directory.—Quarries of all the kinds of rock quarried in Arkansas are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Arkansas.

GRANITE.

Perry County:
1. Fourche (Bigelow).
2. Kenney.
Pope County: 3. Atkins.
Pulaski County:
4. Pulaski Station.
5. Little Rock (5).

SLATE.

Garland County: 1. Near Bear, Montgomery County.
Montgomery County: 2. Slatington (2).
Polk County:
3. Big Fork.
4. Mena (12).
Saline County: 5. Benton.

MARBLE.

Baxter County: 1. Lone Rock.
Boone County:
2. Keener.
3. Zinc.
Independence County: 4. Batesville.
Newton County:
5. Jasper.
6. Wilcockson.
Searcy County: 7. Near St. Joe.

SANDSTONE.

Carroll County: 1. Carrollton.
Cleburne County: 1a. Heber Springs.
Conway County: 2. Morrillton (3).
Franklin County: 2a. Ozark.
Garland County: 3. Hot Springs.
Izard County: 4. Guion.
Johnson County:
5. Clarksville.
6. Lamar.
Searcy County: 7. Leslie (2).
Sebastian County:
8. Fort Smith (6).
9. Greenwood (2).
Washington County: 10. Springdale.
White County:
11. Bald Knob.
12. Russell.
13. Searcy.

LIMESTONE AND LIMEKILNS.

Benton County:
1. Avoca.
2. Garfield.
3. Rogers.
4. Sulphur Springs (2).
Independence County: 5. Batesville and Limeville.
Izard County: 6. Guion (2) and East Sylamore.
Washington County:
7. Elm Springs.
8. Farmington.
9. Viney Grove.

LIMESTONE.

Benton County:
1. Monte Ne.
1a. Gravette.
Boone County:
2. Alpena Pass.
3. Keener.
Carroll County: 4. Eureka Springs.
Lawrence County: 5. Imboden.
Perry County:
6. Fourche.
7. Kenney.
Sebastian County:
8. Fort Smith.
9. Greenwood.
Sharp County: 10. Williford.
Washington County: 11. Johnson.

LOUISIANA.

Limestone.—The only stone reported as quarried in Louisiana is limestone of Tertiary age. This deposit is near Winnfield, Winn Parish. Hand specimens of this limestone sent to the Survey are of a dense, subcrystalline, bluish limestone, gashed and seamed with white calcite veins from the thickness of a knife blade up to three-fourths of an inch. The material makes a good crushed stone for ballast, macadam, and concrete. An analysis published in Mineral Resources for 1911 shows nearly 92 per cent calcium carbonate.

Directory.—The limestone quarry operating in Louisiana is indicated on Plate IV, as follows:

Directory of stone quarries in Louisiana.

LIMESTONE.

Winn Parish: 1. Winnfield.

OKLAHOMA AND TEXAS.

The sedimentary rocks of Oklahoma and Texas include representatives of most of the systems from the Cambrian to the Tertiary, and there are four areas of intrusive rocks where granites occur—two in southern Oklahoma, one in central Texas, and one in western Texas—besides areas of various igneous rocks in western Texas. Hard rocks of Paleozoic age underlie nearly all of Oklahoma, except the "Panhandle," and extend well into north-central Texas. Tertiary rocks of the Great Plains underlie the Panhandle of Oklahoma and the western part of Texas as far south as Pecos River. On the Gulf coast of Texas are sand and clay of Quaternary age, with three parallel belts of Tertiary rocks of different stages of deposition lying farther inland, while still farther in the interior, or extending in a northeast-southwest direction across central Texas and beyond Red River into southeastern Oklahoma, are two belts of Cretaceous rocks. Rock is quarried from all the systems except the later Tertiary of the Great Plains area and the Quaternary deposits of the Coastal Plain, and the distribution of the quarries is shown in Plate V.

OKLAHOMA.

Oklahoma is particularly well supplied with a great variety of stone widely distributed about the State. Granite, marble, sandstone, and limestone are produced, and lime is burned. A fairly detailed report, illustrated by maps, has recently been published, which gives much information in regard to the stone resources of this growing State.[1]

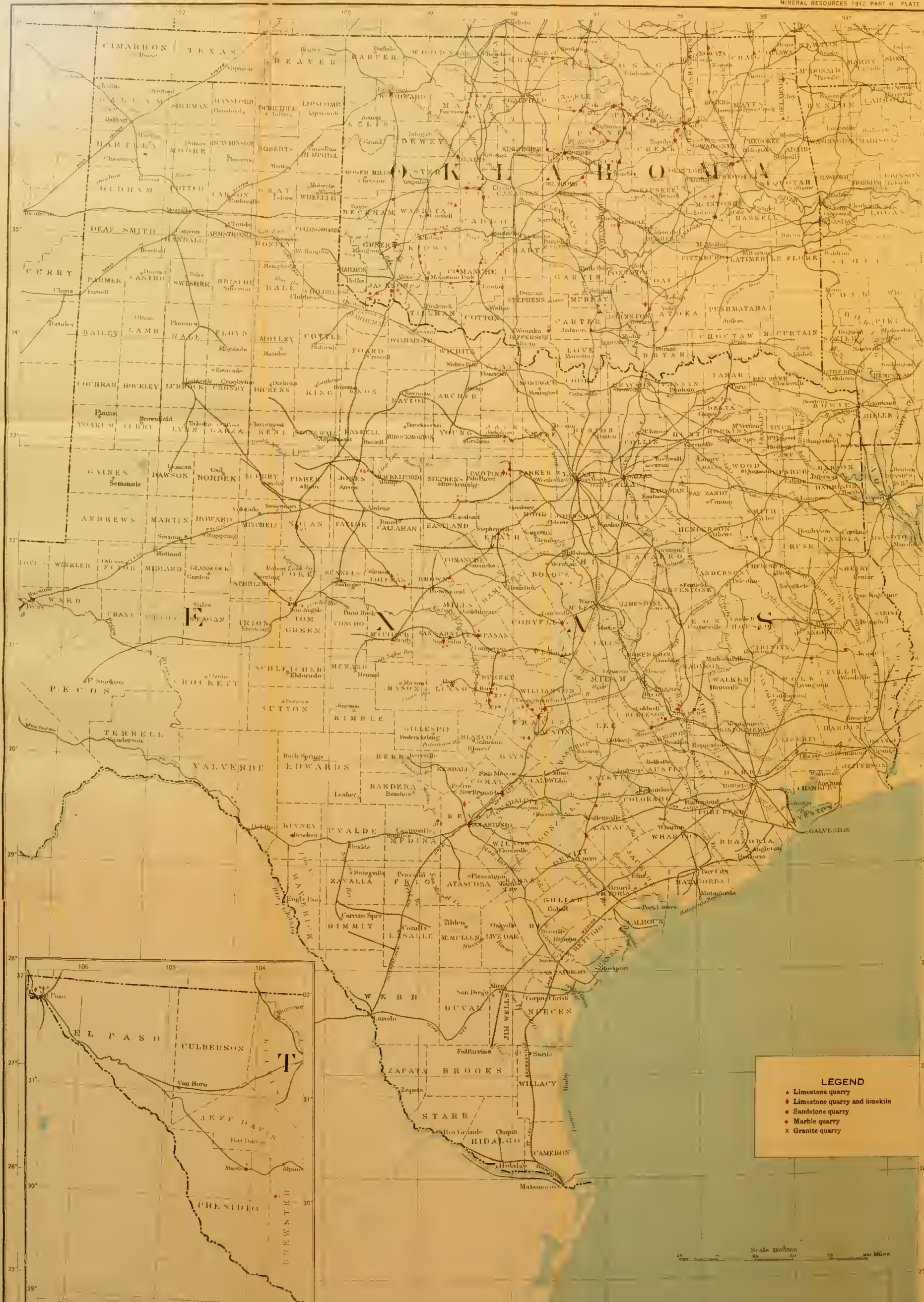
Granite.—Granite and associated igneous rocks occur in two areas in Oklahoma, viz, in the Arbuckle Mountains in the southern part of the State, in Johnston, Atoka, and Murray counties, and in the Wichita Mountains in the southwestern portion, mainly in Kiowa, Greer, Jackson, Swanson, and Comanche counties.

In the Arbuckle Mountains granite occurs in three areas, comprising together more than 100 square miles. The granitic rock in all these areas is considered to be of pre-Cambrian age. This granite is, in general, a coarse-grained, pink rock, and is penetrated in many directions by dikes of basic rock. Other rocks associated with the granite are granite porphyry and aporhyolite. Six quarries have reported production recently from this area, four near Tishomingo and two near Troy.

In the Wichita Mountains intrusive rocks of pre-Cambrian age occur in several separate areas. These rocks consist of granite of various types—rhyolite, quartz monzonite, quartz diorite, diorite, diabase, gabbro, and anorthosite. The character and geologic relations of these rocks are described in a Survey publication.[2] Granite

[1] Gould, C. N., and others, Preliminary report on the structural materials of Oklahoma: Bull. Oklahoma Geol. Survey No. 5, 1911, 182 pp.

[2] Taff, J. A., Preliminary report on the geology of the Arbuckle and Wichita Mountains: Prof. Paper U. S. Geol. Survey No. 31. 1904.



MAP OF OKLAHOMA AND TEXAS

Showing location of limekilns and quarries of limestone, sandstone, marble, and granite

Prepared under the direction of E. F. Burchard

is the principal mountain-making rock in this region. It varies in color from light pink to dark red, and from fine grained to moderately coarse grained. Granite is quarried in Comanche, Greer, and Kiowa counties in the Wichita Mountain area, in a total of 12 quarries.

Sandstone.—Gould makes the following interesting statement concerning sandstone in Oklahoma:[1]

> Sandstone is the most widely distributed building stone in Oklahoma. There is scarcely a county in which it does not occur in quantity, and in most counties it is by far the most abundant building stone. In general, eastern Oklahoma contains a gray or light-brown sandstone; western Oklahoma, red sandstone; while the southern part of the State contains a black or dark-brown stone.

The sandstone in eastern Oklahoma belongs principally to formations of Pennsylvanian age, like that of eastern Kansas, although there is at least one active quarry in Mississippian rocks in Ottawa, the most northeastern county of the State. In western Oklahoma the sandstone belongs principally to the "Red Beds" of Permian age. Although at present comparatively little of this red sandstone is used, many of the earliest structures of the former Territory of Oklahoma were constructed of this stone. There is also sandstone in the Cretaceous area of southeastern Oklahoma, dark red to black in color and rather hard, that is reported to have been quarried for local use. There are about 45 active quarries of sandstone in Oklahoma, distributed over 24 counties.

Limestone.—Limestones of several different ages occur in Oklahoma. The earliest rocks are those of the Cambrian, Ordovician, and Silurian systems which have a total thickness of nearly 8,000 feet, and make up a large part of the Arbuckle Mountains and the northern foothills of the Wichita Mountains. The lowest of these, the Arbuckle limestone, consists of limestone and dolomite of Cambrian and Ordovician age. It is 4,000 to 6,000 feet thick, and samples from the lower part and from the upper 600 or 700 feet have been tested for magnesia and lime, and showed a very small percentage of magnesia. Probably 2,000 feet of massive beds in the middle part of the formation are highly magnesian. The Viola limestone, of Ordovician age, 500 to 700 feet thick, outcrops in a belt about the border of the Arbuckle Mountains and in small areas in the central part. It also occurs in three small hills near Rainy Mountain Mission, in the Wichita Mountains. This formation contains local deposits of chert, but samples taken from the Arbuckle Mountain area show it to contain very little magnesia. It is fine textured and generally hard. Still higher lies the series of Silurian and Devonian limestones which have been called "Hunton limestone," but which are now differentiated into several formations. They have an average thickness of about 200 feet, and vary in physical character and composition. A massive bed at the base is in places almost pure white limestone; in other places it is in large part siliceous. Toward the middle, beds of clay and "marl" are interstratified with the limestone. Near the middle the beds contain a small amount of magnesia, and toward the top local segregations of chert are found. Like the Viola limestone these limestones outcrop around the borders of the Arbuckle Mountains in a narrow belt, besides occurring in many small areas in the central part of the uplift. In northern Oklahoma are a few belts of Carboniferous lime-

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[1] Gould, C. N., op. cit., p. 61.

stone, continuations of the areas which are so important in Kansas. These limestones thin out and disappear to the south, and are of workable thickness only in the northern part of the State. Other thin-bedded limestones of Carboniferous age occur in eastern Oklahoma and extend into Arkansas north of the Boston Mountains. Along the southern edge of the coal field outcrops a long lentil of Mississippian limestone, the Wapanucka, which attains in places a thickness of nearly 300 feet. The eastern end of this belt extends nearly to the Arkansas line on the north flank of the Wichita Mountains, and the western end reaches the Arbuckle Mountains. Gould[1] considers that the Wapanucka limestone is the most valuable limestone in the State for general utility. Near Bromide the stone is white and oolitic, and makes an excellent building stone, the ledge being 50 to 70 feet thick. At Wapanucka and Hartshorne this stone is burned into lime; at Limestone Gap it is crushed for ballast and concrete; and at Hartshorne it is soon to be used as Portland cement material. Cretaceous limestones occur in the southern part of the State, and several distinct formations are associated with limy clays. These limestones are mostly soft, thin bedded, and of various shades from light blue to white. The lowest bed is massive, white, and generally homogeneous.

Gould[2] discusses the limestones of Oklahoma according to six separate areas: Northern Oklahoma, the Ozark uplift, the Wapanucka limestone area (in southeastern Oklahoma), the Cretaceous area (south of the Wapanucka area), the Arbuckle Mountains area, and the Wichita Mountains area. In his discussions and in his maps Gould appears not to have included limestones that, according to reports to the Survey from producers of stone and lime, outcrop in Major, Dewey, Blaine, northern Kiowa, Greer, and Jackson counties, and which are apparently in the area of Permian rocks.

Limestone has been quarried recently in 27 counties of Oklahoma from a total of 67 quarries, 10 of which quarries produced stone for lime. Building stone constitutes a large item in the value of the limestone output, but the output of crushed stone is valued at a higher figure than all the rest of the limestone product.

Marble.—One deposit of true marble has been discovered in Oklahoma. It is exposed at several localities along Sallisaw Creek, in Sequoyah County. Its color ranges from pure white to pink and in places it is mottled. This deposit is near the Mississippian-Pennsylvanian geologic boundary, but is probably within the Mississippian area.

This marble has been quarried near Marble City, and most of the product used for building stone, some of it in the construction of buildings in Oklahoma City.

Production.—The total output of stone in Oklahoma in 1912 was valued at $429,788, a decided decrease compared with the value of the 1911 output which exceeded $700,000. In 1912 the production of each class of stone was valued as follows: Granite, $14,460; sandstone, $5,334; limestone, $409,994; and the State ranked thirty-second as a stone producer, as compared with twenty-ninth in 1911. A large part of the stone quarried in 1911 was for ballasting railroads, most of which work was discontinued before 1912.

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[1] Op. cit., pp. 77–78.

[2] Op. cit., pp. 72–83.

Directory.—Quarries of all the kinds of rock quarried in Oklahoma are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Oklahoma.

GRANITE.

Comanche County: 1. Lawton.
Greer County: 2. Granite (6).
Johnston County:
3. Tishomingo (4).
4. Troy (2).
Kiowa County:
5. Cold Springs (2).
6. Mountain Park (2).
7. Roosevelt.

MARBLE.

Sequoyah County: 1. Two miles from Marble City (2).

SANDSTONE.

Beckham County: 1. Elk City (2).
Blaine County: 1a. Near Hydro, Caddo County. (See No. 4 below.)
Caddo County:
2. Bridgeport.
3. Hinton.
4. Hydro.
Creek County: 5. Sapulpa.
Grant County: 6. Deer Creek (2).
Jackson County:
7. Creta.
8. Olustee.
Jefferson County: 9. Cornish.
Le Flore County: 10. Heavener.
Lincoln County: 11. Kendrick.
Logan County:
12. Crescent (2).
13. Guthrie.
McIntosh County:
14. Eufaula.
15. Checotah (2).
Muskogee County: 16. Muskogee (2).
Noble County: 17. Perry (2).
Oklahoma County: 18. Luther.
Osage County: 19. Pawhuska (2).
Ottawa County: 20. Miami (3).
Pawnee County:
21. Cleveland (2).
22. Pawnee.
Payne County:
23. Cushing (2).
24. Stillwater.
25. Yale (2).
Pottawatomie County: 26. Maud.
Rogers County: 27. Oologah.
Tulsa County: 28. Tulsa.
Wagoner County: 29. Tullahassee.
Washita County: 30. Cordell (2).
Woodward County: 31. Woodward.

LIMESTONE AND LIMEKILNS.

Atoka County: 1. Caddo (nr.).
Coal County: 2. Bromide (2).
Dewey County: 3. Butte (R D from Fay)
Delaware County: 4. Grove.
Johnston County: 5. Wapanucka.
Nowata County: 6. Lenapah.
Pawnee County: 7. Hallett.
Tulsa County: 8. Lost City (2).

LIMESTONE.

Atoka County: 1. Chockie.
Blaine County:
1a. Canton.
2. Geary.
Caddo County: 2a. Cement.
Carter County: 3. Ardmore.
Craig County: 4. Bluejacket.
Comanche County:
5a. Cache.
5. Lawton.
5b. Meers.
6. Richards (2).
Delaware County: 7. Kansas.
Greer County: 7a. Mangum.
Jackson County:
8. Creta.
8a. Near Eldorado.
9. Olustee (2).
Kay County:
10a. Chilocco.
10. Newkirk (4).
11. Ponca City (3).
12. Uncas (7).
Kiowa County:
13. Gotebo.
14. Hobart (3).
14a. Komalty.
Logan County: 15. Guthrie.
Major County:
16. Cleo.
16a. Fairview.
Murray County:
17. Crusher (2).
18. Dougherty.
Muskogee County: 18a. Muskogee (2).
Noble County: 19. Perry.
Pawnee County:
20. Cleveland.
21. Pawnee (2).
Payne County: 22. Ripley.
Pittsburg County: 23. Hartshorne (2).
Pontotoc County: 24. Fitzhugh.
Tulsa County:
25. Garnett.
26. Tulsa.
Washington County: 27. Dewey.
Washita County: 28. Colony.

TEXAS.

The quarry map (Pl. V) shows that the greatest development of quarries has taken place in a broad area extending from the Oklahoma line southward through the middle portion of the State to about the latitude of San Antonio. The quarries in this region (except those of granite) fall mostly within the areas underlain by Cretaceous rocks at the east, Pennsylvanian in the middle, and Permian beds at the west. Outside of this region, however, there are a few quarries in the marine Tertiary deposits in the eastern part of the State and in the intrusive and metamorphic rocks in western Texas. A small area of Cretaceous rocks near El Paso furnishes limestone for lime and cement. The sparseness of the quarries as compared with their distribution in more thickly settled States is well brought out by the map.

Granite.—Granite occurs in two widely-separated parts of Texas. One is in central Texas, the other in the west or trans-Pecos Texas. The pre-Cambrian granite area in central Texas has been the subject of study by Spencer and Paige, and the latter has published a report in which the granites receive much attention.[1]

Paige also contributed the following statement on granite to an earlier report:[2]

Granite occurs in great abundance in the pre-Cambrian complex of Llano and Burnet counties, Tex. Many large areas exist where pure, clean stone can be found. Many areas exist also where the granites are mixed with fragments of the schists which they have intruded. The opening of quarries in areas characterized by this latter condition is always a more or less hazardous undertaking, for though an area may be selected which seems quite sufficient to form a workable quarry floor, no assurance can be had that the rock will continue clean in depth. A number of such quarries have been opened in Llano County, and the experience of quarrymen has shown that much care must be exercised to avoid such mixed zones. The desire to obtain a stone easily worked has been one of the factors leading to the selection of such localities, for clean rock in areas where it was very little altered has been reported to be too hard to be desirable by the monument workers. Why the stone should be softer in these mixed areas is not known.

Though there are at present in this region many varieties of stone, a rough classification may be made into (1) a coarse-grained pink variety, (2) a fine to medium grained gray variety, and (3) a fine to medium grained pink variety.

The first has been most extensively quarried at Granite Mountain, Burnet County. * * * Llano County * * * has produced stone of this character.

Of the fine to medium grained varieties the gray is far more abundant. In many places granite that is pink on the surface will prove gray in depth. There do exist, however, in this region pink granites of fine to medium grain.

The coarse-grained granite of southwestern Llano County will probably some day be utilized. There is an almost unlimited quantity of this stone.

Facilities for shipment undoubtedly vitally affect the Llano County granite industry. With increasing growth of the large cities in the South and with additional railroads there should be established a more profitable and extensive industry than exists at present. Though now the larger part of the rock is used for monumental purposes, there is much granite eminently suited for large structures if means of shipment were better and a more active market available. * * * The construction of the Galveston jetty has provided one of the largest markets for rough and crushed stone.

The State capitol at Austin was also built of red granite from Granite Mountain.

In trans-Pecos Texas quarries have been opened in Brewster and El Paso counties. According to Dumble,[3] the granites of trans-Pecos

[1] Paige, Sidney, Mineral resources of the Llano-Burnet region, Texas, with an account of the pre-Cambrian geology: Bull. U. S. Geol. Survey No. 450, 1911, 103 pp.

[2] Burchard, E. F., Structural materials available in the vicinity of Austin, Tex.: Bull. U. S. Geol. Survey No. 430, 1910, pp. 299-303.

[3] Dumble, E. T., Building stones of Texas: Stone, vol. 5, 1892, pp. 566-567.

Texas are well suited to building and ornamental purposes. They are, for the most part, light or dark gray in color. Certain areas are near the Southern Pacific Railroad in the Quitman and Franklin mountains. Porphyries of almost every color also are abundant in trans-Pecos Texas, and many of them should prove beautiful and durable building stones.

In all about 25 quarries have reported production of granite in 4 Texas counties. Building stone and concrete afford the principal markets for Texas granite.

Sandstone.—Sandstone available for quarrying in Texas is found principally in rocks of Pennsylvanian and Tertiary age, although the Cambrian and Ordovician, as well as the Permian, contain sandstone which has been quarried locally. Most of the sandstone output of the State is used for concrete. Fifteen quarries in 12 counties produce sandstone in Texas. When the value of the output of sandstone as compared with the population of Texas and the areas of available rock are considered, there is still room for the development of many quarries so situated as to reduce the freight rates on stone in many building centers.

Limestone.—Limestone occurs in practically all the systems of rocks that contain sandstone, and in addition, the Cretaceous of central Texas, consists very largely of limestone. The principal area of Cretaceous rocks in Texas occurs as a wide belt extending southward across the central part of the State from Red River to the Rio Grande. The cities of Sherman, Dallas, Fort Worth, Waco, Austin, and San Antonio are located on this belt. A railroad either follows or parallels this belt of Cretaceous rocks, and many railroads cross it. Two divisions of the Cretaceous system contain limestone deposits of remarkable purity. These are the Austin chalk and the limestones of the Fredericksburg group (Goodland limestone to the north and Edwards limestone and Comanche Peak limestone to the south). The Austin chalk is a massive white, friable, chalky limestone. It is several hundred feet thick and carries from 70 to 90 per cent of carbonate of lime and generally less than three-fourths of 1 per cent of magnesium carbonate. The silica is variable, and in places increases in quantity as the lime carbonate decreases. The limestones of the Fredericksburg group are situated west of and generally parallel to the outcrop of the Austin chalk. They occur in large areas in Wise, Parker, Hood, Erath, Bosque, Hamilton, Coryell, Lampasas, Burnet, Blanco, Kendall, Comal, and Bexar counties. Large areas are exposed in the Edwards Plateau west of San Antonio. North of the Brazos River valley they are represented by the Goodland limestone, a massive, semicrystalline, white limestone, 30 to 50 feet thick. From the Brazos River valley southward they gradually increase in thickness, reaching 300 feet on Colorado River. In central Texas the lower part is a massive, white chalky limestone nearly 100 feet thick (Comanche Peak limestone), and the upper part is composed of thick beds of nearly pure chalky and siliceous limestone beds alternately stratified (Edwards limestone). These siliceous beds contain quantities of nodular and almost pure flints.

In the article referred to above, published after an investigation had been made of the local structural materials which might be used in the construction of a Federal building at Austin, the writer described certain of the limestone formations as follows:[1]

In the immediate vicinity of Austin there are several limestone formations belonging to the Cretaceous system that contain beds suitable for building stone. The lowest formation, stratigraphically, is the Glen Rose limestone. Above this formation, and separated from it by formations of clay and chalky limestone, is another extensive formation known as the Edwards limestone. Overlying the Edwards limestone are the Georgetown and Buda limestones, which are separated from each other by a bed of clay—the Del Rio clay. All these limestones belong to the Lower Cretaceous. In the Upper Cretaceous there is one extensive formation—the Austin chalk—which has yielded stone for building purposes.

The Glen Rose limestone underlies the plateau country northwest of Austin and forms the canyon of Colorado River, beginning about one-half mile above the city dam site and extending up the river for about 20 miles. It is well exposed in the river bluffs of Mount Bonnel and Mount Barker, in the canyons of Dry Creek and Bull Creek, and on the ridge between these creeks. The total thickness of the formation is about 450 feet. It consists principally of alternating hard and soft limestone beds of varying texture. Many of the beds are chalky and some are argillaceous. Occasionally a sandy phase of the rock may be noted, and in few places shaly layers are present. The hard beds are generally compact, but ledges of coarse, honeycombed stone have been noted. The rock is mostly cream-colored, with some white and gray layers and here and there a yellowish layer. The thickness of the individual beds ranges from a few inches to about 10 feet or more. Many of the beds are fossiliferous and some of the fossils are large and abundant. Some of the beds are slightly oolitic. There appears to be a small proportion of iron oxide and magnesia disseminated throughout the formation, as is indicated by the light-buff or yellow color to which certain of the beds weather on exposure.

About 7 miles by wagon road northwest of the post office at Austin there are some small quarries in the Glen Rose limestone. * * * The highest opening is in a fairly hard, even-grained, fine-textured, slightly oolitic limestone. The rock contains many small fossils, most of which are in a fragmental state. When fresh this stone shows small buff to yellowish specks of iron oxide, which give the stone, in mass, a light-buff tint; but this tint becomes lighter after the stone is thoroughly dry. The rock is horizontally bedded and the best ledge ranges from 10 to 14 inches in thickness. The joints are not numerous in the rock, and slabs 3 to 5 feet in length and width may be obtained. Stone from this particular ledge possesses the hardness requisite to receive and hold a tool finish, and it is unfortunate that the ledge is not thicker. In the opinion of local stone masons, however, it is not necessary to lay this stone on its bed, and of course if it can be successfully laid on its edge stones cut from it can be faced in large dimensions. This ledge has been quarried for several hundred feet along the outcrop, where little or no cover had to be removed, and by the removal of a thickness of 2 or 3 feet of thin-bedded stone, débris, etc., an important supply of this stone might be uncovered. Between 60 and 100 feet lower down on the same hillside are softer beds of a finer texture and somewhat lighter color, which have been quarried to a larger extent. The softer stone is more easily worked and may be sawed by hand. It is capable of being tooled in the same manner as the harder stone, but probably will not prove as durable. * * * Sufficient work has been done to demonstrate that a large supply of stone is available there. On the opposite or northwest side of Dry Creek valley are quarries * * * in rocks of the same horizon as those opened * * * on the southeast slope. The hard ledge at the top barely exceeds a thickness of 10 inches here. The lower ledge of softer rock ranges from 18 to 22 inches in thickness, but it is overlain by 15 inches of cherty limestone, which must be removed in order to get the material suitable for building stone. The principal drawback to working these stones on a large scale has been the distance that they must be hauled to the railroad or to the city. The road passing north of Mount Bonnel is well kept, but has a steep grade close to Dry Creek. * * *

The Edwards limestone outcrops along Colorado River a short distance above and below the city dam site, and its outcrop extends and widens to the southwest of Colorado River and to the north of Austin, west of the International & Great Northern Railway. It is composed mostly of limestone, with some marly layers. In general the beds are whitish, but layers of buff, cream, yellow, or dull gray, and even brownish yellow, are present. In composition many of the beds are nearly pure carbonate of lime. The limestones vary greatly in degree of induration, ranging from hard, ringing,

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[1] Burchard, E. F., op. cit., p. 293.

durable rock to soft, friable chalk. Some of the beds are coarsely crystalline, with well-preserved fossils, and are capable of being highly polished. Other beds are close grained. Some of the beds are very compact; others are porous and pervious. For building purposes only the compact varieties are of importance, and since there is some variation in the texture of the same bed it is important in prospecting to open up a sufficient space to prove that the bed is homogeneous in texture for some distance. One deleterious feature of the Edwards limestone as regards its suitability for building purposes is the presence of great quantities of chert or flint, which occurs in nodules and sheets of thin, flat lenses. These flints vary in dimension from 2 inches to a foot or more. Fossils are abundant in many of the beds of the Edwards limestone, and these fossils are determined in some places where it is desired to secure a stone to be tool faced. If the stone is used as rubble the presence of fossils is not so objectionable. The thickness of the Edwards limestone is probably about 300 feet.

On the northeast side of Colorado River 2 or 3 miles west of the post office at Austin * * * are several old abandoned quarries in very hard limestone, which is considered to belong in the upper part of the Edwards limestone. One bed in this vicinity is composed of a mass of large fossil shells, which have been almost entirely replaced by calcite. This stone has a white chalky color on fresh fracture, and in places it is tinted cream-yellow and pale pink. It is susceptible of high polish, and when polished makes a beautiful stone for interior purposes; on this account it has been called the "Austin marble." It is not at present commercially utilized for decorative purposes, but has been largely used as rubble, as may be seen in the facing of the foundation of the present Federal building at Austin. Close to these fossiliferous beds are beds of hard light-gray fine-grained limestone, containing only a few fossils. The stone contains numerous crystals of calcite scattered here and there through the mass, and occasionally a slight stain of iron oxide may be noted. The bed most suitable for cut-stone work is about 14 inches thick, and there are a number of other beds from 6 inches to 1 foot in thickness. Stone of this character * * * was used in the facing of the present post-office building above the foundations. The rock was tool faced and has withstood the 30 years' exposure to the weather exceedingly well. In January, 1910, the stone appeared to be almost white in color, but it is understood that the building has been cleaned by rubbing two or three times since it was completed, the last cleaning having been done within the past three years. * * * About * * * three-fourths of a mile below the dam site is an abandoned quarry in very hard, coarsely crystallized gray limestone, which occurs in massive beds 2 feet or more thick. Little of this stone is available without considerable stripping, but the stone is very durable and of a pleasing color and texture.

At Oak Hill, about 7 miles southwest of Austin, * * * there occurs a very hard limestone, either in the basal part of the Edwards limestone or in the upper part of the Glen Rose limestone, that is reported to have been used in the foundations of the capitol at Austin.

The most extensive working quarries of building limestone in the vicinity of Austin are at Cedar Park, on the Houston & Texas Central Railroad, about 27 miles northwest of Austin. This rock, which is here provisionally referred to the Edwards limestone, outcrops or lies below only a few inches of soil over a large area of the divide between Colorado and San Gabriel rivers, west of the Houston & Texas Central Railroad. It is quarried at three places, west and northwest of the station of Cedar Park, * * *, and is hauled to the railroad at Cedar Park and to Leander. The rock that is quarried consists almost entirely of calcium carbonate, and is soft enough when freshly quarried to be cut with a handsaw. When fresh and containing quarry moisture the rock is decidedly cream colored. When removed from the quarry it soon dries to light gray or nearly to white. After weathering it becomes of a light cream to light buff color. The rock is compact, fine grained to subcrystalline, and in places slightly oolitic. The beds are massive and show no stratification within 6 or 7 feet of the surface, the maximum depth to which the rock has been opened by working. The rock that is quarried is slightly fossiliferous, and it is reported that below the portion that is quarried fossils are so numerous as to render the stone less desirable. The rock has a metallic, bell-like ring in large blocks, especially when dry. It is reported to weigh 150 pounds per cubic foot and to withstand a crushing strength of about 2,960 pounds per square inch. Relatively, therefore, this rock is not very hard or strong, but it appears suitable for building purposes in the dry climate of central and southwest Texas, where it has been used probably more than any other of the local stones, both for facing and for sills, caps, water tables, columns, and other exterior trimmings. * * * The stone is stripped by scrapers and by hand and is quarried by channeling to depths of 5 to 7 feet, boring under the blocks by hand augers, and then wedging them up. The quarries * * * consist of irregularly shaped pits about 300 feet long. The rock is handled by derricks and hauled by wagon to the railroad in mill blocks. The only limitation to the size of blocks obtainable lies in the facilities for lifting and transporting the stone. The stone is so easily cut and dressed on the job that the quarrymen do not attempt to produce dimension stone. * * * It is reported that the stone at Cedar Park has been used in Federal buildings at Gainesville and Laredo, Tex.

The Austin chalk occupies a northeast-southwest belt from 2 to 5 miles wide, within which is the city of Austin. This formation has been traced from a point north of Dallas to one southwest of San Antonio and is very similar in character throughout its extent. The rock is a white chalky limestone of fine to coarse texture and occurs in beds of varying thickness, separated in places by friable beds of marl. When fresh and impregnated with ground water the chalk has a bluish tint, but it usually bleaches white when dry and in places shows slight blotches of yellow from the oxidation of specks of iron pyrite. Fossils are abundant in places in the Austin chalk and range from the shells of Foraminifera and other minute organisms to large Inoceramus, oyster shells, and ammonites. The Austin chalk may be some 500 feet thick, and for the most part its beds are very poorly indurated. In all localities noted the hardest beds were softer than the stone at Cedar Park described above. One sample of stone, which is very fine grained, homogeneous, of a light cream color, and susceptible of a smooth rubbed finish, was produced * * * about 7 miles southwest of Austin, about one-fourth mile from the International & Great Northern Railroad.

Limestone has been produced from 64 quarries in Texas within the last three years, 29 of which produce stone for lime. These quarries are distributed among 31 counties. By far the greater part of the output of limestone not used for making lime is sold as crushed stone for macadam, ballast, and concrete.

Marble.—True marble is found in Mason County, central Texas, and in several counties of trans-Pecos Texas, and beds of crystalline limestone susceptible of a good polish are found in many other parts of the State. Dumble[1] states that among the true marbles of Mason County are beds that are snowy white and of even grain. From the Carrizos to the Quitman Mountains outcrops of fine-grained marble occur in the vicinity of the railroad, and include white as well as banded and clouded varieties. Bluish limestone probably of Lower Ordovician age outcropping at Marble Falls, Burnet County, is of a dense subcrystalline character, and will doubtless take a good polish. Other varieties of nonmetamorphosed marble are reported to occur elsewhere in Burnet County, and in Llano, San Saba, Gillespie, and other counties, and many of them are well adapted for interior decorative purposes. Certain quarries in areas of Cretaceous and Tertiary rocks, remote from any intrusive rocks, report the production of marble which is in reality limestone susceptible of receiving a good polish. The fossiliferous Cretaceous limestone at Austin, known locally as the "Austin marble," already referred to, is to be classed as such.

Reports of the production of marble within the last two or three years have been received by the Survey from 5 quarries in as many counties in Texas, but no production was reported in 1912.

Production.—Texas is reported to have produced in 1912 stone valued at $680,365 at the quarries, and to have ranked thirtieth as a stone producer in the United States. The value of the output was distributed as follows: Granite, $67,613; sandstone, $82,501; limestone, $530,251. In 1911 the total value of the stone output was $588,777, and the State then ranked thirty-first as a stone producer.

Tests of Texas building stone.—The results of a number of tests made on several varieties of Texas building stone, compiled by the writer may be of interest here:

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[1] Dumble, E. T., op. cit., p. 567.

Results of tests of Texas building stones.[a]

No.	Material.	Location.	Dimensions.			Compressive strength.			Percentage of absorption.	Specific gravity.	Weight per cubic foot.
			Height.	Cross section.	Area of cross section.	Pressure at which it cracked and spalled.	Pressure at which it crushed.	Crushing strength per square inch.			
			Inches.	*Inches.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*			*Pounds.*
1	Limestone	Austin (court-house stone)	4	2.25 by 2.25	5.027	17,200	17,200	3,422	0.068	2.1616	134.76
2	Do	Duval, Gault quarry	4	2.20 by 2.25	4.95	28,300	31,200	6,303	.031	2.3915	149.09
3	Do	8 miles from Austin, Hancock quarry	4	2.37 by 2.37	5.617	12,000	12,800	2,279	.058	2.1794	135.86
4	Limestone (fossil)	Austin, Loomis & Christian quarry	4	2.28 by 2.25	5.13	22,300	42,100	8,207	.011	2.5992	162.03
5	Limestone	Burnet County, Honey Creek	4	2 by 2	4	35,000	59,800	14,950	.0004	2.7057	168.67
6	Do	12 miles south of Austin, Slaughter Creek	4	2 by 2	4	....	80,115	20,029	.0623	2.25	....
7	Do	do	4	2 by 2	4	....	58,180	14,545	.0597	2.278	....
8	Do	do	4	2 by 2	4	....	79,000	19,750	.0655	2.251	....
9	Do	do	4	2 by 2	4	....	81,280	20,320	.0092	2.588	....
10	Do	13 miles south of Austin, Bear Creek	4	2 by 2	4	....	29,365	7,341	.0899	2.119	....
11	Do	do	4	2 by 2	4	....	49,020	12,255	.0845	2.153	....
12	Do	do	4	2 by 2	4	....	40,040	10,010	.0554	2.265	....
13	Do	do	4	2 by 2	4	....	29,220	7,305	.0589	2.248	....
14	Do	Cedar Park	1	1 by 1	1	2,300	2,300	2,300	.021	3.47	157.87
15	Do	Round Rock	1	1 by 1	1	1,495	1,495	1,495	.1205	3.26	144.77
16	Do	McLennan County	1	1 by 1	1	3,180	3,180	3,180	.0573	2.97	158.49
17	Do	Lueders, Jones County	1	1 by 1	1	2,487	2,487	2,487	.0474	2.91	160.37
18	Marble	Burnet County, Fort Croghan quarry	4	2.27 by 2.24	5.0848	69,290	70,080	13,782	.0039	2.679	166.99
19	Marble (pink)	San Saba County	1	1 by 1	1	5,100	10,330	10,330	.0062	2.81	166.7
20	Marble (black)	Brewster County, Jordan quarry	1	1 by 1	1	....	10,420	10,420	.0016	2.74	170.35
21	Marble (white)	do	1	1 by 1	1	....	3,784	3,784	.0021	2.10	130.41
22	Sandstone	Fairland, Burnet County	1	1 by 1	1	2,800	4,450	4,450	.0601	2.91	154.75
23	Sandstone (gray)	Moulton, Lavaca County	1	1 by 1	1	2,100	2,400	2,400	.0941	2.81	149.76
24	Sandstone (red)	Ward County	1	1 by 1	1	1,900	2,000	2,000	.0738	3.04	156
25	Granite (red)	Burnet County	4	2 by 2.11	4.22	49,900	50,180	11,891	.0009	2.625	163.64
26	Do	Llano County, Teich quarry	1	1 by 1	1	9,600	11,990	11,990	.0028	2.64	163.49
27	Granite (gray)	do	1	1 by 1	1	10,900	11,950	11,950	.0028	2.69	165.98
28	Do	Llano County, Bradshaw quarry	1	1 by 1	1	7,970	10,060	10,060	.0021	2.70	167.23
29	Granite (light-gray)	Burnet County, Ueberall quarry	1	1 by 1	1	8,310	9,340	9,340	.0021	2.76	170.97
30	Granite (dark-gray)	do	1	1 by 1	1	10,650	10,880	10,880	.0021	2.95	182.83
31	Granite ("opal")	Llano County	1	1 by 1	1	11,800	15,300	15,300	.0036	2.67	164.73
32	Granite	Presidio County	1	1 by 1	1	7,220	15,970	15,970	.0073	2.67	163.49
33	Serpentine	Gillespie County, 35 miles south of Llano	1	1 by 1	1	8,400	8,950	8,950	.0079	2.61	159.74

[a] Nos. 1 to 13, 18, and 25 were tested by Col. D. W. Flagler at Rock Island Arsenal, October, 1881, and the data published in the report of the Texas Capitol Building Commissioners, 1883. Nos. 14 to 17, 19 to 24, and 26 to 33 were tested at the engineering department, University of Texas, and the data published by Dr. W. B. Phillips, of the University of Texas, in the Mining World, June 24, 1905.

Directory.—Quarries of all the kinds of rock quarried in Texas are listed below by class of rock, county, and town (or post office).

Directory of stone quarries in Texas.

TEXAS.

GRANITE.

Brewster County: 1. Marathon.
Burnet County:
2. Burnet.
2a. Fairland.
3. Granite Mountain.
3a. Marble Falls (2).
El Paso County: 4. El Paso (3) (also Sunset Heights).
Llano County:
5. Kingsland (2).
6. Llano and vicinity (11).

MARBLE.

Brewster County: 1. Cathedral (near Alpine).
De Witt County: 2. Yoakum.
Kinney County: 3. Brackettville.
Presidio County: 4. Marfa.
San Saba County: 5. San Saba.

SANDSTONE.

Burleson County:
1a. Sand Pit (near Clay).
1. Somerville.
Burnet County: 2. Fairland.
Eastland County: 2a. Ranger.
Fayette County: 3. Muldoon.
Grimes County: 4. Anderson.
Jasper County: 5. Near Rockland, Tyler County.
Lampasas County: 6. Lometa (2).
Lavaca County: 7. Moulton.
Palo Pinto County: 8. Mineral Wells.
Polk County: 9. Stryker.
Tom Greene County: 10. San Angelo.
Ward County: 11. Barstow (2).

LIMESTONE AND LIMEKILNS.

Bexar County:
1. Olga (near).
2. San Antonio (5).
Brown County: 3. Brownwood (2).
Coleman County: 4. Santa Ana (2).
Comal County: 5. New Braunfels.
Coryell County: 6. Lime City.
Dallas County: 7. Dallas (2).
El Paso County:
8. Courchesne.
9. El Paso (4).
Nolan County: 9a. Maryneal.
Palo Pinto County: 10. Mineral Wells.
San Saba County: 10a. San Saba (2).
Tarrant County: 11. Fort Worth (2).
Travis County: 12. McNeil.
Williamson County: 13. Round Rock (3).

LIMESTONE.

Bell County: 1a. Belton.
Cherokee County: 1. Rusk.
Bosque County: 1b. Clifton.
Brown County: 1c. Blanket.
Coleman County: 2. Coleman (2).
Collins County: 2a. McKinney.
Erath County:
3. Dublin.
3a. Stephenville.
Garza County: 3b. Post.
Grayson County: 4. Denison.
Guadalupe County: 5. Schertz.
Jack County:
6. Jacksboro.
7. Stewarton.
Jones County:
8. Clear Fork.
9. Lueders (3).
Kaufman County: 9a. Elmo.
Lampasas County: 10. Lampasas.
McCulloch County: 11. Brady (2).
Navarro County: 12. Richland.
Palo Pinto County: 13. Salesville.
Runnels County: 14. Ballinger (2).
Smith County: 14a. Bullard.
Stephens County: 14b. Near Tiffin, Eastland County.
Tom Greene County: 15. San Angelo.
Travis County: 16. Oakhill (2).
Williamson County:
17. Cedar Park (2).
17a. Leander (2).

MONTANA AND WYOMING.

Montana and Wyoming are supplied with a great variety of rocks since they are in both the Rocky Mountain and the Great Plains areas. The mountain ranges of southwestern Montana and central Wyoming generally have a core of intrusive rocks, much of which is granitic, and on the flanks of the crystalline core lie great thicknesses of sandstone and limestone generally highly tilted and finely exposed for quarrying. Besides the intrusive rocks there are considerable areas of effusive rocks, some of which are suitable for local use, and there are metamorphosed beds including true marbles in the zones of contact between the igneous and sedimentary rocks.

Granite, marble, sandstone, and limestone are quarried in this group of States, although the active quarries of granite are only in Montana. The quarry map (Pl. VI) shows how little developed the quarry industry is in these States. This is, of course, due mainly to the lack of population. With the building of large cities and the assurance of a steady demand for stone, capital will be attracted to the development of the stone resources, but at present many of the well-known building stones of the Central and Eastern States are shipped into this area.

MONTANA.

The eastern fourth of Montana is underlain by continental Oligocene (Tertiary) deposits, as is western North Dakota, and but little good stone can be expected in this area. West of the Tertiary deposits the Cretaceous rocks form a broad area in the northern part of the State, but they narrow where they pass into north-central Wyoming. The Cretaceous area is more or less broken by areas of eruptive rocks and by domes in which older sedimentary rocks are exposed. There are valuable sandstone beds in the Cretaceous, some of which are already being quarried. The northwestern part of Montana is underlain largely by rocks of Cambrian age, and the southwestern part by intrusive rocks, some of them of pre-Cambrian age and others of post-Cambrian age, and the intrusives are flanked by Paleozoic rocks, in part undifferentiated, and in part known to include beds of the Cambrian, Ordovician, Carboniferous, Jurassic, and Triassic systems. The limestone formations are generally of Paleozoic age.

Granite.—Granite outcrops in the Rocky Mountains and in most of the counties to the west. Quarries are at present operated in Gallatin, Jefferson, and Lewis and Clark counties, and according to Rowe[1] has been quarried also in Silver Bow County. The largest quarries are near Helena, some at Baxendale, Lewis and Clark County, and some at Clancy, Jefferson County. The granite obtained at Baxendale is gray, of medium sized, but uneven grain.

Small, fine-grained "knots" or nodules, of a darker color than the main mass of the granite, are found throughout this rock and are detrimental to its use as a monumental stone. This granite is reported to appear best in rock-faced masonry.

The granite at Clancy is a medium dark gray, fairly coarse-grained material, carrying quartz, feldspar, biotite, and pyroxene. The feld-

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[1] Rowe, J. P., Some economic geology of Montana: Bull. Univ. Montana No. 50, Geol. Ser. No. 3, 1908, p. 49.

spars are irregular in size and in places rather large twinned crystals are irregularly scattered through the mass, giving the granite an irregular grained appearance. Hard, dark knots of fine-grained material reaching as much as 2 or 3 inches in diameter are numerous, but it is reported that the rock may be so laid in the walls of buildings as to avoid showing many of the knots. The quarry is reported to be partly in a "bowlder" formation—that is, not to have reached the solid, covered formation—but the bowlder blocks are apparently fresh, clean, and sound when the outside is cut away, and large enough to yield caps and sills 11 or 12 feet long. This granite was used to face the two new wings of the State capitol at Helena under construction in the autumn of 1910, and is shipped to all parts of the State. A large quarry in fairly coarse-grained, black and white granite is operated at Welch, about 17 miles east of Butte.

According to Rowe[1] the granite formerly quarried near Homestake, Silver Bow County, was also used extensively in the large buildings of Butte. The same authority states that the granite in Blodgette Canyon, Ravalli County, a few miles north and west of Hamilton, is probably the best and most abundant granite in Montana. There is much fine, even-grained gray granite, and other ledges are coarser and border on a reddish tinge. All varieties of rock in this section have a high crushing strength. This granite area is about 5 miles from a railroad and a tramway would have a down grade all the way from the quarry.

A reddish-brown tough, easily worked porphyritic rock, used locally for building in Helena, is quarried about 3½ miles southwest of the city. The Power Block, several store fronts, churches, and the new Catholic college building are constructed of it. A greenish porphyritic rock is quarried on the outskirts of Helena for local use as footings and as backing in walls of buildings, but it is too fractured, so far as it has been exposed by quarrying, to be suitable for dimension stone.

Sandstone.—The sandstone deposits of Montana available for quarrying are extensive, and are situated mainly east of the Rocky Mountains in the Cretaceous and Tertiary areas. At present 10 quarries are reporting to the Survey from the following counties: Cascade, Chouteau, Gallatin, and Yellowstone, and according to Rowe[2] quarries have been operated also in Beaverhead, Carbon, Custer, Fergus, and Sweet Grass counties. Probably the best known sandstone is that quarried near Columbus, Yellowstone County. It is of late Cretaceous or early Tertiary age.

The rock outcrops in the bluffs of Yellowstone Valley and a large quarry is operated about 1 mile north-northeast of Columbus. When fresh the rock is rather bright bluish gray in color, but oxidizes to olive-gray. The rock is composed of fine grained angular silica sand, with fine dark carbonaceous specks in thin bands, "leaves," and pockets. Dilute hydrochloric acid shows traces of calcium carbonate in the cementing material. More carbonaceous material shows on the bedding planes than in the mass of the rock. The rock splits freely along all the carbonaceous laminæ and parallel to the bedding planes and breaks fairly well across the bedding. In the quarry oxidation along bedding and joint planes has penetrated the rock from a few

[1] Rowe, J. P., op. cit., pp. 49–50.
[2] Idem, pp. 44–47.

MAP OF MONTANA AND WYOMING

Showing location of limekilns and quarries of limestone, sandstone, marble, and granite

Prepared under the direction of E. F. Burchard

inches to more than a foot. The beds lie nearly horizontal, in layers 6 inches to 5 feet thick, and are cut by nearly vertical joints spaced 3 to 10 feet apart. The stripping is rather heavy here, and although it is a detriment in working the quarry, the abundance of unoxidized stone available is probably due largely to the protective cover of shale and argillaceous sandstone above.

The quarry is well equipped and a sawing and finishing plant is operated in connection with the quarry. The output is used for dimension stone and for heavy masonry, ballast, etc. The stone is shipped to all the cities of Montana, and was used for the original portion of the capitol at Helena.

Another sandstone outcropping in Yellowstone County is quarried at Billings. It belongs to the Eagle sandstone, of Cretaceous age. This rock resembles the stone at Columbus but is softer and is of a buff gray color and occurs at a lower geologic horizon. It has been used in several of the public buildings at Billings.

In Cascade County several quarries have been opened a few miles southeast and southwest of Great Falls in sandstone of Cretaceous age. A buff-gray sandstone quarried 7½ miles southwest of town was used in the Cascade County courthouse and in the Roman Catholic cathedral at Great Falls. A fine-grained pinkish to purplish red sandstone is worked at Eaton, a suburb southeast of Great Falls and also farther from the city and has furnished material for a church and other buildings at Great Falls; and a white to buff-gray silica sandstone quarried 4½ miles southeast of the city is used for rubble, foundations, and as ballast.

In Beaverhead County fine-grained light-gray sandstone has been quarried about 15 miles southwest of Dillon and has been used in Dillon and Salt Lake City. Some of the stone is friable and has been used as flux in one of the copper smelters in Anaconda. Quarries have been opened in Cretaceous sandstone at Red Lodge, Gebo, and Bridger, Carbon County. Sandstone is quarried for buildings in Havre, Chouteau County, at quarries about 4 miles southwest of the town. This bed is of Cretaceous age. In Custer County fine-grained brown sandstone of Cretaceous age is reported to have been quarried a few miles from Miles City and to occur at many other places in the southern and central part of the county. Several quarries in Cretaceous sandstone are reported to have been operated near Lewistown, Fergus County, and to have furnished stone for a number of the public buildings at this place. Several of the best buildings at Big Timber, Sweet Grass County, are reported to have been constructed from sandstone quarried near Big Timber.

Quartzite, an extremely indurated sandstone, is found in many of the mountain counties of Montana. Rowe[1] makes the following statements with regard to certain quartzites of western Montana:

> Beaverhead County has probably the finest colored quartzite in the State, and Missoula County undoubtedly has the largest quantity. This stone, owing to its poor rift and jointing is not much quarried, but the bowlders are used largely in these two counties for retaining walls and foundations. Having pronounced colors, a high crushing power, and being little acted upon by meteoric agents, it is eminently fitted for building purposes.
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> The Dillon (Beaverhead County) quartzite is found about 5 miles from the town and is known as the Rattlesnake or Reservoir region. The stone has a beautiful deep red to pinkish color and is used in Dillon and in Butte for building purposes. The latest

[1] Rowe, J. P., op. cit., pp. 50–51.

large buildings in Butte using this stone are the D. J. Hennessy $30,000 residence on Excelsior Avenue and the handsome residence of Attorney C. F. Kelly on West Park. The retaining wall and foundation of these houses, running 6 or 8 feet above ground, are built of this nicely colored, well-chosen rock. The beautiful home of Attorney Orve Evans on Excelsior Avenue, Butte, is entirely built of this Dillon quartzite. No other stone in Montana is as beautiful, if well chosen, or as durable as the Montana quartzite rock.

The Missoula quartzite is found almost everywhere around the northern edges of Missoula Valley. In some locations the colors are quite pronounced, but no systematic quarrying has ever been done. Most of the houses in the city of Missoula have their foundations made of quartzite, but the stone is hauled, in the shape of bowlders, from Rattlesnake Creek, Pattee Canyon, and near the Maclay ranch, a few miles from town. The rock occurs in large ledges and probably belongs to the pre-Cambrian formation. These deposits will some day be put to good use.

Under sandstone might also be mentioned Tertiary volcanic ash which has been deposited in several of the mountain valleys in the western third of the State. Rowe gives the following notes on this material:[1]

This rock is found in many counties of Montana, but [in] only a few places in the State are the beds coherent enough for building purposes. The rock is a beautiful whitish color, usually very fine grained and in some localities quite solid. Beaverhead, Gallatin, Rosebud, Missoula, and Ravalli counties are the chief producers of this rock in the State. About nine miles northwest of Dillon, Beaverhead County, in the Frying Pan Basin, is located the best volcanic ash building stone in Montana. The bed is from 30 to 50 feet thick and is found on either side of the wagon road running through the basin. The lower portion of the main quarry is composed of soft, white, rather friable ash, while up the creek a hundred or more feet the rock is quite hard, cream colored rhyolite. Many buildings in Dillon are built of this rock, such as the city library and many private residences; the upper foundation, 6 to 8 feet above the surface of the normal dormitories; lower story of the county high school; trimmings and arches of the new public school buildings are other buildings partially built from this stone. Mr. Hight's cottage on Excelsior Avenue, Butte, and a few others, some two stories, on the west side, are good illustrations. The rock does not weather readily, and is very easily quarried and worked. If nonstaining mortar is used it keeps its color well and makes a pretty looking building. It will never be used, however, for the main walls of large buildings.

There are some large deposits in the Bitter Root Valley, near Victor and Stevensville that are quite coherent.

Limestone.—Limestone is found chiefly in the western mountainous part of Montana, where it occurs in great abundance along the flanks of the mountain ranges. In the Plains region, which comprises the eastern two-thirds of the State, the formations are mostly of Cretaceous age, except in the local uplifts of the Little Rock, Judith, and Snowy mountains. The Cretaceous formations contain lenses and concretions of limestone which are available for burning to quicklime. In the mountainous regions the limestones are mainly of Paleozoic age, and the principal limestone-bearing series is the Mississippian, whose massive beds flank the great ranges of the State. Devonian and Silurian limestones are impure and the Cambrian limestones are thin bedded and generally irregular in composition. Limestone beds outcrop along the northern slope of the mountain front from Red Lodge, in Carbon County, westward to Livingston, northward about the flanks of the Bridger, Little Belt, and Belt ranges to the Main Range west of Great Falls. Practically all the southern ranges of the western part of the State are uplifts with cores of gneiss or granite mantled by limestones of various ages. Such rocks occur westward almost to the Bitterroot Valley. Deposits of interesting limestones occur about 5 miles south of Havre. The limestones are

[1] Rowe, J. P., op. cit., p. 51.

notable because the action of igneous intrusions has produced in them considerable wollastonite, a natural lime silicate.

Limestone is quarried in 12 counties in Montana, a total of 23 quarries having been enrolled as producers in recent years. At 12 of these quarries in 8 counties the stone produced was used for the manufacture of lime. (See list of quarries by counties.) Over two-thirds of the value of the limestone output came from sales of stone for flux, although much of the limestone that is now produced in Montana is burned into lime that is used in the refining of beet sugar. Analysis of limestones quarried in Carbon, Cascade, Gallatin, Jefferson, Lewis and Clark, and Park counties were published in Mineral Resources for 1911, Part II, page 675. Nearly all these rocks, especially those that are high in calcium carbonate, are used in beet-sugar factories.

Marble.—The production of marble has recently been reported from quarries in Gallatin and Lincoln counties. No data are at hand as to the character of the Lincoln County rock. According to Rowe[1] the Marble near Manhattan, Gallatin County, is similar to Mexican onyx and takes a splendid polish. He states that marble has also been quarried in Nelson Gulch, 6 miles southwest of Helena, and at Dempsey Creek, Powell County. The deposits in Nelson Gulch are reported to show seven distinct varieties of marble, including white statuary marble, marble for monumental work, and blue marble suitable for building.

Phyllite (siliceous slate).—Among the metamorphic rocks that occur in Montana, phyllite, a micaceous rock related to slate, is reported by Rowe[2] to be quarried near Kalispell, Flathead County. This rock is not reported to be suitable for making roofing slates, but is quarried rather for building purposes, especially for foundations. The rock is hard and flinty and is not readily acted upon by weathering agencies. It has been used at Kalispell and at Missoula.

Production.—The stone output for 1912 in Montana was valued at $216,079, as compared with $212,233 in 1911. The 1912 total comprised granite valued at $28,666; sandstone, $33,280; and limestone, $154,133. Montana in 1912 ranked thirty-ninth as a producer and fortieth in 1911.

Directory.—Quarries of all the kinds of rock quarried in Montana are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Montana.

GRANITE.

Gallatin County: 1a. Bozeman.
Jefferson County:
1. Clancy (Shingle Gulch).
2. Welch (Welch Placer).

Lewis and Clark County: 3. Helena and Baxendale (2)

MARBLE.

Gallatin County: 1. Manhattan (near).

Lincoln County: 22. Libby

SANDSTONE.

Cascade County: 1. Great Falls (3).
Chouteau County: 2. Havre (2).
Gallatin County: 3. Bozeman.

Yellowstone County:
4. Billings (3).
5. Columbus.

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[1] Rowe, J. P., op. cit., pp. 48–49.

[2] Idem, pp. 51–52.

Directory of stone quarries in Montana—Continued.

LIMESTONE AND LIMEKILNS.

Cascade County: 1. Albright (2).
Gallatin County:
2. Bozeman.
Trident.
Jefferson County:
3. Boulder.
4. Limespur.
Madison County: 5. Alder (Virginia City).
Missoula County: 5a. Huson.
Park County: 6. Livingston (2).
Powell County: 7. Elliston.
Sweet Grass County: 8. Big Timber.

LIMESTONE.

Carbon County: 1a. Bridger.
Flathead County: 1. Kalispell (7).
Gallatin County: 2. Trident (mail Logan).
Lewis and Clark County: 3. Helena and East Helena (2).
Silverbow County: 4. Maiden Rock.

WYOMING.

Wyoming is provided with a great variety and abundance of good building stones, yet these resources are little developed at present. Pre-Cambrian granitic rocks form the cores of the Rocky Mountains, the Front Range, the Hartville, and the Bighorn Mountains, yet no production of granite is at present reported to the Survey. The well-known "Sherman gravel," which is quarried along the Union Pacific Railroad from the top of the Front Range in the southeastern part of the State and used for hundreds of miles to the east and west of the quarry as railroad ballast, is simply disintegrated granite. On the flanks of the crystalline rock masses of the mountains and the Black Hills are beds of Paleozoic rock ranging in age from Cambrian to Jurassic, in which are great thicknesses of limestone, sandstone, and quartzite. Cretaceous rocks border the Paleozoics around the mountain uplifts, and Tertiary deposits form broad areas in northeastern and central-southwestern Wyoming. Tertiary eruptive rocks form the surface material in much of northwestern Wyoming, including most of the area of the Yellowstone Park. In places bordering the intrusive rocks beds of limestone have been metamorphosed to marble.

Granite.—Although no granite is at present produced on a commercial scale in Wyoming there is no lack of excellent stone, much of which is not beyond the reach of transportation lines. About 9 miles northeast of Guernsey, at McGinnis Pass, is an extensive exposure of granite in the Hartville Mountains. The outcrop extends one-half to three-fourths of a mile from east to west and 3 to 4 miles from north to south. The rock forms a ridge here which reaches a height of probably 300 feet. A branch of the Chicago, Burlington & Quincy Railway to the Chicago iron mine is within 1¼ miles to the west, and a spur could easily be built from it across the valley. At McGinnis Pass the granite can be quarried from hillside openings, although much of the surface rock is bowldery and would have to be moved in order to reach solid granite.

The granite is medium to coarse grained and rather irregular in texture. On the surface the color is light pinkish gray. The appearance of the rock in crevices suggests that the pink shade may be, in part at least, due to weathering. In general, large homogeneous masses occur, but in a few places inclusions of dark gneissic material were noted, as well as veins of quartz and pegmatite.

Along North Platte River are reported outcrops of granite of many shades and varieties.

Sandstone.—Sandstone is so widely distributed in Wyoming and generally so easily dressed that it early became an important building stone. There are many more sandstone quarries than limestone quarries in the State, yet the value of the sandstone production is much the smaller because of the fact that the majority of the sandstone quarries have been opened for local use and are worked only intermittently, perhaps not at all in some years, and in other years perhaps only long enough to supply stone for one job.

A coarse and in places conglomeratic quartzite is quarried near Rawlins. This quartzite is reported to overlie granite and may be of Cambrian age. It has been used in the construction of the Masonic Building in Rawlins.

Sandstone of late Carboniferous age has been quarried about 2½ miles east of Laramie, but it is not worked much now. This stone is light grayish buff with a faint pink tinge in places; it is of fine grain and contains a little calcareous cement. A few pyrite specks are visible. The stone is rather soft, but becomes harder on exposure and is suitable for large buildings in a dry climate. Spalling, a common weathering effect on sandstones, was noted in this stone only where laid on edge near the ground and subjected to dampness. This sandstone is used in some of the State University buildings at Laramie. Sandstone quarried near Aladdin is probably also of Carboniferous age.

Red sandstone probably of Permian age occurs in places east of the Front Range northwest of Cheyenne. A series of quarries has been opened along Chugwater Creek about three-fourths of a mile north of Iron Mountain station. The rock is hauled by wagons to Bradley Spur. About 40 feet of beds are exposed here, which dip 25° S. 70 E. The layers range in thickness from 1 or 2 inches to 16 inches or more. The rock is composed of very fine angular grains, is of a uniform light brick-red color, and is faintly banded parallel to the bedding. Slight effervescence is produced by hydrochloric acid. The rock is of medium hardness, and it splits along the bed and can be trimmed without difficulty. This red sandstone has been used in the Cheyenne high-school building. In the same locality, about half a mile south of Iron Mountain station, grayish-white fine grained sandstone lying east of and above the "Red Beds" is quarried for building stone. The grains are of subangular quartz with some white, amorphous silica in the interstices. There is no calcareous material in the cement, but calcium carbonate has been deposited in crusts along joint planes. The rock is fairly firm except on the surface where friable material occurs. Blocks up to 5 feet or more long are obtainable and can be split fairly evenly into layers 4 inches to 2 feet thick. The Stockgrowers National Bank at Cheyenne is built of this stone.

Another quarry in grayish-white sandstone has been opened at Bradleys Spur, 1½ miles north of Iron Mountain station, and adjoining the Colorado & Southern Railway. This rock is hard, and composed of fine, subangular to round, clear quartz grains, one sixtieth of an inch and less in diameter. It is thin to massive beds and is jointed into blocks up to 4 by 10 feet. Large blocks free from iron stain can be obtained here. The rock splits and trims nicely. A good deal of rock has been quarried here. The cut follows a ridge about 400 feet on the strike of the beds which dip 65° N. 65° E. St.

Mary's Cathedral in Cheyenne is built of this stone. White sandstone is reported to be quarried also about 2½ miles south of Horse Creek station.

Although no determinations have been made of the age of these light-colored beds their relations to the red sandstone suggests that they may be of Cretaceous age, and possibly belong to the Dakota sandstone.

Four miles southeast of Rawlins a large quarry has been opened in medium-grained grayish-buff sandstone. An exposure of more than 80 feet of beds is visible here at the top of the bluffs on the south side of the valley. The top 12 feet of stone, which are not very hard, are quarried for building stone. This stone is impregnated with fine black grains, possibly of carbonaceous matter. Next below are ledges of harder, finer grained stone aggregating 50 feet in thickness, some of which has been quarried for grindstones. This deposit dips about 4° S. and is divided by two sets of vertical joints into blocks 10 to 30 feet wide. The rock is slightly calcareous, and in places the joint planes are coated with films of calcium carbonate or with iron oxide. Building stone in rough blocks is produced at this quarry, the cutting and trimming being done on the job. The rock is hauled to Rawlins by traction engine in trains of three wagons carrying about 20 tons in all. This sandstone has been used in many buildings in Wyoming, including the Federal building and the capitol at Cheyenne. The rock in the Federal building is tool faced and is embellished by many turned columns with smooth rubbed surfaces. The rock in this building shows a few small spots caused by iron oxide. Under cornices where water has seeped down the stone shows lighter colored spots as though lime or other alkalis had been brought to the surface.

One mile north of Rawlins are several openings in quartzite. The material is grayish, greenish, and pinkish. Pink predominates in the higher strata, but the general color effect of the rock is faint pinkish gray, and there are faint bands in places. The rock dips 10° E. and separates sharply into layers ranging in thickness from 1 inch to nearly 5 feet, but mostly between 8 and 12 inches. These beds, which are exposed to a thickness of 30 to 50 feet outcrop, for more than a mile in the bluffs. The age of these beds is probably Cretaceous. The rock is used locally for building purposes in Rawlins. It can be delivered there more cheaply than sandstone but is more expensive to dress, and for that reason has little market elsewhere. The Elks' home in Rawlins, built of this quartzite trimmed with "Rawlins sandstone" and roofed with red tile, is a very handsome structure. This quartzite is also quarried by the Union Pacific Railroad Co. in a cut west of Rawlins and used as ballast.

Sandstone for use at Sheridan is quarried at Arno, Dietz, and Absarokee Park. The rock quarried at the two places first named is buff or greenish buff in color, which is not at all uniform, is fine grained and gritty, and contains may fine black specks interspersed throughout the mass. This stone is rough and does not cut well enough for use as dimension stone and so is used principally for foundations, basements, and steps. This stone occurs in the area of Eocene (Tertiary rocks), according to Survey Professional Paper 71. Absarokee Park is in the foothills of the Bighorn Mountains, about

16 miles southwest of Sheridan. The rock quarried here is reported to be 30 to 40 feet thick and to lie in massive beds that dip about 45° NE. The stone is fine grained, not very hard, although harder than the stone from Arno, and of light-gray color. It is used locally for general building purposes. Some of it is laminated by carbonaceous and ferruginous matter, and weathering soon cuts streaks along the laminations, although the color is fairly stable. In places streaks and concretions of limonite are present. The long haul makes the cost of this stone in Sheridan approximately equal to that of limestone from Indiana, but the time required to deliver an order of the latter stone has necessitated opening the Absarokee quarry. This rock is probably of late Cretaceous or early Tertiary age.

At Newcastle a sandstone, probably of Cretaceous age, is quarried for building purposes. This stone is grayish, fine grained, slightly micaceous, and has about the same texture as the stone from Absarokee Park. It contains in places spots and streaks of petroleum which produce brownish-yellow discolorations. It is said that these discolorations may be removed by washing the stone with an acid. There are several places in Wyoming at which sandstone, probably of Cretaceous age, is quarried, among them Cody, Lander, Thermopolis, and Glencoe, in regard to which there are no data available. In the Hartville uplift, at Sunrise, a purplish ferruginous quartzite occurs in abundance, capping the hills southeast of the main shaft of the iron mine, and about 1 mile east of Guernsey and within one-eighth of a mile north of the Chicago Burlington & Quincy Railway spur to the Chicago mine are outcrops of a dark-red quartzite interbedded with cherty dolomite. Both the rocks at the latter locality are badly fractured, but some material for local use might be obtained from the quartzite.

The present records of the Survey show a total of 20 sandstone quarries distributed among 9 counties in Wyoming.

Limestone.—Little limestone has been quarried in Wyoming for building. There are, however, extensive deposits of limestone in the Paleozoic and Cretaceous formations, and quarries have been opened from which stone for the manufacture of lime and for use in beet-sugar refining is obtained, as well as crushed stone for ballast and concrete. Many of these limestones, especially those found in Albany, Carbon, Laramie, and Weston counties are nearly pure calcium carbonate. Analyses of several of these limestones were published in Mineral Resources for 1911, Part II, pages 697–698. Ten quarries in 6 counties produce limestone in Wyoming. The bulk of the output goes to beet-sugar factories, some of which are in other States.

Marble.—Marble has been reported from several places in Wyoming. In Muskrat Canyon fine-grained reddish marble variegated with white and drab colors as well as pink marble of uniform color are reported to occur. White and greenish marbles of good quality are reported to occur on Cedar Creek in the eastern part of the Platte River valley.[1] White, crystalline limestone or marble with mossy veining is reported to occur about a mile west of the railway near Iron Mountain station. It has been suggested by Darton [2] that possibly limestone in the

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[1] Merrill, G. P., Stones for building and decoration, 1903, p. 242.

[2] Darton, N. H., Geology of the Bighorn Mountains: Prof. Paper, U. S. Geol. Survey No. 51, 1906, p. 115.

upper part of the Madison limestone in the Bighorn Mountains might be worked for marble. A deposit near Hartville is now enrolled as a possible marble producer.

Stone tests.—The following results of compression tests of Wyoming building stones have been kindly furnished the writer by J. C. Fitterer, professor of civil engineering in the University of Wyoming, under whose direction the tests were made:

Tests of Wyoming building stone.

Stone:	Compressive strength (pounds per square inch).
Buff sandstone from Rawlins	1,910
Buff sandstone from Rawlins	2,140
Gray sandstone from Laramie	4,300
Red sandstone from Laramie	4,010
Limestone from Laramie	4,300

Production.—The total production of stone in Wyoming in 1912 was valued at $68,479, compared with $40,544 in 1911. In 1912 Wyoming ranked forty-fourth, as compared with forty-fifth in 1911. The production in 1912 of sandstone was valued at $3,730 and the production of limestone was valued at $64,749.

Directory.—Quarries of all kinds of rock quarried in Wyoming are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Wyoming.

MARBLE.

Laramie County: 1. Hartville.

SANDSTONE.

Albany County:
1a. Laramie.
Bighorn County:
1. Cody (2).
Carbon County:
2. Rawlins (2).
Crook County:
2a. Alladin.
Fremont County:
3. Lander (3).
4. Thermopolis (2).
Laramie County:
5. Iron Mountain.
6. Underwood (2).
Sheridan County:
7. Arno.
8. Dietz.
9. Absawkee Park.
Unita County:
10. Glencoe (2).
Weston County:
11. Newcastle.

LIMESTONE AND LIMEKILNS.

Albany County:
1. Laramie (4).
Carbon County:
2. Rawlins.
Hot Springs County:
3. Thermopolis (2).

LIMESTONE.

Laramie County:
1a. Horse Creek.
Platte County:
1. Hartville (also near Guernsey).
Sheridan County:
2. Sheridan.

COLORADO AND NEW MEXICO.

The most important areas of stone for quarrying in Colorado and New Mexico are in the western two-thirds of these States, in the mountainous portions rather than in the region of the Great Plains. In the Great Plains the underlying rocks are largely of Cretaceous and

Tertiary age and include many beds that are not wholly consolidated. However, in the foothills of the Front Range where the rocks have been subjected to considerable pressure and tilting at the time of the uplift of the mountains the beds, whatever their age, may be very much harder than farther east on the plains. Colorado appears to be very abundantly supplied with rocks of all varieties suitable for quarrying, and generally well distributed, and New Mexico only slightly less abundantly supplied. The greater density of population, has of course, necessitated the more rapid development of the stone resources of Colorado. One geological condition that favors Colorado is the more abundant distribution of intrusive granitic rocks as contrasted with the more extensive areas of effusive rocks in New Mexico, and another feature that puts New Mexico at a disadvantage is the large area of "desert wash" that fills many of the valleys in the central and southern part of the State.

The quarries of this group of States are shown in Plate VII.

COLORADO.

The stone-producing formations in Colorado comprise rocks of practically all ages from the pre-Cambrian intrusives to the post-Tertiary effusives, including between them sediments of nearly all the Paleozoic and Mesozoic formations, besides metamorphic marbles and slates.

Granite.—The granites of Colorado are found in a broad north-south belt which nearly coincides with the middle third of the State. There is a great variety of granitic rock available, and naturally those rocks which are quarried first are those most conveniently situated with reference to transportation lines and markets, besides possessing the essential requirements of good building stones. Reference to the map (Pl. VII) shows how closely the quarries follow the railroads. Among the well-known granites quarried in Colorado are gray and red granites from Texas Creek; gray granite from near Gunnison, Salida, and Cotopaxi; red granite from Platte Canyon; and pink granite from Cotopaxi.

The following brief notes as to character of the granites are derived from an unpublished thesis on tests of building stones of Colorado, by A. P. Poorman, prepared at the University of Colorado, 1909:

Gray granite near Texas Creek: Medium-grained light-gray biotite granite, carrying small quantities muscovite and magnetite. Quarried 3½ miles southwest of railroad station. Uses, monumental and buildings.

Red granite near Texas Creek; Coarse gneissoid, with pink feldspars, and small quantities of quartz and biotite. Has been subjected to severe strain. Quarried 3 miles northwest of railroad station.

Granite near Buffalo Creek: Coarse massive-grained, composed of pink feldspar, quartz, biotite, and a little hornblende.

Granite near Salida: Bluish-gray even-grained monzonite, carrying predominately feldspar and small crystals of biotite and hornblende as essential constituents and almost no quartz. Quarried 11 miles from Salida and hauled to city by teams.

Granite near Cotopaxi: Medium-grained hornblende-bearing biotite granite with predominating white feldspar and quartz. Pyrite present in a few small grains. Quarried 2½ miles south of station. Another variety adjacent to last mentioned is light-colored granite of medium coarse grain. Composed mostly of feldspars (microcline most abundant), with subordinate quantities of quartz and biotite.

Granite near Silver Plume: Gray medium-grained, composed of feldspar (microcline, plagioclase, and orthoclase), quartz, biotite, a small quantity of muscovite, and occasional pyrite grains.

Rhyolite near Gunnison: Quarried 7 miles west of Gunnison and 1 mile south of Denver & Rio Grande Railroad. Hauled by wagons downhill.

From a recent paper by Hunter[1] the following notes are derived:

Aberdeen granite: Gray medium-grained, even-textured, approaching quartz diorite in composition. Minerals, quartz 36 per cent; feldspar, 51 per cent; biotite, 12 per cent; accessory minerals (magnetite, apatite, ipidote, calcite, titanite), 1 per cent. Compressive strength, 14,340 pounds per square inch. State Capitol at Denver built of this granite.

According to the Survey records there have been 36 active granite quarries in Colorado within the last two or three years, distributed among 12 counties. In 1912 granite valued at $55,010 was marketed from Colorado quarries. More than $35,000 worth was sold rough for monumental work; more than $10,000 worth for building stone; a little was sold as rubble; and all the rest as crushed stone for roads and concrete.

Slate.—The occurrence of slate has been reported from several counties in Colorado, but only one quarry has been opened. This is in Gunnison County and is in the same area of metamorphosed rocks in which large deposits of marble have been discovered on Yule Creek.

Marble.—Marble deposits have been known in several counties in Colorado for more than 30 years, but only within the last 6 or 7 years has any important development taken place. Merrill[2] states that a specimen of handsome black, white-veined breccia marble has been sent to the National Museum from Pitkin; that a chocolate-colored marble is reported to occur near Fort Collins, and a breccia marble near Boulder. According to records of the Colorado State School of Mines, Denver, 1884, a white dolomitic marble is reported from Calumet, Chaffee County. A yellow marble stated to resemble the famous Siena marble of Italy has been reported to the Survey from near Canon City.

The most extensively developed deposits of marble in Colorado are on Yule Creek, in northern Gunnison County. The deposits that are quarried here are high on the left bank of the creek and dip westward at an angle of about 52°. The marble bed is reported to be about 240 feet thick, and to contain four bands of chert, each 2 to 4 feet thick. The underlying rock is cherty blue dolomite, and overlying the marble is a sill of igneous rock which is, in turn, overlain by 500 to 800 feet of blue cherty limestone. The marble itself is for the most part white and of medium fine grain, but there are bands of handsome green-stained material within the mass. This quarry has a complete equipment and has maintained a large output of marble for several years. The rock is carried to the mill at Marble about 3½ miles distant by an electric tramway. At the marble mill, which is electrically driven and is one of the most completely equipped in the United States, the product is sawed, planed, turned, polished, carved, and otherwise prepared for all kinds of interior and exterior construction work. This white marble has been used for interior decoration in the Cuyahoga County courthouse at Cleveland, Ohio, in the Cheesman Park shelter house, Denver, Colo., and in office buildings in Salt Lake City and elsewhere.

Sandstone.—The sandstone beds that form the hogbacks at the foot of the Front Range in north-central Colorado from the Wyoming line nearly to Denver are among the most important deposits of this

[1] Hunter, J. F., The Aberdeen granite quarry near Gunnison, Colo.: Bull. U. S. Geol. Survey No. 540-K, 1913.

[2] Merrill, G. P., op. cit., p. 208.

MAP OF COLORADO AND NEW MEXICO
Showing location of limekilns and quarries of limestone, sandstone, marble, slate, and granite

Prepared under the direction of
E. F. Burchard

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class of rock not only in Colorado, but in the Rocky Mountain States. There are several types of excellent sandstone here, and generally the beds are tilted so that they dip at a high angle to the east and are easily quarried on their upturned edges. A railway line parallels this strip of sandstone outcrop a few miles to the east, and most of the quarry sites are readily reached by spur tracks. These favorable conditions, together with the markets afforded by the large cities and thriving towns east of the mountains in Colorado, have resulted in the growth of a considerable sandstone quarrying industry in Larimer and Boulder counties. Notes on a few of these quarries will indicate the character of the typical stone. At Arkins, near Fort Collins, Larimer County, a number of quarries have been in existence for many years. The most important varieties of stone are red sandstone and light-gray and tan-colored beds, all fine grained. The red stone is from the "Red Beds." Many buildings in Fort Collins and neighboring towns are built of the red stone. Sawed stone with carved cornices and window blocks is very popular. Buildings of red stone are trimmed with gray, and vice versa.

The light-colored stone is very hard, approaching quartzite in its degree of induration. The gray sandstone is reported to belong to the Lyons sandstone of Pennsylvanian and Permian (?) age. In places the stone shows faint brownish bands and dark-brown spots caused by the oxidation of iron pyrites. The beds are sharply defined, and separate as cleanly as though sawed. The thickness of the various strata ranges generally between 1 and 8 inches. The rock is cut by joints, but not so closely as to prevent large blocks from being obtained. The product is used mainly for dimension stone, rubble, sidewalk and crossing slabs, culverts, paving blocks, fence posts, etc., the clearer stone being of course the more valuable for dimension work.

Along St. Vrain Creek in Boulder County, pink, yellow, and bluish-gray sandstone occurs. The stone is reported to be quartzitic and rather hard, and is popular as a building material. These beds are probably of Cretaceous age.

About 1½ miles southwest of Boulder a quarry has been opened in light-pink angular medium grained quartz sand cemented by silica. The rock shows cross-bedding and splits along flat, smooth bedding planes into layers 1 inch to 15 inches thick. The beds dip 45°–50° E., and the quarry is worked upward from the base of the exposure of bare rock. The product is used for rubble and ashlar.

South of Denver in the foothills of the Front Range there are also valuable deposits of sandstone, both red and lighter colored. Near Colorado City a fine grained red sandstone outcrops in a bold ridge nearly a mile long and accessible from both sides. The sandstone is composed of rounded quartz grains cemented by silica, calcium carbonate, and iron oxide. The rich red color is due to the iron oxide. The strata stand nearly vertical, and the thickness of the beds is variable, permitting blocks of almost any size to be quarried, the limit being set only by the capacity of the derricks. Several quarries have been opened in this stone.

Near Golden a salmon-red sandstone occurs, and near Morrison both red and white sandstones are abundant. Grayish to tan-colored arkose, indurated to the hardness of quartzite, occurs near Sedalia, Douglas County. This rock, on account of the sharp outlines and the freshness of the crystals of quartz and feldspar is often mistaken for granite. Light gray, fine grained sandstone, mottled in places, is found in a ledge on Turkey Creek, Pueblo County, and near Canon City light-colored sandstone occurs in extensive ridges. Stone from Canon City locality is reported to have been used in the construction of the Denver courthouse. The most southerly outcrops of sandstone at the foot of the Front Range are near Trinidad, where there are several quarries which ship stone to outside points.

Other deposits of sandstone occur in the intermountain counties. At Steamboat Springs, Jackson County, creamy-white to pink sandstone is quarried. In Eagle, Delta, Montrose, La Plata, Rio Grande, and Conejos counties quarries are operated to supply local demands and could ship much stone if markets were opened.

The output of sandstone in Colorado in 1912 was valued at $108,169 at the quarries. Stone for building and paving constituted the largest items in the sales, but important quantities were used for ganister, curbing, flagging, road making, and rubble.

Limestone.—The limestones of Colorado may conveniently be divided geographically and geologically into two groups. The first of these groups includes limestone mostly of Cretaceous age, which occurs in the Plains region of the eastern half of the State and in a narrow belt immediately east of the Front Range. The second group includes the limestones mostly of Carboniferous age, which lie west of the Front Range. The two limestone formations of greatest importance in the Cretaceous system are the Niobrara and the Greenhorn. The Niobrara limestone outcrops as a narrow but fairly continuous belt from the Wyoming line southward to Colorado Springs, passing just west of Fort Collins and Denver. South of Colorado Springs are two areas of Niobrara limestone, which occupy much of Pueblo, Otero, Huerfano, Las Animas, Bent, Prowers, Kiowa, and Cheyenne counties, the upper area of outcrop lying along Arkansas River, from near Florence to the Kansas line. The thickness of the Niobrara is about 400 feet, but calcareous shale makes up a considerable part of this thickness.

In central and western Colorado limestones of Mississippian age cover large areas. Analyses of limestones from a number of points in Garfield, Grand, Gunnison, Jefferson, Park, Pitkin, and Summit counties indicate that this limestone is low in magnesia.

The abundance of easily worked sandstone, as well as the suitability of much of the granite for building purposes in Colorado has retarded the development of any of the limestone beds in this State for building purposes. Such limestones as are used as building stone are of the crystalline variety and are classed as marble. For chemical uses and the manufacture of lime the limestones of Colorado are much in demand. Limestone is quarried in 13 counties in Colorado, 8 of which produce lime, and a large output is recorded for 1912, valued at $365,004, of which $313,237 was for smelter flux and $46,189 was for sugar factories. The total given above does not include the value of limestone quarried for the manufacture of lime and cement.

Production.—The total production of stone in Colorado in 1912 was valued at $1,420,607, as compared with $1,610,434 in 1911. Colorado ranked fifteenth in 1911, and seventeenth among the stone-producing States in 1912. The most valuable output was that of marble, followed by limestone for manufacturing purposes, sandstone, and granite.

Directory.—Quarries of all the kinds of rock quarried in Colorado are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in Colorado.

COLORADO.

GRANITE.

Boulder County:
- 1a. Crescent.
- 1b. Crags.
- 1. Lyons (2).

Chaffee County:
- 2. Granite.
- 3. Barre.
- 4. Salida (10).
- 5. Turret (3).

Clear Creek County: 6. Silver Plume (2).
Douglas County: 7. Castle Rock.
El Paso County: 8. Cascade.
Fremont County:
- 9. Cotopaxi.
- 10. Texas Creek (3).
- 10a. Whitehorn.

Gunnison County: 10b. Aberdeen.
Jefferson County:
- 11. Buffalo Creek (2).
- 12. Golden.

La Plata County: 13. Durango.
Larimer County: 14. Arkins.
Pitkin County: 15. 10 miles SE. of Aspen
Rio Grande County: 16. Del Norte.

SLATE.

Gunnison County: Marble (2).

MARBLE.

Chaffee County:
- 1. Buena Vista.
- 2. Salida.

Fremont County: 3. Fremont.
Gunnison County: 4. Marble (3).
Pitkin County: 5. Aspen.
Saguache County: 6. Villa Grove.

SANDSTONE.

Boulder County:
- 1. Boulder (4).
- 2. Lyons (11) and Noland (5).

Conejos County: 3. Osier.
Delta County:
- 4. Austin.
- 5. Delta (2).

Douglas County: 6. Sedalia.
Eagle County: 7. Peachblow.
El Paso County: 8. Colorado City (3).
Fremont County:
- 9. Canon City (5).
- 10. Florence.

La Plata County: 11. Durango (7).
Larimer County:
- 12. Arkins (4) and Lowerey.
- 13. Bellvue and Stout.
- 14. Fort Collins (8).
- 15. Loveland.

Las Animas County: 16. Trinidad (4).
Montrose County:
- 17. Montrose (2).
- 18. Olathe (2).

Pueblo County: 19. Turkey Creek.
Rio Grande County: 20. Del Norte (2).
Routt County: 21. Steamboat Springs.

LIMESTONE AND LIMEKILNS.

Boulder County: 1. Boulder (2).
Chaffee County: 2. Newett.
Douglas County: 3. Platte Canon (silica).
Fremont County:
- 4. Calcite (3).
- 5. Canon City.

Gunnison County: 6. Los Gunnison (Cement Creek).
La Plata County: 7. Rockwood (3).
Larimer County:
- 8. Fort Collins.
- 9. Ingleside.

Pitkin County: 10. Thomasville (2).

LIMESTONE.

Chaffee County: 1. Garfield (2).
Douglas County: 2. Near Littleton, Arapahoe County.
El Paso County: 3. Manitou.
Jefferson County:
- 4. Golden.
- 5. Morrison.

Mesa County: 6. Dominguez (near).
Pueblo County:
- 7. Lime.
- 8. Livesey.

San Juan County: 9. Silverton.

NEW MEXICO.

The development of the abundant stone resources of New Mexico is chiefly dependent upon the growth of local markets and the extension of railroads. There is no lack of granite, marble, sandstone, and limestone, and, although the occurrence of quarriable slate beds has not been reported to the Survey, the geologic conditions suggest that in the areas of metamorphosed sediments deposits of good slate should eventually be discovered. Areally the granitic rocks should be found in the Sangre de Cristo Range, also in a north-south range east of Albuquerque and Socorro, and in detached areas in the southwestern part of the State. All these areas contain pre-Cambrian intrusive rocks. Large areas of Tertiary effusive rocks occur in the northern and southwestern parts of the State, and furnish fine-textured stone such as rhyolite and trachyte for local building. The broad areas of Carboniferous and Cretaceous rocks are made up largely of sandstone, limestone, and shale, and where limestone and shale are in contact with igneous rock, deposits of marble and slate may be expected.

Granite.—Granite, as has been suggested above, is present in several counties in New Mexico, but it is quarried in only two of them, viz, Grant and Valencia counties, in three quarries. The locality furnishing the greater part of the granite output at present is near Belen, Valencia County.

Marble.—Marble, which is also widely distributed in New Mexico, has been quarried in the following six counties: Grant, Gaudalupe, Lincoln, Luna, Otero, and San Miguel. Only a small production is maintained at present, since most of the quarries are idle. Merrill[1] mentions the occurrence of a beautifully banded light and dark green impure serpentinous rock north of Gila River between Silver City and the Arizona line. The rock appears to be suitable for both ornamental and building purposes, but on account of its remoteness and of difficulties that might be experienced in quarrying the deposit, it has not yet been exploited.

Sandstone.—Sandstone production has recently been reported from Colfax, Lincoln, Mora, San Miguel, and Valencia counties. No samples of sandstone from New Mexico are available at the Survey, but Merrill[2] gives the following interesting note:

> In the vicinity of Las Vegas, Hot Springs, and Albuquerque occur beds of light-gray, brown, and pink sandstone, of fine texture and apparently excellent quality. They are not as yet much used, owing simply to lack of demand for stone of any kind. A soft, very light gray volcanic tuff occurs at Santa Fe, which may prove of value for building purposes in a dry climate, or one where the temperature does not often fall below the freezing point.

Limestone.—Limestone of the Cambrian, Ordovician, Carboniferous, and Cretaceous systems occur in New Mexico, although little is known concerning their chemical and physical properties, except where they have been studied in connection with metalliferous and coal deposits. In the vicinity of Carthage, Socorro County, the Pennsylvanian San Andreas limestone has a thickness of about 200 feet and outcrops within half a mile of a railroad. Limestone quarries are situated in 8 counties, of which 6 have produced stone for the manufacture of lime. The output of limestone other than for lime is used for railroad ballast and concrete.

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[1] Merrill, G. P., op. cit., pp. 365–366.

[2] Idem, pp. 149–150.

Production.—The total value of the stone output of New Mexico in 1912 was $325,937, compared with $406,454 in 1911. The rank of this State was thirty-four in both 1911 and 1912. The production of limestone makes up the bulk of the output, although the production of granite is of much importance.

Directory.—Quarries of all the kinds of rock quarried in New Mexico are listed below by class of rock, county, and town (or post office):

Directory of stone quarries in New Mexico.

GRANITE.

Grant County:
1. Lordsburg.
2. Steins.

Valencia County:
3. Sais.

MARBLE.

Grant County:
1. Lordsburg.

Guadalupe County:
2. Potrillo.

Lincoln County:
3. White Oaks.

Luna County:
4. Columbus (2).

Otero County:
5. Alamogordo (2).

San Miguel County:
6. Las Vegas.

SANDSTONE.

Colfax County:
1. Cimarron.
2. Raton (5).

Lincoln County:
3. Whiteoaks.

Mora County:
4. Watrous (3).

San Miguel County:
5. Las Vegas (4).

Valencia County:
6. Belen.

LIMESTONE AND LIMEKILNS.

Grant County:
1. Silver City.

Mora County:
2. Watrous.

San Juan County:
3. Kirtland.

San Miguel County:
4. Las Vegas (Hot Springs).

Santa Fe County:
5. Santa Fe.

Valencia County:
6. Blue Water (3).

LIMESTONE.

Guadalupe County:
1. Vaughan.

Lincoln County:
2. Tecolote.

Santa Fe County:
3. Cerrilos.

SURVEY PUBLICATIONS ON BUILDING AND OTHER STONE, SLATE, AND ROAD METAL.

The following list comprises the more important publications on stone, slate, and road metal by the United States Geological Survey. These publications, except those to which a price is affixed, can be obtained free by applying to the Director, United States Geological Survey, Washington, D. C. The priced publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The annual volumes on Mineral Resources of the United States between 1882 and 1899 and for 1911 contain not only statistics of stone production but occasional discussions of available stone resources in various parts of the country. Many of the Survey's geologic folios also contain notes on stone resources that may be of local importance.

MISCELLANEOUS PUBLICATIONS.

Alden, W. C., The stone industry in the vicinity of Chicago, Ill.: Bull. 213, 1903, pp. 357–360. 25c.

Bain, H. F., Notes on Iowa building stones: Sixteenth Ann. Rept., pt. 4, 1895, pp. 500–503. $1.20.

Bastin, E. S. (See Leighton, Henry, and Bastin, E. S.)

Burchard, E. F., Concrete materials produced in the Chicago district: Bull. 340, 1908, pp. 383–410.

——— Structural materials near Austin, Tex.: Bull. 430, 1910, pp. 292–316.

——— Structural materials near Minneapolis, Minn.: Bull. 430, 1910, pp. 280–291.

——— Stone resources east of Mississippi River: Mineral Resources U. S. for 1911, pt. 2, 1912, pp. 782–834.

Butts, Charles, Variegated marbles southeast of Calera, Shelby County, Ala.: Bull. 470, 1911, pp. 237–239.

Clapp, F. G., Limestones of southwestern Pennsylvania: Bull. 249, 1905.

Dale, T. N., The slate belt of eastern New York and western Vermont: Nineteenth Ann. Rept., pt. 3, 1899, pp. 153–200. $2.25.

——— The slate industry of Slatington, Pa., and Martinsburg, W. Va.: Bull. 213, 1903, pp. 361–364. 25c.

——— Notes on Arkansas roofing slates: Bull. 225, 1904, pp. 414–416. 35c.

——— Slate investigations during 1904: Bull. 260, 1905, pp. 486–488. 40c.

——— Note on a new variety of Maine slate: Bull. 285, 1906, pp. 449–450. 60c.

——— Recent work on New England granites: Bull. 315, 1907, pp. 356–359. 50c.

——— The granites of Maine: Bull. 313, 1907, 202 pp. 35c.

——— The chief commercial granites of Massachusetts, New Hampshire, and Rhode Island: Bull. 354, 1908, 228 pp.

——— The granites of Vermont: Bull. 404, 1909, 138 pp.

——— Supplementary notes on the granites of New Hampshire: Bull. 430, 1910, pp. 346–372.

——— Supplementary notes on the commercial granites of Massachusetts: Bull. 470, 1911, pp. 240–290.

——— The commercial marbles of western Vermont: Bull. 521, 1912, 170 pp.

——— and Gregory, H. E., The granites of Connecticut: Bull. 484, 1911, 137 pp.

——— and others, Slate deposits and slate industry of the United States: Bull. 275, 1906, 154 pp. 15c.

Darton, N. H., Marble of White Pine County, Nev., near Gandy, Utah: Bull. 340, 1908, pp. 377–380.

——— Structural materials near Portland, Oreg., and Seattle and Tacoma, Wash.: Bull. 387, 1909, 36 pp.

Diller, J. S., Limestone of the Redding district, California: Bull, 213, 1903, p. 365. 25c.

Eckel, E. C., Slate deposits of California and Utah: Bull. 225, 1904, pp. 417–422. 35c.

——— Cement materials and industry of the United States: Bull. 243, 1905, 395 pp. Edition exhausted. (Treats of limestone.)

Eckel, E. C., Burchard, E. F., and others, Portland cement materials and industry of the United States: Bull. 522, 1913, 401 pp. (Treats of limestone.)

Gardner, James H., Oolitic limestone at Bowling Green and other places in Kentucky: Bull. 430, 1910, pp. 373–378.

Hillebrand, W. F., Chemical notes on the composition of the roofing slates of eastern New York and western Vermont: Nineteenth Ann. Rept., pt. 3, 1899, pp. 301–305. $2.25.

Hopkins, T. C., The sandstones of western Indiana: Seventeenth Ann. Rept., pt. 3 (continued), 1896, pp. 780–787. $1.00.

——— Brownstones of Pennsylvania: Eighteenth Ann. Rept., pt. 5 (continued), 1897, pp. 1025–1043. $1.00.

——— and Siebenthal, C. E., The Bedford oolitic limestone of Indiana: Eighteenth Ann. Rept., pt. 5 (continued), 1897, pp. 1050–1057. $1.00.

Humphrey, R. L., The fire-resistive properties of various building materials: Bull. 370, 1909, 99 pp. 20c.

Hunter, J. F., The Aberdeen granite quarry near Gunnison, Colo.: Bull. 540–K, 1913, pp. 5–8.

Keith, A., Tennessee marbles: Bull. 213, 1903, pp. 366–370. 25c.

Leighton, Henry, and Bastin, E. S., Road materials of southern and eastern Maine: Bull. 33, Office of Public Roads, Department of Agriculture, 1908. (May be obtained from Department of Agriculture.)

Loughlin, G. F., The gabbros and associated rocks at Preston, Conn.: Bull. 492, 1912, 158 pp.
Pack, Robert W., Ornamental marble near Barstow, Cal.: Bull. 540–K, 1913, pp. 9–14.
Paige, Sidney, Marble in Chiricahua Mountains, Arizona: Bull. 380, 1909, pp. 299–311.
Purdue, A. H., The slates of Arkansas: Bull. 430, 1910, pp. 317–334.
Ries, H., The limestone quarries of eastern New York, western Vermont, Massachusetts, and Connecticut: Seventeenth Ann. Rept., pt. 3 (continued), 1896, pp. 795–811. $1.00.
Shaler, N. S., Preliminary report on the geology of the common roads of the United States: Fifteenth Ann. Rept., 1895, pp. 259–306. $1.70.
——— The geology of the road-building stones of Massachusetts, with some consideration of similar materials from other parts of the United States: Sixteenth Ann. Rept., pt. 2, 1895, pp. 277–341. $1.25.
Siebenthal, C. E., The Bedford oolitic limestone [Indiana]: Nineteenth Ann. Rept., pt. 6 (continued), 1898, pp. 292–296. $1.00.
——— (See also Hopkins, T. C., and Siebenthal, C. E.)
Smith, G. O., The granite industry of the Penobscot Bay district, Maine: Bull. 260, 1905, pp. 489–492. 40c.
Udden, Jon A., Oolitic limestone industry at Bedford and Bloomington, Ind.: Bull. 430, 1910, pp. 335–345.
Watson, T. L., Granites of the southeastern Atlantic States: Bull. 426, 1910, 282 pp.

STONE AND SLATE STATISTICS.

The statistical reports on the production of stone, etc., will be found in the following volumes of Mineral Resources of the United States, the prices quoted being for the complete volume:

1882. Structural materials, pp. 450–464. 50c.
1883–4. Structural materials, pp. 662–670. 60c.
1885. Structural materials, by H. H. Sproull, pp. 396–413. 60c.
1886. Structural materials, by Wm. C. Day, pp. 517–566. 40c.
1887. Structural materials, by Wm. C. Day, pp. 503–534. 50c.
1888. Structural materials, by Wm. C. Day, pp. 516–557. 50c.
1889–90. Stone, by Wm. C. Day, pp. 373–440. 50c.
1891. Stone, by Wm. C. Day, pp. 456–473. 50c.
1892. Stone, by Wm. C. Day, pp. 704–711. 50c.
1893. Stone, by Wm. C. Day, pp. 543–602. 50c.
1894. Sixteenth Ann. Rept., U. S. Geol. Survey, pt. 4, Nonmetallic products.
Stone, by Wm. C. Day, pp. 436–510. $1.20.
1895. Seventeenth Ann. Rept., U. S. Geol. Survey, pt. 3 (continued), Nonmetallic products, except coal. $1.00.
Stone, by Wm. C. Day, pp. 759–811.
1896. Eighteenth Ann. Rept., U. S. Geol. Survey, pt. 5 (continued), Nonmetallic products, except coal. $1.00.
Stone, by Wm. C. Day, pp. 948–1068.
1897. Nineteenth Ann. Rept., U. S. Geol. Survey, pt. 6 (continued), Nonmetallic products, except coal and coke.
Stone, by Wm. C. Day, pp. 205–309.
1898. Twentieth Ann. Rept., U. S. Geol. Survey, pt. 6 (continued), Nonmetallic products, except coal and coke. $1.00.
Stone, by Wm. C. Day, pp. 269–464.
1899. Twenty-first Ann. Rept., U. S. Geol. Survey, pt. 6 (continued), Nonmetallic products, except coal and coke.
Stone, pp. 333–360.
1900. Stone, pp. 661–692. 70c.
1901. Stone, pp. 641–666. 70c.
1902. Stone, pp. 665–701. 70c.
1903. Stone, pp. 755–789. 70c.
1904. Stone, pp. 801–841. 70c.

1905. Slate, by A. T. Coons, pp. 1011–1017; Stone, by A. T. Coons, pp. 1021–1067. $1.00.
1906. Slate, by A. T. Coons, pp. 1001–1005; Stone, by A. T. Coons, pp. 1007–1041.
1907. Slate, by A. T. Coons, pt. 2, pp. 557–562; Stone, by A. T. Coons, pt. 2, pp. 563–605. 50c.
1908. Slate, by A. T. Coons, with general note on the classification and characteristics of slate, by T. Nelson Dale, pt. 2, pp. 521–532; Stone, by A. T. Coons, pt. 2, pp. 533–579. 80c.
1909. Slate, by A. T. Coons, pt. 2, pp. 557–568; Stone, by E. F. Burchard, pt. 2, pp. 569–608.
1910. Slate, by A. T. Coons, pt. 2, pp. 627–641; Stone, by E. F. Burchard, pt. 2, pp. 643–682; Portland cement materials, by E. F. Burchard, pt. 2, pp. 488–535. (Discussion of limestones.)
1911. Slate, by A. T. Coons, pt. 2, pp. 723–739; Stone, by E. F. Burchard, pt. 2, pp. 741–834; Lime (Analyses of various limestones and limes), by E. F. Burchard, pt. 2, pp. 645–718. $1.10.
1912. Slate, by A. T. Coons, pt. 2, p. –; The commercial qualities of slates of the United States and their localities, by T. Nelson Dale, pt. 2, pp. ——; Stone, by E. F. Burchard, pt. 2, pp. ——.

ABRASIVE MATERIALS.

By Frank J. Katz.

REVIEW OF THE ABRASIVE INDUSTRY IN 1912.

The total value of the abrasive materials entering the trade during 1912 increased 10 per cent as compared with the value for 1911. There was an increase both in domestic production of natural and artificial abrasives and in importation. The value of natural abrasives produced increased about 3 per cent; of artificial abrasives, 17 per cent; and of imports, about 11 per cent.

In the natural abrasive industry gains were shown in the production of millstones and of quarry products made in connection with them, such as chasers and drag stones, of grindstones and pulp stones, of oilstones, whetstones, and scythestones, and of abrasive garnet. There was a slight decrease in the value of diatomaceous earth and tripoli, of emery, and of pumice.

The total estimated value of all the abrasive materials consumed in the United States during the six years 1907 to 1912 is given in the following table:

Total value of all abrasive materials consumed in the United States, 1907–1912.

Year.	Natural abrasives.	Artificial abrasives.	Imports.	Total value.
1907	$1,680,737	$1,027,246	$754,140	$3,462,123
1908	1,074,039	626,340	476,073	2,176,452
1909	1,329,750	1,365,820	653,779	3,349,349
1910	1,406,805	1,604,030	977,718	3,988,553
1911	1,526,763	1,493,040	815,854	3,835,657
1912	1,576,556	1,747,120	898,892	4,222,568

The value of abrasive materials imported for consumption into the United States during 1911 and 1912 is as follows:

Value of abrasive materials imported into the United States, 1911 and 1912.

Materials.	1911	1912
Millstones and burrstones	$36,028	$27,562
Grindstones	123,727	131,080
Hones, oilstones, and whetstones	54,379	45,398
Emery and corundum	336,644	501,725
Infusorial earth, tripoli, and rottenstone	35,665	24,253
Pumice	118,977	74,478
Diamond dust and bort	110,434	94,396
Total	815,854	898,892

NATURAL ABRASIVES.

Under the head of natural abrasives in this report are included (1) millstones, (2) grindstones and pulpstones, (3) oilstones and scythestones, (4) corundum and emery, (5) abrasive garnet, (6) infusorial earth and tripoli, and (7) pumice. The difficulty of separating abrasive quartz and feldspar from the quartz and feldspar produced for other purposes has led to their omission from the chapter on abrasives, and such information as appears about them in "Mineral Resources" will be found in the chapter entitled "Feldspar and quartz." The statistics in this report represent only that part of the production of natural abrasives that properly comes under the abrasive industry, except as indicated below; thus only a small percentage of the sandstone that is quarried is used in the manufacture of abrasives—grindstones and pulpstones—the remainder being used chiefly in the building industry. There is difficulty in separating that portion of the production of tripoli and infusorial earth which is used as an abrasive from that which is not; hence the production of these substances is given in full. A large part of both of these products is not used as an abrasive, but is applied to other and diverse uses. Infusorial earth, for example, which is a nonconductor of heat and is of light weight, is used extensively as a packing material for furnaces, steam pipes, and boilers, and as a fireproof building material. Similarly, tripoli, in addition to being ground and used as an abrasive, is used as a filtering medium. Almost the entire output of millstones, pumice, emery, and garnet (except gem garnet) is used in the abrasive industry.

Natural abrasives were produced in 1912 in 25 States, which are listed below:

Alabama: Millstones.
Arkansas: Oilstones.
California: Infusorial earth and pumice.
Connecticut: Infusorial earth.
Georgia: Infusorial earth.
Illinois: Tripoli.
Indiana: Oilstones.
Kansas: Pumice.
Kentucky: Oilstones.
Maryland: Infusorial earth.
Massachusetts: Emery and infusorial earth.
Michigan: Grindstones and scythestones.
Missouri: Tripoli.
Montana: Grindstones.
Nebraska: Pumice.
Nevada: Infusorial earth.
New Hampshire: Garnet and scythestones.
New York: Millstones, emery, garnet, and infusorial earth.
North Carolina: Millstones and garnet.
Ohio: Grindstones, pulpstones, oilstones, scythestones.
Pennsylvania: Millstones.
Utah: Grindstones, scythestones.
Vermont: Scythestones.
Virginia: Millstones and infusorial earth.
West Virginia: Grindstones.

In 1912 Colorado disappeared from the list as a producer of grindstones; Georgia was added as a producer of infusorial earth; Utah as a producer of grindstones and scythestones; and California added pumice to its list of abrasive products. The output of these commodities in these States is small.

In the following table is given the value of the natural abrasive materials produced during the last five years:

Value of natural abrasives produced in the United States, 1908–1912.

Kind of abrasives.	1908	1909	1910	1911	1912
Millstones	$31,420	$35,393	$28,217	$40,069	$71,414
Grindstones and pulpstones	536,095	804,051	796,294	907,316	916,339
Oilstones and scythestones	217,284	214,019	228,694	214,991	232,218
Corundum and emery	8,745	18,185	15,077	6,778	6,652
Garnet	64,620	102,315	113,574	121,748	137,800
Abrasive quartz and feldspar	79,146	(a)	(a)	(a)	(a)
Infusorial earth and tripoli	97,442	122,348	130,006	147,462	125,446
Pumice	39,287	33,439	94,943	88,399	86,687
Total	1,074,039	1,329,750	1,406,805	1,526,763	1,576,556

a See chapter on feldspar and quartz.

MILLSTONES.

PRODUCTION.

The production of millstones, burrstones, chasers, and drag stones in the United States in 1912 amounted to $71,414 in value, an increase of $31,345, or 43.89 per cent, compared with the value reported to the Survey in 1911. The production of millstones in this country in 1912 was the largest since 1888, when it amounted to $81,000. For the last 25 years the returns to the Survey from this industry have shown great fluctuations, which have been difficult to account for satisfactorily. It is natural to suppose that the market for millstones, made as they are from quartz conglomerate, would have declined in recent years because of the introduction of other grinding machinery. The replacement of the millstones, it is but natural to assume, would be gradual, and the value of millstones would therefore show a steady falling off. This, however, has not been the case. From a maximum value of $200,000 in 1880 the value of millstones fell to $100,000 in 1887; from $81,000 in 1888 the value declined rapidly to $16,587 in 1891; in the following year there was a rise in value to $23,417, followed by a marked decline in the two following years, until the lowest production ever reported, namely, $13,887, was reached in 1894. Since that year the values have risen and fallen, as will be observed from the table of production, without any apparent rule. One fact, however, is to be noted, which is that the value of the production has maintained a much higher average than for the year 1894, when its lowest point was reached.

Millstones were produced in 1912 in Alabama, New York, North Carolina, Pennsylvania, and Virginia, the same States that produced them in 1911. The output in New York was between two and three times that of 1911, and this State regained its lead in the millstone industry in the United States; Virginia was second, with a production nearly 50 per cent larger than that of the preceding year; North Carolina increased its production by more than one-third; in Pennsylvania and Alabama, where only small quantities were produced, there was slight decrease and increase, respectively.

In the following table is given the value of millstones, chasers, and rider or drag stones produced in the United States from 1908 to 1912, inclusive:

Value of millstones produced in the United States, 1908–1912, by States.

State.	1908	1909	1910	1911	1912
New York	$18,341	$13,138	$13,753	$13,335	$34,246
Virginia	7,954	} 22,255	5,273	17,635	25,866
North Carolina	4,052		} 9,191	9,099	9,352
Pennsylvania	1,073				} 1,950
Alabama	....				
Total	31,420	35,393	28,217	40,069	71,414

The following table gives the value of millstones produced in the United States since 1880:

Value of millstones produced in the United States, 1880–1912.

1880	$200,000	1897	$25,932
1881	150,000	1898	25,934
1882	200,000	1899	28,115
1882	150,000	1900	32,858
1884	150,000	1901	57,179
1885	100,000	1902	59,808
1886	140,000	1903	52,552
1887	100,000	1904	37,338
1888	81,000	1905	37,974
1889	35,155	1906	48,590
1890	23,720	1907	31,741
1891	16,587	1908	31,420
1892	23,417	1909	35,393
1893	16,639	1910	28,217
1894	13,887	1911	40,069
1895	22,542	1912	71,414
1896	22,567		

IMPORTS.

The imports of burrstones and millstones for consumption in the United States in 1912 amounted to $27,562, as compared with $36,028 in 1911. The decrease was in material imported in the rough, the imports of finished stones, which have never been large, having increased somewhat over that of the three preceding years. The value of the imports of burrstones and millstones during the last five years is given in the following table:

Value of burrstones and millstones imported and entered for consumption in the United States, 1908–1912.

Year.	Rough.	Made into millstones.	Total.	Year.	Rough.	Made into millstones.	Total.
1908	$16,075	$2,567	$18,642	1911	$35,153	$875	$36,028
1909	22,125	465	22,590	1912	26,236	1,326	27,562
1910	33,740	1,023	34,763				

THE MILLSTONE INDUSTRY.

In this report for 1909 notes were given on the millstone industry in New York and Virginia. The industry is one which undergoes little change from year to year, and statements made in the former report still hold; the descriptions are therefore given again below.

New York.—New York has led for many years in the production of millstones and chasers, the latter term being applied to stones which run on edge or on a horizontal shaft. The raw material is obtained in Ulster County, southeastern New York, and is known as Esopus stone, Esopus being an early name for Kingston, which was formerly the main point of shipment. The material suitable for millstones is quarried from the Shawangunk conglomerate, which is found near the western base of Shawangunk Mountain, in the valley of Rondout River. This material is exceedingly scanty, being confined in linear extent to a strip extending from High Falls on the north to Kerhonkson on the south, a distance of approximately 10 miles. Beyond these limits the texture and other properties of the rock have been found unsuitable for the highest grade of stones.

The methods employed in quarrying the rock are simple. The rock is pried or split out, advantage being taken of the joint planes, especially the concentric-surface joints. The tools used are the ordinary hand drill, together with plugs and feathers. Blasting is often resorted to, but the charges of powder are usually light. The rough stones thus obtained are quarry dressed and finished, these operations being performed entirely by hand, the chief tools employed being the bull point and the hammer. The operation of drilling the "eye" is performed by centering the stone and then drilling from the center of both faces inward. In many stones the eye is square. To fashion a square eye a round eye is first drilled out and then squared up. A few of the men engaged in the industry make a modification of the regular millstone for use in grinding paint. In this modification the ordinary millstone is cut in halves and an iron casting is placed between the halves, which are then joined together by an iron band.

Chasers are larger than the regular millstones. They are used for heavier work, such as grinding quartz, feldspar, barytes, etc., and, as already mentioned, they run on edge. Though they are made with a diameter as short as 24 inches, they are usually turned out with diameters ranging from 50 to 84 inches, and are as much as 22 inches in thickness. These chasers are run on pans paved with roughly cubical blocks of the conglomerate, with edges about a foot in length. In grinding quartz in such pans the chasers are used in the preliminary crushing; then rough blocks, usually three in number, are either attached to or carried along by lateral arms, which in turn are joined to a vertical revolving shaft. By the circular movement of these blocks the material placed in the pan is ground to powder.

There were 14 operators in New York in 1912. One quarry was reported idle during the year and one former operator has gone out of business.

Virginia.—The millstone industry in Virginia is confined to quarries near Prices Fork, Montgomery County, about 5 miles west of Blacksburg, the site of the Virginia Polytechnic Institute. The rock is regarded as of Mississippian (lower Carboniferous) age. The material from which the stones are quarried varies from a normal conglomerate to a fine-grained quartzitic rock. It includes pebbles, some of them as large as walnuts, though most of them are smaller. The rock has a bluish cast. Its bedding planes are very distinct, and layers only an inch thick may be observed. It is extremely hard and tough and resists erosion to a marked degree. It underlies Brush Mountain for miles, and for this reason the millstones are frequently termed Brush Mountain stones. The stone can not be quarried by blasting, and it is therefore extracted by hand power, with drill and hammer, plug and feathers. Millstones and drag or rider stones are the principal products made at the Virginia quarries.

Five operating firms or individuals reported production during 1912. One of these sold out during the year.

North Carolina.—Three operators reported production of millstones near Salisbury, Rowan County.

Pennsylvania.—Millstones were made at East Earl and Lincoln, Lancaster County.

Alabama.—A few millstones were quarried and made at Dutton, Jackson County.

GRINDSTONES AND PULPSTONES.

PRODUCTION.

The value of the grindstones and pulpstones produced in the United States in 1912 was $916,339, an increase of $9,023, or 1 per cent, as compared with the value for 1911. The increase appears in the value of the pulpstones, the value of grindstones having declined slightly as compared with 1911. As stated in previous reports, the grindstone industry is in a normally healthy condition, and although the output for 1910 was slightly below that for 1909, the recent advance in value of production has been steady, barring of course the depression in the grindstone and all other industries in 1908. In 1911, for the first time in the history of the grindstone and pulpstone industry, the value of the production amounted to more than $900,000.

In the following table is given the value of grindstones and pulpstones during the six years 1907 to 1912, inclusive:

Value of the production of grindstones and pulpstones, 1907–1912.

1907	$896,022	1910	$796,294
1908	536,095	1911	907,316
1909	804,051	1912	916,339

The States producing grindstones in 1912 were Ohio, Michigan, West Virginia, Montana, and Utah, the production of the first two States named being by far the most important. Ohio as usual maintained the leading position in the industry, the value of the grindstone production of the State being between six and seven times that of Michigan. Ohio also produced pulpstones. The output of grindstones in other States was small as compared with that of the two leading States.

The following table shows the value of grindstones and pulpstones produced in the United States from 1908 to 1912, by States:

Value of grindstones and pulpstones produced in the United States, 1908–1912, by States.

State.	1908	1909	1910	1911	1912
Colorado		(a)	(a)	(a)	
Michigan	(a)	(a)	(a)	(a)	(a)
Montana	(a)			(a)	(a)
Ohio	$482,128	$679,930	$699,033	$742,107	$787,621
Utah					(a)
West Virginia		(a)	(a)	(a)	(a)
Other States	[b] 53,967	[c] 124,121	[c] 97,261	[d] 165,209	[e] 128,718
Total	536,095	804,051	796,294	907,316	916,339

[a] Included in "Other States."
[b] Includes Michigan and Montana.
[c] Includes Colorado, Michigan, and West Virginia.
[d] Includes Colorado, Michigan, Montana, and West Virginia.
[e] Includes Michigan, Montana, Utah, and West Virginia.

The value of the production of pulpstones and grindstones in the United States from 1880 to 1912, inclusive, is shown in the following table:

Value of grindstones and pulpstones produced in the United States, 1880–1912.

1880	$500,000	1897	$368,058
1881	500,000	1898	489,769
1882	700,000	1899	675,586
1883	600,000	1900	710,026
1884	570,000	1901	580,703
1885	500,000	1902	667,431
1886	250,000	1903	721,446
1887	224,400	1904	881,527
1888	281,800	1905	777,606
1889	439,587	1906	744,894
1890	450,000	1907	896,022
1891	476,113	1908	536,095
1892	272,244	1909	804,051
1893	338,787	1910	796,294
1894	223,214	1911	907,316
1895	205,768	1912	916,339
1896	326,826		

IMPORTS.

The value of the imports of grindstones increased in 1912, amounting to $131,080 as compared with $123,727 in 1911. This is the greatest importation recorded during the last five years but was exceeded by that for 1906, which amounted to $134,136.

The imports for the last five years are given in the following table:

Value of pulpstones and grindstones imported and entered for consumption in the United States, 1908–1912.

1908	$80,382	1911	$123,727
1909	99,153	1912	131,080
1910	106,596		

CANADIAN PRODUCTION.[1]

The value of the production of grindstones in Canada in 1912 [2] amounted to $44,290 as compared with $52,942 in 1911. In the

[1] From reports of Canada Dept. Mines.
[2] Preliminary report on the mineral production of Canada during 1912, Canada Dept. Mines, 1913, p. 8.

following table is given the value of the Canadian production of grindstones during the last five years:

Value of production of grindstones in Canada, 1908–1912.

1908	$45, 128	1911	$52, 942
1909	50, 944	1912	44, 290
1910	47, 196		

OILSTONES AND SCYTHESTONES.

PRODUCTION.

The production of oilstones (including hones and whetstones) and scythestones in the United States during 1912 amounted to $232, 218 in value, an increase of $17,227 as compared with the value for 1911. Oilstones were produced in Arkansas, Indiana, Ohio, and Kentucky, especially in Arkansas, which has led in the production for many years. New Hampshire led in the production of scythestones, but Vermont, Ohio, Michigan, and Utah also contributed important quotas. A description of the scythestone industry in New Hampshire was given in this report for 1909, and a description of Arkansas oilstones, oilstone deposits, and industry was included in this report for 1911. In the following table is given the value of oilstones (including whetstones) and scythestones produced in the United States since 1891:

Value of oilstones and scythestones produced in the United States, 1891–1912.

1891	$150, 000	1902	$221, 762
1892	146, 730	1903	366, 857
1893	135, 173	1904	188, 985
1894	136, 873	1905	244, 546
1895	155, 881	1906	268, 070
1896	127, 098	1907	264, 188
1897	149, 970	1908	217, 284
1898	180, 486	1909	214, 019
1899	208, 283	1910	228, 694
1900	174, 087	1911	214, 991
1901	158, 300	1912	232, 218

IMPORTS.

The following table shows the 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, 1908–1912.

1908	$44, 304	1911	$54, 379
1909	68, 018	1912	45, 398
1910	45, 819		

CORUNDUM AND EMERY.

PRODUCTION.

The United States produced no corundum in 1912, and has produced none since 1906. The entry in the following table for 1912 is for emery, which came from Chester, Hampden County, Mass., and from near Peekskill, Westchester County, N. Y. The domestic production of emery in 1912 amounted to $6,652 in value, or 1.33 per cent of the imports. This ratio between domestic production and imports is smaller than that of 1911, but 1912 was marked by a notable increase in the imports and a slight decrease in the value of the domestic production. The decline in value of output in 1912 amounted to $126, or about 1.86 per cent, and the increase in quantity was 333 short tons, or 50 per cent. The value of the material per ton was $6.70, compared with $10.29 in 1911. The statement of value represents the material as shipped from the mines, where it undergoes a rough sorting or cobbing.

In the following table are given the quantity and value of the emery produced in the United States since 1906, the figures for the preceding years including the value of corundum:

Annual production of corundum[a] and emery, 1881–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1881	500	$80,000	1897	2,165	$106,574
1882	500	80,000	1898	4,064	275,064
1883	550	100,000	1899	4,900	150,600
1884	600	108,000	1900	4,305	102,715
1885	600	108,000	1901	4,305	146,040
1886	645	116,190	1902	4,251	104,605
1887	600	108,000	1903	2,542	64,102
1888	589	91,620	1904	1,916	56,985
1889	2,245	105,567	1905	2,126	61,464
1890	1,970	89,395	1906	1,160	44,310
1891	2,247	90,230	1907	1,069	12,294
1892	1,771	181,300	1908	669	8,745
1893	1,713	142,325	1909	1,580	18,185
1894	1,495	95,936	1910	1,028	15,077
1895	2,102	106,256	1911	659	6,778
1896	2,120	113,246	1912	992	6,652

[a] No production of corundum since 1906.

IMPORTS.

The following table gives the quantity and value of the emery and corundum imported into the United States from all foreign countries during the last five years. The year 1912 was marked by an increase in the imports as compared with the preceding year. Both the quantity and the value of the imports have fluctuated irregularly during the last decade.

Emery and corundum imported into the United States, 1908–1912.

Year.	Grains.		Ore and rock.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Long tons.*			
1908	1,735,366	$89,702	8,084	$146,105	$12,592	$248,399
1909	2,696,960	132,264	9,836	186,930	19,803	338,997
1910	2,311,464	106,570	28,948	509,661	13,527	629,758
1911	1,382,813	76,027	10,822	245,459	15,158	336,644
1912	2,135,922	105,325	16,391	379,529	16,871	501,725

CANADIAN CORUNDUM.

The Manufacturers' Corundum Co. controls and makes the whole of Canadian production of corundum. The production in 1912 amounted to 1,960 short tons, valued at $239,091, or 6⅜ cents a pound.[1]

Shipments of Canadian corundum, 1908–1912, in short tons.

The following table gives the quantity and value of Canadian corundum shipped during the last five years:

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1908	1,089	$100,398	1911	1,472	$161,873
1909	1,491	162,492	1912	1,960	239,091
1910	1,870	198,680			

ABRASIVE GARNET.

PRODUCTION.

The production of abrasive garnet in 1912 amounted to 4,182 short tons, valued at $137,800. This was an increase of 106 tons in quantity and of $16,052 in value as compared with 1911. The industry was confined, as usual, to three States—New York, New Hampshire, and North Carolina. The statistics of production in the abrasive garnet industry are given below:

Production of abrasive garnet, 1895–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1895	3,325	$95,050	1904	3,854	$117,581
1896	2,686	68,877	1905	5,050	148,095
1897	2,554	80,853	1906	4,650	157,000
1898	2,967	86,850	1907	7,058	211,680
1899	2,765	98,325	1908	1,996	64,620
1900	3,185	123,475	1909	2,972	102,315
1901	4,444	158,100	1910	3,814	113,574
1902	3,926	132,820	1911	4,076	121,748
1903	3,950	132,500	1912	4,182	137,800

INFUSORIAL EARTH AND TRIPOLI.

PRODUCTION.

Infusorial earth and tripoli were produced in 1912 in the following States: California, Connecticut, Georgia, Illinois, Maryland, Massachusetts, Missouri, Nevada, New York, and Virginia. By the term "tripoli" is meant a light porous siliceous rock, supposed to have resulted from the leaching of calcareous material from a siliceous limestone. Infusorial earth is entirely different in its origin. It is made up largely of silica, is a variety of opal, and represents the remains of certain aquatic forms of plant life known as diatoms. The tripoli came from Illinois and Missouri and the diatomaceous or infusorial earth from the other States mentioned. The reasons for combining the figures of production of these two commodities have been outlined

[1] Preliminary report on the mineral production of Canada during 1912, Canada Dept. Mines, 1913, p. 8.

in former reports on abrasives, and therefore will not again be detailed here.

The value of the production for the year 1912 was $125,446 and was less by $22,016 than the value for 1911. The decrease was 15 per cent in the value of tripoli and 22 per cent in the value of diatomaceous earth. The value of the tripoli from Illinois and Missouri was $102,908 and the value of diatomaceous earth was $22,538. It must be recalled, however, in this connection, that a large part of the tripoli and diatomaceous earth produced in the United States is used for other than abrasive purposes. Missouri tripoli is used, for example, to a certain extent, in the manufacture of filter stones and the Illinois product is sized by screening or floating and used as a wood filler, wood polisher, and probably for other purposes.

In the following table is given the value of the production of infusorial earth and tripoli from 1880 to 1912, inclusive:

Production of infusorial earth and tripoli, 1880–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	1,833	$45,660	1897	3,833	$22,835
1881	1,000	10,000	1898	2,733	16,691
1882	1,000	8,000	1899	4,334	37,032
1883	1,000	5,000	1900	3,615	24,207
1884	1,000	5,000	1901	4,020	52,950
1885	1,000	5,000	1902	5,665	53,244
1886	1,200	6,000	1903	9,219	76,273
1887	3,000	15,000	1904	6,274	44,164
1888	1,500	7,500	1905	10,977	64,037
1889	3,466	23,372	1906	8,099	72,180
1890	2,532	50,240	1907		104,406
1891		21,988	1908		97,442
1892		43,655	1909		122,348
1893		22,582	1910		130,006
1894	2,584	11,718	1911		147,462
1895	4,954	20,514	1912		125,446
1896	3,846	26,792			

TRIPOLI IN OKLAHOMA.

A large deposit of tripoli was found near Peoria, Okla., about 8 miles from Seneca, Mo., in 1912, and by way of preparation for production a mill site and railroad siding were made ready. The company organized in New York to develop the deposit plans to supply ground tripoli for abrasive use. The deposit is near the Missouri tripoli field, and is probably a similar occurrence.

TRIPOLI IN ARKANSAS.

Near Butterfield, Hot Springs County, Ark., there is a tripoli deposit which was experimentally worked in 1911, and some of the product was sold. This occurrence [1] is a weathered calcareous siliceous rock simulating the novaculites. The calcite has been leached out, leaving a pure siliceous residue of fine grain.

The novaculite beds at other localities west of Butterfield have also been altered to tripoli.

IMPORTS.

The imports of infusorial earth and tripoli into the United States are not separately recorded by the Department of Commerce, but are included with rottenstone used for similar purposes.

[1] Oral communication from H. D. Miser, United States Geological Survey.

The value of the imports of rottenstone and of tripoli for the last five years has been as follows:

Value of tripoli, diatomaceous earth, and rotten stone imported for consumption into the United States, 1908–1912.

1908	$17,252	1911	$35,665
1909	24,024	1912	24,253
1910	56,657		

PUMICE.

The pumice produced in the United States in 1912 amounted to 27,146 short tons, valued at $86,687. This was an increase of 5,457 tons in quantity and a decrease of $1,712 in value as compared with 1911. In quantity the production is the largest on record, but the average price per ton and the total value were less than those of the two preceding years.

The statistics of pumice given in the table are those of pumice used for abrasive purposes solely. The pumice used for construction—and it is known that some of the domestic article is so used—is not included. The material comes from three States: California, from Inyo County; Kansas, from Phillips County; and Nebraska, from Furnas, Lincoln, and Harlan counties.

The domestic product is almost wholly a finely comminuted material, volcanic dust or "ash." The imported material, which comes from the Lipari Islands, a group of volcanic islands north of Sicily in the Mediterranean Sea, is a massive, very finely pumiceous or vesicular rock. Very little pumice of this type has been produced in the United States.

The production of pumice in the United States during the last five years is given in the following table. The figures for both domestic production and importation are given below:

Production of pumice in the United States, 1908–1912, in short tons.

Years.	Quantity.	Value.	Price per ton.
1908	10,569	$39,287	$3.72
1909	15,103	33,439	2.21
1910	23,271	94,943	4.08
1911	21,689	88,399	4.08
1912	27,146	86,687	3.19

Value of pumice imported for consumption into the United States, 1908–1912.

1908	$67,094	1911	$118,977
1909	100,997	1912	74,478
1910	104,425		

ARTIFICIAL ABRASIVES.

The artificial abrasives include carborundum, alundum, and crushed steel. Other abrasives, or rather abrasives with other names, which have appeared on the market during the last few years, are forms of the abrasives named adapted to special uses. Such, for example, are aloxite and samite, forms of carborundum, and carborundum fire sand. The abrasive known as "corubin," so far as is known, is not made in this country, but is an European product. Alundum, whose manufacture has been detailed in this chapter in previous years, is finding extended use in the refractory as well as in the abrasive industry.

The production of artificial abrasives since 1906 is given in the following table:

Production of artificial abrasives in the United States, 1906–1912, in pounds.

Year.	Quantity.	Value.
1906	11,774,300	$777,081
1907	14,632,000	1,027,246
1908	8,698,000	626,340
1909	20,468,000	1,365,820
1910	23,027,000	1,604,030
1911	21,292,000	1,493,040
1912	29,002,000	1,747,120

ARSENIC.

By Frank L. Hess.

PRODUCTION AND IMPORTS.

In 1912, as in the four preceding years, the only white arsenic (arsenious oxide, As_2O_3) produced in the United States was that made by the Anaconda Copper Mining Co., the American Smelting & Refining Co., and the United States Smelting Co. as a by-product at their smelters. They made a total of 3,141 short tons, valued at $190,757, an increase of about 9 tons in quantity and of $117,349 in value over the record production of 1911, during which year the output was 3,132 tons, valued at $73,408. The prices given in the returns averaged 3.07 cents a pound f. o. b. New York, but ranged from 2.43 to 3.28 cents a pound.

In view of the much better prices prevailing in 1912 than in 1911, it is rather surprising that there was not a larger increase in production, but instead of an increase one company's output showed a decrease of about 10 per cent.

The imports of arsenical compounds were also the largest on record, amounting to more than 6,156 short tons, valued at $428,741, or about 3.48 cents a pound. The imports include white arsenic, arsenic acid, elemental arsenic, and arsenic sulphides. Of this quantity, it is thought that between 5 and 10 tons only were elemental arsenic, and that sulphides, the yellow sulphide, orpiment ($As_2 S_3$), and the red sulphide, realgar (AsS), amounted to only a few tons. There were also considerable imports of sodium arsenate and other arsenic salts, of which no separate record was kept.

Of the white arsenic produced in this country, the product of the Anaconda Copper Mining Co., at Butte, Mont., was saved from the fumes of the Washoe copper smelter. The arsenic produced at Midvale, Utah, was saved from the fumes made in smelting lead ores of that State. Most of the remainder came from smelter dusts saved at various plants, a part of the dusts coming from foreign ores, among which are those from Daly, British Columbia, which are said to be highly arsenical.

The domestic production and the imports of arsenic compounds of which a record is kept at the custom houses since 1902 are given in the following table:

Production and imports of arsenic, 1902–1912.

Year.	Production of white arsenic.		Imports.[a]			
			"Arsenic or arsenious acid" and "Arsenic, and arsenic sulphide or orpiment."		Paris green and London purple.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (pounds).	Value.
1902	1,353	$81,180	4,055	$280,055		
1903	611	36,691	4,179	294,602		
1904	36	2,185	3,400	243,380	28,498	$985
1905	754	35,210	3,838	256,540	44,931	1,118
1906	737	63,460	3,987	350,045	311,293	21,347
1907	1,751	163,000	5,164	574,998	133,422	21,919
1908	(b)		4,964	430,400	195,000	30,764
1909	1,214	52,946	4,036	303,728	183,765	20,370
1910	1,497	52,305	5,139	314,306	181,363	14,648
1911	3,132	73,408	4,096	247,323	126,191	4,972
1912	3,141	190,757	6,156	428,741	162,272	6,950

[a] Figures furnished by the Division of Statistics, Bureau of Foreign and Domestic Commerce.
[b] There were only two producers of arsenic in the United States in 1908, so that the figures of production may not be given.

Under the head of "Arsenic or arsenious acid," 3,103 tons, valued at $200,616, were imported in 1912, and under the head of "Arsenic and arsenic sulphide, or orpiment," the Monthly Summary of the Division of Statistics, Bureau of Foreign and Domestic Commerce, for December gives 3,379 tons, valued at $246,815, but the quarterly reports give the quantity used above, 3,103 tons, valued at $228,125.

There is no duty on most arsenical compounds imported, and they are not very carefully designated in the customs returns. Arsenious acid is evidently a misnomer, as (see article on "Arsenic," Watts's Chemical Dictionary) arsenious acid has probably not been isolated.

Arsenic acid is imported in iron or steel drums as an aqueous solution carrying about 80 per cent H_3AsO_4. One entry of "arsenic paste" was probably also arsenic acid. Besides the items given, imports of a number of tons each of copper arsenate, arsenic chloride, and lead arsenate, and 332 tons of sodium arsenate, valued at $22,919, were made during the year.

Although the domestic production of white arsenic (As_2O_3) and the imports of arsenical compounds in 1912 were the largest ever made, the New York price of white arsenic, as quoted by the Oil, Paint, and Drug Reporter, rose steadily from 2.5 cents a pound at the beginning of the year to 5.5 cents in the later part of October. During the remainder of the year the price remained at 5 to 5.5 cents, presenting a marked contrast to that in 1911, when the New York price was 1.5 cents a pound in June and part of the smelter product sold at 0.8695 cent f. o. b. at the smelter.

The prices for white arsenic in 1912 were the highest since 1907, when the New York price ranged from 5 to 8.5 cents. The prices for both years were much above the average, as shown by the value of the imports since 1868, the earliest record at hand. During recent years the imports, in part at least, have been valued at a somewhat higher figure than the New York price, but whether this difference in valuation prevailed formerly is unknown to the writer.

At any rate, as arsenical compounds have generally been admitted duty free, there has been little reason for making the invoices at less than the market prices.

The following table has been compiled as the only feasible method known to the writer to show comparative prices since the first records of imports available:

Imports and value of arsenic compounds since 1868[a] in short tons.

Year.	Quantity.	Value.	Price per pound, in cents.	Classification.
Fiscal year ending June 30—	*Short tons.*			
1868	721	$19,191	1.33	Arsenic.
1869	721	29,450	2.04	Do.
1870	283	12,463	2.23	Do.
1871	665	29,822	2.24	Do.
1872	555	30,337	2.73	Do.
1873	381	22,367	2.94	Arsenic and arsenious acid.
1874	888	47,393	2.67	Do.
1875	1,216	53,582	2.20	Do.
1876	254	16,642	3.28	Do.
1877	1,297	71,969	2.78	Do.
1878	1,247	57,213	2.30	Do.
1879	1,241	53,631	2.16	Do.
1880	1,360	62,357	2.29	Do.
1881	1,113	54,056	2.42	Arsenic only.
1882	1,724	91,396	2.65	Arsenic and arsenious acid.
1883	2,805	139,513	2.49	Do.
1884	1,847	83,316	2.26	Arsenic.
1885	1,684	85,782	2.55	Do.
1886	2,521	101,371	2.01	Do.
1887	1,795	78,883	2.20	Do.
1888	3,555	163,645	2.30	Do.
1889	4,352	220,596	2.54	Do.
1890	4,248	229,109	2.70	Do.
1891	2,672	161,367	3.02	Do.
1892	2,467	124,027	2.50	Do.
1893	3,664	207,516	2.83	Do.
Calendar year—				
1893	3,046	180,333	2.96	Arsenic, As_2O_3, AsS, As_2S_3.
1894	3,532	218,636	3.10	Do.
1895	3,492	237,747	3.40	Do.
1896	2,907	215,281	3.71	Do.
1897	3,621	352,284	4.87	Do.
1898	4,343	370,347	4.26	Do.
1899	4,520	386,791	4.28	Do.
1900	2,883	265,500	4.61	Do.
1901	3,495	316,525	4.53	Do.
1902	4,055	280,055	3.46	Do.
1903	4,179	294,602	3.53	Do.
1904	3,400	243,380	3.58	Do.
1905	3,838	256,540	3.34	Do.
1906	3,987	350,045	4.39	Do.
1907	5,164	574,998	5.52	Do.
1908	4,964	430,400	4.34	Do.
1909	4,036	303,728	3.76	Do.
1910	5,139	314,306	3.06	Do.
1911	4,096	247,323	3.01	Do.
1912	6,156	428,741	3.48	Do.

[a] These figures are taken from "Imports and exports, Part I; Imports from 1867 to 1893, inclusive," by Charles H. Evans, S. Rept. No. 259, 53d Cong., 1894; "Imports and duties, 1894–1907," by William W. Evans, Washington, 1908; and the records of the Bureau of Manufactures and Commerce. To 1893 only records by fiscal years ending June 30 can be obtained. From 1868 to 1872 only "arsenic" imports are given. From 1873 to 1883 both "arsenic" and "arsenious acid" were enumerated except in 1881 when no imports of arsenious acid are shown. From 1884 to 1893 only "arsenic" is noted. From 1893 to 1912, inclusive, the imports are designated as "arsenic or arsenious acid" and "arsenic and sulphide of, or orpiment," which, owing to the uncertainty of the articles entered under these terms, have been combined. During the last 10 years white arsenic and probably true arsenic acid have been imported under the head of "arsenic or arsenious acid." So far as can be learned, elemental arsenic, both orpiment and realgar, white arsenic, and possibly other compounds, are included under "Arsenic and sulphide of, or orpiment."

The prices given are, of course, composites and are not exact for any arsenic compound, but they show the relative prices for the last 46 years with sufficient exactness to permit a fair general comparison and to indicate the trend of prices. The values given for the imports for 1911 in particular are probably too high.

CONSUMPTION.

The consumption of arsenic is practically equivalent to the domestic production plus the imports, but besides these a small quantity of arsenic is produced in arsenical or hard lead in smelting arsenical gold and silver ores, and is used for making shot. The use of this hard lead corresponds to the use of antimonial lead similarly produced in smelting. The consumption amounted to about 9,300 short tons of white arsenic, arsenic acid, arsenic sulphide (orpiment and realgar), and elemental arsenic, and 81 tons of Paris green and London purple of foreign production. With the copper arsenate, sodium arsenate, arsenic chloride, arsenical sheep dip (valued at $41,556, arsenic content not given), lead arsenate, and other unrecorded imports of arsenic compounds, it is probable that the total consumption was equal to more than 10,000 tons of arsenic compounds.

USES.

White arsenic is used principally in glass making and in the manufacture of Paris green, lead arsenate, and other insecticides. About 1,621 tons were used in the manufacture of glass during 1911 and the manufacturers estimated that about the same quantity would be used during 1912. The use of arsenic in glass making seems to be largely rule of thumb practice. It is claimed by some that it forms arsenides with iron and other impurities and causes them to settle to the bottom of the melt, and apparently on this theory its use in making window glass from tanks has almost if not entirely ceased in the United States, for, it is claimed, owing to the size of the tanks the impurities settle without the use of arsenic.

It is used in most pot furnaces, but in many places is being replaced by antimony oxide and "needle antimony" (stibnite, native sulphide of antimony). The introduction of impurities, especially iron, which is present in most native sulphides of antimony, would seem to be objectionable. Some flint-glass factories use none and no substitute, but others use as much as 60 tons of white arsenic a year. A few factories use arsenic sulphide (orpiment, As_2S_3) in places of white arsenic. The plate-glass factories use large quantities of white arsenic, the consumption of a single firm reaching 5 tons a month, or between 50 and 60 tons a year. Glassmakers who have studied the subject carefully state that arsenic apparently enters directly into the composition of the glass and probably tends to make a clear glass.

A great quantity of arsenic and arsenate of soda is now being used in the manufacture of Paris green and lead arsenate, and in less quantity in making other compounds for insecticides. With the growth of horticulture and the necessarily greater attention paid to killing insect pests, the demand for arsenical insecticides has grown immensely.

Returns from manufacturers indicate that about 2,500 tons of white arsenic and 300 tons of arsenate of soda were used in 1912 in the manufacture of Paris green, lead arsenate, and zinc arsenate. Arsenate of soda is largely used in making lead arsenate.

Orpiment (arsenic sulphide, As_2S_3) seems to be mostly used in textile dyeing, and was once much used in removing hair from skins to be made into leather, but is being replaced by other compounds.

Elemental or "metallic" arsenic is used, so far as is known, only in shot making, and only a few tons, probably from 5 to 10, a year are consumed. It is said to make the shot take a rounder form, and it also makes it harder.

From the uses enumerated it will be seen that most of the arsenic used is unrecoverable—once used it is gone forever—and there is little or none of the secondary recovery possible which is practiced with tin, lead, iron, and other metals.

BORAX.

By Charles G. Yale and Hoyt S. Gale.

GENERAL CONDITIONS.

In 1912 the production of borate ores in the United States was 42,315 short tons, valued at $1,127,813, as compared with 53,330 tons in 1911, valued at $1,569,151. The quantity stated is the crude ore as mined for delivery at the mill or for shipment. The value assigned is based on the reported boric-acid content of the ore produced. A price of $1 per unit per cent of anhydrous boric acid (boron trioxide B_2O_3) is believed to approximate closely the shipping value of the ores as now produced. On this basis colemanite ore which analyzes 35 per cent boron trioxide is computed at a value of $35 per ton.

All of the borax in this country is now produced from ores derived from California; in fact, virtually the entire product is derived from 4 mines—1 in Inyo County, 1 in Los Angeles County, and 2 in Ventura County. A property in Ventura County resumed production to a small extent in 1912 after having been closed since 1907. There are a considerable number of other large deposits of colemanite ore similar to that now being mined, all of these, so far as now known, being situated in the State of California. Formerly borax was obtained from the so-called marsh deposits, which were worked in Nevada, California, and Oregon.

GENERAL DISTRIBUTION OF BORAX DEPOSITS IN THE UNITED STATES.

The accompanying map (Pl. I) is based in greater part on data from Prof. Gilbert E. Bailey, of the University of Southern California, concerning the California localities. The map shows the more important localities from which borax or borate minerals have been reported and which consist in greater part of the marsh and hot-spring deposits. Present production is limited to a few of the colemanite properties. The legend giving the names of the various deposits in California is also furnished in greater part by Prof. Bailey, the data concerning Oregon and Nevada localities having been added by the writer. Since the first publication of this map in the Mineral Resources report for 1911 the writer has visited a considerable number of these localities.

The following list gives the names of the localities indicated by numbers on the map:

1. Chetco, Curry County, Oreg. Priceite was mined.
2. Marsh deposits near Lake Alvord, Harney County, Oreg.
2½. Marsh deposits near Warner Lake, Harney County, Oreg.
3. Tuscan Springs, Tehama County, Cal. First discovery of borated waters by Veatch.
4. Clear Lake, Lake County, Cal. First workings in California.
5. Solano beds, Fairfield, Solano County, Cal.
6. Hot Springs waters at Gerlach, Washoe County, Nev. Borax plant established at one time.
7. Soda Lakes (Ragtown Ponds), near Fallon, Churchill County, Nev.
8. Salt Wells, Churchill County, Nev. Old marsh borax plant.
8½. Dixie Valley, Churchill County, Nev. Marsh borax.
9. Rhodes Marsh, Esmeralda County, Nev. Former large workings.
10. Teels Marsh, Esmeralda County, Nev. Former large workings.
11. Columbus Marsh, Esmeralda County, Nev. Former large workings.
12. Fish Lake Valley, Esmeralda County, Nev. Marsh deposits; former large workings.
13. Saline Valley, Inyo County, Cal. Marsh deposits; former workings.
14. Coleman (Furnace Creek ranch), Inyo County, Cal. Main works of the 20-mule teams, 1883.
15. Mount Blanco, and other deposits on Furnace Creek, Inyo County, Cal. Large undeveloped deposits of colemanite.
16. Lila C. mine, Ryan, Inyo County, Cal. Colemanite. Property of Pacific Coast Borax Co.; largest producer.
16½. Ash Meadows, Nev., borate spring waters.
17. Panamint Range, Inyo County, Cal. Colemanite reported.
18. El Paso Peak, Inyo County, Cal. Colemanite reported.
19. South end of Death Valley, Inyo County, Cal. Colemanite reported.
20. Resting springs, Zabriskie, Inyo County, Cal. Worked in 1883.
21. China Lake (Mesquite Springs), Kern County, Cal. Worked in 1883.
22. Colemanite reported.
23. Cane Lake, Kern County, Cal. Marsh deposits formerly worked.
24. Rodriguez Lake, Kern County, Cal. Borax locations; never produced.
25. Searles Lake, San Bernardino County, Cal. Marsh deposits formerly worked.
26. Slate Range, San Bernardino County, Cal. Colemanite reported.
27. Town of Borate, San Bernardino County, Cal. Formerly principal works of Pacific Coast Borax Co.
28. American Borate Co.'s works, San Bernardino County, Cal. Recently abandoned.
29. Palms Borate Co.'s mine and plant, San Bernardino County, Cal. Closed down.
30. Property of Palms Borate Co., San Bernardino County, Cal.
31. Mohave Canyon borax mine, San Bernardino County, Cal.
32. Frazier mine, Ventura County, Cal. Colemanite.
32½. Russell Borate Mining Co.'s mine, Ventura County, Cal. Colemanite.
33. National Borax Co. (old Columbus mine), Ventura County, Cal. Colemanite.
34. Lang, Los Angeles County, Cal. Sterling Borax Co.; colemanite; large producer.
35. Mud Volcanoes, Imperial County, Cal. Borax present in waters.

DEVELOPMENT OF BORAX INDUSTRY.

The principal deposits that have been worked as a source of boric acid and borax in the United States fall into several somewhat distinct classes or types.

The first type of borate deposit to be worked in this country consisted of borax in certain natural waters, the borax being extracted by concentration of these solutions. Many springs, especially hot springs, and also a number of the saline lakes of the States mentioned above are known to contain borax in solution ranging in quantity from a trace to quite a considerable percentage. The first workings in California were of waters of this type at Clear Lake, Lake County, about 80 miles almost due north of San Francisco. Borax was discovered in these waters in 1859 by Dr. John A. Veatch, and a commercial production was first established in 1864. At first borax was obtained by evaporation of the lake water, but this was later supplemented by the collection and washing of natural borax crystals which were found embedded in the mud on the bottom of the lake.

MAP SHOWING BORAX DEPOSITS IN THE UNITED STATES.

Based on data furnished chiefly by Gilbert E. Bailey.

The lake water according to one analysis contained 7.66 per cent of dissolved salts, a little over 5 per cent of which was anhydrous boric acid, that is less than 0.4 per cent of the lake water itself.

The occurrence of borax in natural saline waters is believed to be of similar origin to the free boric acid of certain volcanic emanations, an occurrence which has been very widely recognized. One of the principal sources of borax or boric acid in Europe, from which this substance has been produced on a large scale and for a very long time, is the gases, steam, and hot waters of volcanic fumaroles in the Province of Tuscany, in Italy. These waters are ponded in lagoons, where they are concentrated by evaporation accelerated by their own natural heat, and the boric acid is obtained by crystallization as the waters cool.

The second or "marsh" or "dry-lake" type of deposit was based on the discovery of certain borate minerals contained in the saline incrustations that are common throughout the desert region, especially in California and Nevada. In the early days of the borax industry this type of deposit came to yield practically the entire output for a considerable period of time. These saline deposits are the product of evaporation of saline waters which, having been accumulated in undrained reservoirs through long periods of time, have in many places reached considerable magnitude. Fish Lake, Columbus, Rhodes, and Teels marshes in southwestern Nevada near the California line were among the first of this type to be worked and yielded for a time a large production of borax. Dixie Valley and Alkali Valley, near Fallon, and salts on the Black Rock Desert, near Gerlach, in Washoe County, were also worked in Nevada, and Death Valley, Searles Lake (also known as Borax Flat), China Lake, Cane Lake, and Saline Valley in California. In Oregon deposits at the south end of Lake Alvord, in Harney County, were worked for about five years, and it is reported that similar deposits near the Warner Lakes, in Harney County, were also worked.

It appears likely that the borax found in the "marsh" or "dry-lake" deposits may have been primarily derived from the boric acid of adjacent springs, commonly warm or hot springs, so that its ultimate source may be found in volcanic emanations, as in the example cited in the Tuscan fumaroles.

The most characteristic borate mineral of the "marsh" deposits is ulexite, commonly known as "cotton ball," a hydrous borate of sodium and calcium, occurring on the surface of the deposits in white rounded masses composed of fine silky fibers in loose tufts. It is practically insoluble in cold water and but slightly so in hot water. Doubtless the borates contained in the mass of the saline crust include other mineral forms, such as the natural borax, known as tincal.

The method of working the "marsh" borates was simple. The saline mud was shoveled from the surface of the deposit, some portions of the areas having been found by testing to be richer than others. This material was carted to long, semicylindrical iron pans, set in arches of dried mud or stone, and fired beneath with wood fuel obtained in the vicinity. The pans being charged with water, the crude material was thrown in and stirred with poles until, with the aid of heat, all of the soluble salts dissolved. The fires were then withdrawn and the solution allowed to settle, whereupon the clear liquor was drawn off into adjacent vats and the borax crystallized out. The crystals thus obtained were pure enough for shipment. It is believed that in certain deposits where soluble carbonates were not already present in excess sodium carbonate was also added to the solution to break up the combination of lime and boric acid, as found in the "cotton ball."

Bedded mud or clay deposits north of Daggett, Cal., containing low-grade borates of lime, furnished a third and somewhat less important phase in the development of the borax industry. Extensive plants were erected in 1901 for the extraction of boric acid from these mud deposits, but they were forced to suspend operation with the increased development of the higher-grade colemanite ores.

The final stage in the establishment of the borax industry on essentially its present basis came with the recognition and development of deposits of the calcium borate mineral colemanite. Colemanite was first found in Death Valley, Inyo County, Cal., in 1882, and in the following year the deposits were discovered in the vicinity of the old Calico mining district, about 12 miles north of Daggett, in San Bernardino County, and later at many places in similar formations of the same general region that had previously been worked for the marsh and mud borate deposits. The production of borax and boric acid is now derived wholly from these borate of lime deposits, in which colemanite furnishes the entire source of supply.

Colemanite, a borate of lime, contains in its pure form boron trioxide, 50.9 per cent; lime, 27.2 per cent; and water, 21.9 per cent. It is a white, massive, crystalline mineral, frequently colored to darker hues by impurities, but somewhat resembling calcite in general appearance. It has a very distinct cleavage and is commonly found in clear, glassy crystals with well-developed forms.

Colemanite has hitherto been described as a bedded deposit, interstratified in the Tertiary lake sediments, which have so wide a distribution in the general region in which the deposits occur. On the basis of recent observation, however, it is now believed that most and probably all of the colemanite deposits are of vein origin and not bedded deposits, as has been assumed. These ores are obtained by ordinary mining methods, usually underground developments. They exist in deposits usually of extreme irregularity, but sometimes reaching great size.

The colemanite as mined is of varying degrees of purity, the commercial ore ranging from 20 or 25 per cent boron trioxide (anhydrous boric acid) to nearly 40 per cent as shipped. The higher-grade ores are generally shipped crude to refineries near markets or distributing points. At several of the colemanite mines roasters and mills have been installed for separating and purifying the ore and driving out water of crystallization in the mineral before shipment.

The reduction of colemanite to borax and boric acid is accomplished by reaction with sodium carbonate, forming the soluble borax. The borax is crystallized in vats, the method in general resembling the crude processes applied in the earlier days of the industry.

As to the reserve of colemanite ores, the impression seems to have gained some credence that this mineral has already been found in so many places and in such quantities in relation to the limited demand for borax and boric acid in the present market, that there need be no fear of the exhaustion of the deposits. It is true that large undeveloped deposits of colemanite are already known, and that beyond the normal increase in the use of these substances from year to year the amount of present production can hardly be forced. So long as the pure colemanite deposits last, unless they fall into monopolistic control, the price of borax will probably be low, as it now is (about 4 cents a pound, New York quotations on refined borax). On the other hand, in nearly all deposits mining of colemanite has proceeded with great rapidity and possibly in a more or less wasteful way. Mining entries are generally driven ahead more or less at random, the pockets of ore being "gutted" and shipped before attention is directed to the blocking out of ore in reserve. For this the keen competition in the borax market has been responsible. From this condition it may be concluded that even the large deposits of colemanite now known will not last indefinitely, and the exhaustion of one after another of the workable deposits is anticipated. Since the discovery of colemanite in 1882 at least one large district has been worked out and abandoned.

From the foregoing, however, it is not necessary to predict catastrophe to our domestic production of borax. Even should the richer deposits ultimately become exhausted, there are many other possible sources of supply, including the marsh deposits formerly worked, to which recourse could again be had. More important than this, a new factor is entering the field of the borax industry with very recent developments. The natural saline deposits of the western desert region have come into prominence as a possible source of potash, carbonate of soda, common salt, and other products, including borax as one of the very promising marketable by-products of any industry which may succeed in developing the other salts on a commercial basis. Borax in this form may be produced in such quantities as to become a very potent factor in the market. Positive predictions on this point can not, however, be made pending experimental tests of projects already reported to be under way.

USES OF BORAX AND BORIC ACID.

In previous chapters in the Mineral Resources of the United States the various uses to which borate compounds may be put have been enumerated. Borax is used in many trades, and it is not easy even for the producers of the substance to tell in what particular way it is used. Records in the sales department of one of the largest producers in the United States show that the following trades, duly classified, are the purchasers of borax:

For enameling—in crockery establishments, by enamelers, potters, and tile manufacturers. For food—in baking powder, butcher supplies, creameries, dairies, food preservatives, flavoring extracts; by fish and food packers, meat packers, sirup and pickle manufacturers. For kitchen and toilet—by borax packers, dealers, wholesale dealers, department stores, dry goods stores, general stores, hotels, and mail-order houses. For laundry—in laundry supplies; by soap manufacturers, and starch manufacturers. For manufactures—of automobiles, agricultural implements, axles, axes; by brass and copper smiths, blacksmiths, bicycle manufacturers; in blacking, boilers, candles, casein, cotton, carpets, dyes, electrical supplies, foundries, firearms, glass, glue, hardware and iron, hats, ink, jewelry, lamps; by miners and assayers; in machinery, nickel plates, oil, paints, and varnish, pumps, paper, plumbers' supplies, printing, playing cards, stove polish, steel and wire, sewing machines, shoes, silk, tobacco, tanneries, tools, threads, textiles, wagons and carriages, water clarifiers, welding compounds, willow ware, and watchcases. For medicine—in drug specialties, use in hospitals, by manufacturing chemists, in patent medicines.

PRODUCTION.

The statistics of production of borate ores in California from 1895 to 1912, inclusive, are given in the following table:

Production of borate of lime, or colemanite, in California, 1895–1912.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1895	5,959	$595,900	1904	b 45,647	$698,810
1896	6,754	675,400	1905	b 46,334	1,019,154
1897	8,000	1,108,000	1906	b 58,173	1,182,410
1898	8,000	1,120,000	1907	b 52,850	1,121,520
1899	20,357	1,139,882	1908	b 25,000	975,000
1900	25,837	1,013,251	1909	b 41,434	1,534,365
1901	23,231	1,012,118	1910	b 42,357	1,201,842
1902	a 20,004	2,538,614	1911	b 53,330	1,569,151
1903	b 34,430	661,400	1912	b 42,315	1,127,813

a Refined product, including 2,000 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 1912, inclusive:

Imports for consumption of borax and borates into the United States, 1902–1912, 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
1907	2,268,065	77,258	2,959	175	534,524	23,547
1908	641,632	22,058	40	4	385,064	14,702
1909	7,124	1,023	20,284	1,956	265,985	8,708
1910	6,860	1,170	563	66	336,466	11,164
1911	9,582	732	28,815	5,230	458,900	17,666
1912	9,280	636	16,091	1,861	232,545	8,752

The world's production of borates, etc., 1900–1912.

[Metric tons.]

Year.	United States, calcium borate.	Bolivia, calcium borate.	Chile, calcium borate.	India, borax.	German Empire, boracite.		Italy, boric acid, crude.	Peru, calcium borate.	Argentina, boric acid.	Turkey, boracite.
					Prussia.	Total.				
1900	23,439	....	13,177	224	217	232	2,491	7,080	....	....
1901	21,075	3,065	11,547	162	164	184	2,558	4,156	....	....
1902	18,148	593	14,327	....	172	196	2,763	5,055	....	....
1903	31,235	1,206	16,879	....	135	159	2,583	2,466	....	....
1904	41,411	1,196	1,673	212	115	135	2,624	2,675	....	....
1905	42,034	2,146	19,612	....	151	183	2,700	1,954	....	....
1906	52,774	....	28,996	....	124	161	2,561	2,598	....	....
1907	47,945	....	28,374	....	90	114	2,305	2,451	....	a 13,714
1908	22,680	....	35,039	....	105	128	2,520	2,870	....	a 11,221
1909	37,589	....	32,218	....	123	149	2,431	2,715	805	(b)
1910	38,426	....	(b)	c 319	138	167	2,502	2,351	d 571	(b)
1911	48,381	....	(b)	(b)	(b)	160	2,648	(b)	(b)	(b)
1912	38,388	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)

a Years ending March, 1908, and March, 1909.
b Not available.
c Exports, 1910, was produced in Tibet, but exported from India.
d Exports.

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FLUORSPAR AND CRYOLITE.

By Ernest F. Burchard.

FLUORSPAR.

PRODUCTION.

Among the noteworthy features of the fluorspar industry in 1912 were the large increase in the quantity of domestic spar sold and the decrease in the quantity of spar imported. Newly discovered fluorspar veins are reported near Duffields, Jefferson, Morrison, and Wagon Wheel Gap, Colo., and a small quantity was produced at the first three of these localities. With this increase in interest in this phase of her mining industry, Colorado moves, as a fluorspar producer, from fifth place in 1911 to third place in 1912.

The total quantity of domestic fluorspar reported to the Survey as marketed in 1912 was 116,545 short tons, valued at $769,163, as compared with 87,048 short tons, valued at $611,447, marketed in 1911, an increase in quantity of 29,497 short tons and in value of $157,716. This increase represents nearly 34 per cent of the quantity and nearly 26 per cent of the value of the product marketed in 1911. The production and sales of fluorspar in 1912 were by far the greatest ever recorded. The average price per ton for the whole country, considering all grades of fluorspar, gravel, lump, and ground, was approximately $6.60 in 1912, as compared with $7.02 in 1911, a decrease of 42 cents a ton, or nearly 6 per cent. This value represents the selling price on board cars or barges at railroad or water shipping points, and with reference to the product from Colorado, New Mexico, and New Hampshire, the price reported for much of the spar includes the cost of a long wagon haul—$1.50 to $3 a ton. In Illinois the principal producing mines are near river transportation and the mines reporting from Kentucky in 1912 are near a railroad, so that the cost of long wagon hauls has not entered into the reported value of the fluorspar from those States.

The total quantity of domestic gravel spar marketed in 1912 was 99,285 short tons, valued at $578,294, as compared with 69,825 short tons, valued at $420,932, in 1911, an increase in quantity of 29,460 tons and in value of $157,362. The average price per ton of domestic gravel spar was $5.82 in 1912, as compared with $6.03 in 1911, a decrease of 21 cents a ton. The sales of domestic lump spar in 1912 were 5,315 short tons, valued at $36,553, as compared with 4,402 short tons, valued at $31,831, in 1911, an increase in quantity of 913 tons and in value of $4,722. The average price per ton of lump spar was approximately $6.88 in 1912, as compared with $7.23 in 1911, a decrease of 35 cents a ton. The sales of domestic ground spar in 1912 were 11,945 short tons, valued at $154,316, as compared with 12,821 short tons, valued at $158,684, a decrease in quantity of 876 tons and in value of $4,368.

Fluorspar was produced in 1912 in five States, Illinois, Kentucky, Colorado, New Hampshire, and New Mexico, in the order named. Increases in sales were reported in Illinois and Colorado, and slight decreases in Kentucky, New Hampshire, and New Mexico. Gravel spar was produced by all the States; Illinois and Kentucky reported sales of lump spar, and Illinois of ground spar. The product of the mines in New Hampshire and New Mexico is classed as gravel spar, since it is sold entirely for flux in steel making, but much of the spar shipped from these two States would yield an excellent grade of lump spar if it were hand picked.

For the first time in 12 years it is impossible to give in detail the production of fluorspar from Illinois separately, although between 80 and 90 per cent of the fluorspar produced in the United States comes from that State. In publishing the statistics of production of the various minerals it is the custom of the Survey to conceal the production of individuals; therefore the production of a single State is not given unless three or more producers report from that State, except when the producers interested have given express permission for the publication of their figures.

The total stocks of fluorspar reported at the mines or at shipping points December 31, 1912, were 8,516 short tons, as compared with 8,205 short tons reported on hand at the close of 1911. Owing to inaccurate methods of estimating stocks, these figures can be regarded as only approximate; it is found, however, that the stocks on hand at the close of one year, together with the tonnage mined during the following year, less the tonnage marketed during that year, check within a few hundred tons with the stocks reported on hand at the close of the second year.

The following table gives the quantity and value of the different grades of fluorspar marketed in the United States in 1911 and 1912:

Fluorspar marketed in 1911 and 1912, in short tons.

State.	Gravel.		Lump.		Ground.		Total quantity.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1911.								
Illinois	55,869	$337,919	3,357	$24,018	9,591	$119,698	68,817	$481,635
Kentucky	8,128	49,775	1,045	7,813	3,230	38,986	12,403	96,574
Other States[a]	5,828	33,238					5,828	33,238
Total	69,825	420,932	4,402	31,831	12,821	158,684	87,048	611,447
1912.								
Illinois } Kentucky }	97,150	565,784	5,315	36,553	11,945	154,316	114,410	756,653
Other States[a]	2,135	12,510					2,135	12,510
Total	99,285	578,294	5,315	36,553	11,945	154,316	116,545	769,163

[a] Includes Colorado, New Hampshire, and New Mexico.

The annual production of fluorspar from 1883 to 1912 is given in the following table. Beginning with the year 1906, the quantities reported represent marketed production.

Production of fluorspar in the United States, 1883–1912, in short tons.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1883	4,000	$20,000	1899	15,900	$96,650
1884	4,000	20,000	1900	18,450	94,500
1885	5,000	22,500	1901	19,586	113,803
1886	5,000	22,000	1902	48,018	271,832
1887	5,000	20,000	1903	42,523	213,617
1888	6,000	30,000	1904	36,452	234,755
1889	9,500	45,835	1905	57,385	362,488
1890	8,250	55,328	1906	40,796	244,025
1891	10,044	78,330	1907	49,486	287,342
1892	12,250	89,000	1908	38,785	225,998
1893	12,400	84,000	1909	50,742	291,747
1894	7,500	47,500	1910	69,427	430,196
1895	4,000	24,000	1911	87,048	611,447
1896	6,500	52,000	1912	116,545	769,163
1897	5,062	37,159			
1898	7,675	63,050	Total	803,324	4,956,265

Figure 1 shows graphically the course of fluorspar production in the United States from 1883 to 1912. Two periods of fluctuation in output—between 1888 and 1898 and between 1902 and 1908—are in strong contrast with the large and steady increase in production in the periods 1898 to 1902 and 1908 to 1912. For convenience of comparison the imports, beginning with the first full year for which records are available, 1910, are shown on the same diagram.

The total quantity of fluorspar reported to the Survey as mined in the United States in 1912 was 117,282 short tons, as compared with 93,563 short tons mined in 1911.

COMPOSITION OF GRAVEL SPAR MARKETED.

Fluorspar or fluorite, chemically, calcium fluoride (CaF_2), consists of calcium and fluorine in the proportion of 51.1 to 48.9. The mineral is crystalline, only slightly harder than calcite. It crystallizes in the isometric system and is found commonly in cubical crystals. In color the spar ranges according to purity from a clear, slightly bluish or green glasslike substance through various other brilliant colors to dark purple, although much of it is white and opaque. It is seldom, however, that absolutely pure spar is marketed, although lump spar used in the manufacture of chemicals is often found to contain less than 1 per cent of impurity. A large number of chemical analyses made on receipts of gravel spar at the Minnequa works of the Colorado Fuel & Iron Co. during 1912 indicate the percentages of the principal constituents shown in the accompanying table. These percentages may be considered as only approximately the averages of monthly receipts, as the tonnages on which they are based are not in all cases equivalent.

Analyses of gravel fluorspar from Colorado, Illinois, and New Mexico.

	Calcium fluorid (CaF_2).	Silica (SiO_2).	Lime carbonate ($CaCO_3$).	Oxides, mostly iron (Fe_2O_3).
Colorado (unwashed spar):				
Jamestown	82.16	10.64	2.26	4.27
	79.38	11.12	2.80	4.49
	79.22	12.16	1.85	4.75
Morrison	71.65	23.26	1.52	2.04
Jefferson	68.34	28.33	1.34	1.69
Duffields	80.55	14.55	3.07	1.50
New Mexico (unwashed spar): Deming	92.31	5.28	1.19	1.07
Illinois (washed spar): Rosiclare	87.64	4.15	6.41	1.58

TRADE CONDITIONS.

The strong demand for American fluorspar that existed in 1911 continued throughout 1912 with perhaps slightly more activity, especially during the latter part of the year. The demand in the

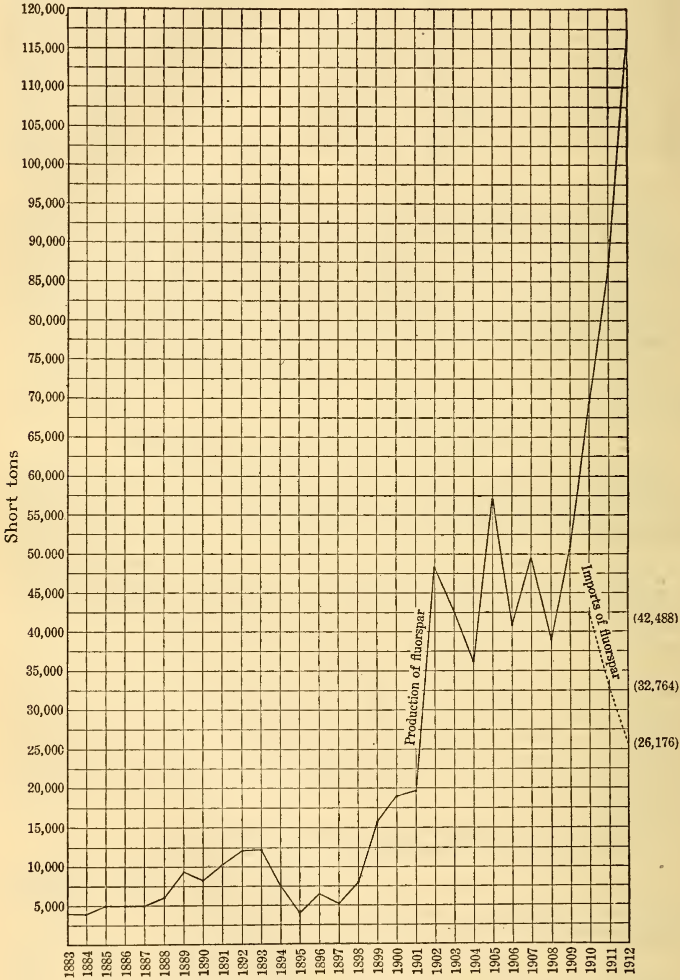

FIGURE 6.—Production of fluorspar in the United States, 1883–1912, and imports, 1910–1912.

eastern United States was supplied in large part by two large mines and mills in Hardin County, Ill., and by seven mines in Crittenden County, Ky. Prices were lowered slightly, and several of the smaller mines in southern Illinois and western Kentucky, especially those situated at a distance from rail or water transportation routes, were not operated. Probably the output in southern Illinois would have been still greater had not the mines at Fairview and Rosiclare been flooded by the Ohio River in the spring of 1912.

In Colorado six producers reported an output of fluorspar, and a small quantity was produced near Deming, N. Mex. The product from both of these States was shipped to the open-hearth steel plant of the Colorado Fuel & Iron Co. at Minnequa. The output of these States was, however, inadequate to the requirements of the steel plant, which received approximately as much spar from Illinois as from Colorado and New Mexico. In Colorado the production was from the vicinity of Jamestown, Jefferson, Duffields, and Morrison, the mines near Evergreen and Rosita having been idle. Jefferson, Morrison, and Duffields are new producing localities.

Although competition of low-grade fluorspar imported from England is keenly felt along the Atlantic seaboard, the imports, as noted on another page, showed a decrease.

Wholesale market quotations on lump spar at Pittsburgh at the close of 1912 were $8 to $9 a ton.[1]

The following table shows the production of open-hearth steel during the last five years:

Production of open-hearth steel in 1908–1912, in long tons.[a]

	Basic.	Acid.	Total.
1908	7,140,425	696,304	7,836,729
1909	13,417,472	1,076,464	14,493,936
1910	15,292,329	1,212,180	16,504,509
1911	14,685,932	912,718	15,598,650
1912	19,641,502	1,139,221	20,780,723

[a] Statistics from 1908 to 1911 according to Ann. Repts. Am. Iron and Steel Association, and for 1912 (subject to revision) from report of Am. Iron and Steel Inst., both of Philadelphia, Pa.

IMPORTS.

Prior to August, 1909, fluorspar was imported into the United States duty free, and the full statistics of importation were not obtainable before that date. Large quantities of gravel spar produced at a low cost from the tailings of lead mines and from the gob in abandoned mines in England have been shipped to this country as ballast at a very low freight rate. The material thus produced is high in silica and is almost entirely consumed by open-hearth steel makers. Before 1909 spar from England competed with American fluorspar as far west as Pittsburgh and practically fixed the market price at that point. In the Lehigh and Susquehanna Valleys of Pennsylvania and other localities near the Atlantic seaboard English fluorspar can yet be purchased advantageously under present conditions, and large quantities are consumed annually in open-hearth steel furnaces in those localities. The imports of fluorspar entered for consumption into the United States in 1912 were 26,176 short tons, valued at $71,616, as compared with 32,764 short tons, valued at $80,592, in 1911. The value assigned to the material in 1912 was $2.74 a ton, as compared with $2.46 a ton in 1911. The imports of fluorspar in 1911 amounted to about 47 per cent of the domestic production of

[1] Eng. and Min. Jour., Dec. 7, 1912.

gravel spar, but in 1912 they had dropped to less than 27 per cent of the domestic production. The reported average price, exclusive of the duty, increased from about 41 per cent in 1911 to about 47 per cent of the price of domestic gravel spar in 1912. According to the prices reported, the average cost to the consumer, including the duty of $3 a ton, but excluding freight charges, was $5.46 a ton in 1911, as compared with $6.03 for domestic gravel spar, and in 1912 the cost of the imported material on the same basis was $5.74, as compared with $5.82 for domestic gravel spar. The freight charges on domestic spar to points where it is consumed are considerably higher than on foreign spar from the docks to eastern steel plants, so that the differences in cost to the consumer are relatively greater than are indicated. Notwithstanding this difference, the imports of spar continue to decrease notably, while the production of domestic spar increases. This is probably owing mainly to the fact that the new large mills in southern Illinois are putting on the market a higher and more uniform grade of spar than can be obtained by importation; and since fluorspar is largely sold on its percentage of purity, purchasers find that the purer spar is more efficient and consequently cheaper in the end.

The following table (see also fig. 1) shows the imports of fluorspar into the United States since August 1, 1909:

Fluorspar imported, 1909–1912, in short tons.

	Quantity.	Value.	Average price per ton.
1909	6,971	$26,377	$3.78
1910	42,488	135,152	3.18
1911	32,764	80,592	2.46
1912	26,176	71,616	2.74

APPARENT CONSUMPTION OF FLUORSPAR.

No accurate estimate of the annual consumption of fluorspar in the United States can be made without a knowledge of the stocks maintained by the consumers. These stocks are probably variable, but as the value of fluorspar as a flux in open-hearth steel making and in other metallurgical operations has become so generally appreciated, consumers are taking care to keep larger stocks in reserve. However, the sales of domestic spar plus the imports (there are no considerable exports at present) should give from year to year an index to the quantity entering into consumption and should indicate the relative increase or decrease in consumption. The apparent consumption of spar in 1912 was 142,721 short tons, as compared with 119,812 short tons in 1911, an increase of more than 19 per cent.

The following table indicates the apparent consumption of fluorspar in the United States in the years 1910, 1911, and 1912:

Apparent consumption of fluorspar, 1910–1912, in short tons.

	Sales of domestic spar.	Imports.	Apparent consumption.
1910	69,427	42,488	111,915
1911	87,048	32,764	119,812
1912	116,545	26,176	142,721

CANADA.

According to the preliminary mineral statistics of Canada for the year 1912 there were produced in 1912 in Canada 41 short tons of fluorspar, valued at $240, or $5.85 a ton, as compared with 34 tons, valued at $238, or $7 a ton, in 1911.

GREAT BRITAIN.

The production of fluorspar in England has an important bearing on the industry in the United States, for practically all the competing material is imported from that country. Only since 1903 has the output of Great Britain exceeded 10,000 tons annually, but, except in 1908 and 1911, there has been a steadily increasing annual production of spar to 1911, which is the latest year for which statistics are available. According to the official report of output of mines and quarries issued by the British home office at London, there were produced in 1911 a total of 55,231 long tons, valued at $92,176, or $1.67 a ton, as compared with 61,621 long tons, valued at $100,629, or $1.63 a ton, produced in 1910. In 1911, 28,689 tons were produced in Derbyshire, mostly from quarries and open workings (probably mine dumps), and 26,542 tons from mines and mine dumps in Durham. Of the 1910 output, 19,410 tons were produced from mines in Derbyshire, including large quantities produced from mine dumps, and 18,133 tons from quarries in the same county, while 24,078 tons were produced from mines and mine dumps in Durham. When the output of fluorspar in England in 1911 is compared with the imports of fluorspar into the United States in that year, and in view of the fact that the imports are derived almost wholly from England, it appears that more than 52 per cent of the production of England was shipped to the United States in 1911.

CRYOLITE.

PRODUCTION.

No cryolite is produced in the United States, the entire supply used in this country being imported from Ivigut, an Eskimo hamlet on the southern coast of Greenland.

IMPORTS AND PRICES.

The quantity of cryolite reported to have been imported for consumption into the United States in 1912 was 2,126 long tons, valued at $48,293, as compared with 2,007 long tons, valued at $47,093, in 1911. The average price per ton declared in 1912 was apparently $22.72, as compared with $23.46 in 1911. Cryolite was imported free of duty in 1912.

PHOSPHATE ROCK.

By W. C. Phalen.

PRODUCTION.

The marketed production of phosphate rock in the United States in 1912 was 2,973,332 long tons, valued at $11,675,774. As compared with the marketed production of 1911 which amounted to 3,053,279 long tons, valued at $11,900,693, there was a decrease in quantity of 79,947 tons, or 2.6 per cent, and in value of $224,919, or 1.9 per cent. The quantity of hard rock marketed in Florida in 1912 as compared with 1911, showed an increase which was true also of its value and the price per ton which it brought, but the sales of both land pebble and river pebble in this State declined. There was also a decrease in the quantity of land rock sold in South Carolina. In Tennessee the sales of both brown and blue rock diminished. The sale of phosphate rock in the Western States, Idaho, Utah, and Wyoming, increased slightly, but the production of these States is very insignificant, amounting to less than one-half of 1 per cent of the production of the country.

In this report it will be understood that by production is meant the phosphate rock actually marketed; it does not mean the quantity mined. The quantity of phosphate rock mined showed gains in 1912 as compared with 1911, except in South Carolina; for example, 3 per cent in Florida, approximately 12.5 per cent in Tennessee, and 10.5 per cent for the three Western States combined. The total quantity mined in 1912 was 3,190,587 long tons, as compared with 3,102,415 long tons mined in 1911. Information regarding Arkansas can not be given for the reason that there was only one producer in that State in 1912. Stocks of rock on hand at the close of 1912 showed a gain of nearly 37 per cent in the Florida field and of nearly 61 per cent in the Tennessee field. In South Carolina stocks diminished by about 27 per cent. On the whole activity in the main southern phosphate fields did not experience a setback. The relative production of the different States is of interest from year to year, and during the year 1912 the proportions were very nearly the same as for 1911.

The total marketed production of phosphate rock in the United States from the beginning of the industry in 1867 to 1912 is shown in the following table:

Marketed production of phosphate rock in the United States, 1867–1912, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1867–1887	4,442,945	$23,697,019	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	1907	2,265,343	10,653,558
1894	996,949	3,479,547	1908	2,386,138	11,399,124
1895	1,038,551	3,606,094	1909	2,338,264	10,796,456
1896	930,779	2,803,372	1910	2.654,988	10,917,000
1897	1,039,345	2,673,202	1911	3,053,279	11,900,693
1898	1,308,885	3,453,460	1912	2,973,332	11,675,774
1899	1,515,702	5,084,076			
1900	1,491,216	5,359,248	Total	42,614.142	174,005.049

The marketed production of the various kinds of phosphate rock, by States, in 1911 and 1912 was as follows:

Production of phosphate rock in the United States, 1911–12, based on the quantity marketed, in long tons.

State.	1911			1912		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Florida:						
Hard rock	443,511	$2,761,449	$6.23	493,481	$3,293,168	$6.67
Land pebble	[a] 1,992,737	6,712,189	3.37	[a] 1,913,418	6,168,129	3.22
River pebble	(a)	(a)		(a)	(a)	
Total	2,436,248	9,473,638	3.89	2,406,899	9,461,297	3.93
South Carolina;						
Land rock	169,156	673,156	3.98	131,490	524,760	3.99
River rock	0	0		0	0	
Total	169,156	673,156	3.98	131,490	524,760	3.99
Tennessee:						
Brown rock	[b] 365,068	1,450,063	3.97	359,692	1,420,726	3.95
Blue rock	[c] 72,302	263,954	3.65	[c] 63,639	219,750	3.45
White rock	0	0		0	0	
Total	437,370	1,714,017	3.92	423,331	1,640,476	3.88
Western States	[d] 10,505	39,882	3.80	[d] 11,612	49,241	4.24
Grand total	3,053,279	11,900,693	3.90	2,973,332	11,675,774	3.93

[a] Small quantity of river pebble included with land pebble.
[b] Includes small quantity of rock from Kentucky.
[c] Includes small quantity of rock from Arkansas.
[d] Includes Idaho, Utah, and Wyoming.

PRODUCTION BY STATES.

FLORIDA.

The production of phosphate rock in Florida, which at present is the leading State in the phosphate industry, amounted in 1912 to 2,406,899 long tons, valued at $9,461,297. Compared with 1911 this was a decrease of 29,349 tons in quantity, or 1.2 per cent, and of $12,341 in value, or 0.13 per cent. The output was the greatest, with the exception of that for 1911, the year of maximum production, in the phosphate industry in this State, and the decline was, as shown above, very slight when its entire magnitude is considered.

The decline in production was in the land pebble, which decreased nearly 4 per cent. In the table following the figures of output and value of land pebble include river pebble which is concealed, because there was but one shipper of this class of phosphate rock in 1912. The smallness of the river-pebble industry does not affect in any way the general statements made for land pebble. The average price per ton of land pebble declined 15 cents in 1912 as compared with 1911. The increase in the hard-rock production was slightly more than 11 per cent. The average price per ton of hard rock increased 44 cents. The production of phosphate in Florida in 1912 amounted to 81 per cent of the entire output of the United States.

The following table shows the quantity and value based on marketed product of each variety of phosphate rock produced in Florida from 1908 to 1912, inclusive:

Phosphate rock marketed in Florida, 1908–1912, classified by grades, in long tons.

Year.	Hard rock.		Land pebble.		River pebble.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	595,743	$4,566,018	1,085,199	$3,885,041	11,160	$33,480	1,692,102	$8,484,539
1909	513,585	4,026,333	1,266,117	4,514,968			1,779,702	8,541,301
1910	438,347	3,051,827	1,629,160	5,595,947			2,067,507	8,647,774
1911	443,511	2,761,449	a1,992,737	6,712,189	(b)	(b)	2,436,248	9,473,638
1912	493,481	3,293,168	a1,913,418	6,168,129	(b)	(b)	2,406,899	9,461,297

a Includes a small quantity of river pebble. b Included in land pebble.

TENNESSEE.

Tennessee furnished 14.2 per cent of the phosphate rock produced in the United States in 1912, as compared with 14.3 per cent in 1911. The total production of the State amounted to 423,331 long tons, a decrease of 14,039 tons, or 3.2 per cent, as compared with 1911, and the value of the output in 1912 was $1,640,476, a decrease of $73,541, or 4.3 per cent. The small quantity of hard rock produced in Arkansas included with the production of blue phosphate rock in Tennessee affects the figures only slightly.

The price of rock per ton in Tennessee decreased for all grades in 1912 as compared with 1911—the price per ton of brown rock fell from $3.97 to $3.95; that of blue rock from $3.65 to $3.45; and the average price per ton declined from $3.92 to $3.88.

The following table shows the tonnage and value of each grade of Tennessee phosphate rock marketed from 1908 to 1912, inclusive:

Phosphate rock marketed in Tennessee, 1908–1912, classified by grades, in long tons.

Year.	Brown rock.		Blue rock.		White rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	374,114	$1,572,525	79,717	$299,941	1,600	$4,755	455,431	$1,877,221
1909	274,410	1,035,364	66,705	275,165			341,115	1,310,529
1910	329,382	1,262,279	a 68,806	241,071			398,188	1,503,350
1911	b 365,068	1,450,063	a 72,302	263,954			437,370	1,714,017
1912	359,692	1,420,726	a 63,639	219,750			423,331	1,640,476

a Includes a small quantity of hard rock from Arkansas.
b Includes a small quantity from Kentucky.

SOUTH CAROLINA.

The production of phosphate rock in South Carolina in 1912 amounted to 131,490 long tons, valued at $524,760. This was a decline of 37,666 long tons, or 22 per cent, in quantity and of $148,396, or 22 per cent, in value. Only land rock is represented in these figures, as there was no production of river rock during 1911 and 1912. The value per ton was $3.99, as compared with $3.98 in 1911. The State's output was 4.4 per cent of that of the entire country during 1912.

The following table shows the quantity and value of phosphate rock marketed in South Carolina from 1908 to 1912, inclusive:

Phosphate rock marketed in South Carolina, 1908–1912, classified by grades, in long tons.

Year.	Land rock.		River rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	192,263	$854,837	33,232	$135,044	225,495	$989,881
1909	201,254	888,611	6,700	21,975	207,954	910,586
1910	[a] 179,659	733,057	(b)	(b)	179,659	733,057
1911	169,156	673,156			169,156	673,156
1912	131,490	524,760			131,490	524,760

[a] Includes a small quantity of river rock.
[b] Included in land rock.

WESTERN STATES.

The production of phosphate rock in 1912 in Idaho, Utah, and Wyoming amounted to 11,612 long tons, as compared with 10,505 long tons in 1911, a gain of 10.5 per cent. The value of the product increased 23 per cent, the average price per ton being $4.24, as compared with $3.80 in 1911. The output of the Western States amounted to 0.4 per cent of that of the entire country.

IMPORTS OF FERTILIZER MATERIALS.

The imports of fertilizer materials into the United States in 1912 included a considerable diversity of substances, as will be seen from the following table, which gives the figures for the last five years:

Fertilizers imported and entered for consumption in the United States, 1908–1912, in long tons.

Product.	1908		1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Apatite	1	$10	2,925	$19,013			20	$300	100	$1,400
Bone dust or animal carbon, and bone ash, fit only for fertilizing purposes	6,897	145,663	29,035	685,291	48,979	$1,140,476	36,856	943,472	117,717	878,686
Calcium cyanamid or lime nitrogen	(a)	(a)	(a)	(a)	3,540	177,552	5,292	292,496	9,311	493,519
Guano	23,222	322,766	44,197	772,674	33,565	667,870	36,869	774,315	19,128	329,624
Kainit	129,063	730,934	163,943	854,998	582,197	2,798,198	563,957	2,748,140	511,976	2,386,362
Manure salts, including double manure salts	(a)	(a)	[b]52,958	601,804	147,242	1,013,009	159,796	1,660,040	171,757	1,797,05
Phosphates, crude	14,311	82,863	9,983	99,060	21,706	235,040	16,153	157,394	28,821	231,255
Slag, basic, ground or unground	627	4,348	690	5,880	10,774	93,650	12,622	87,994	12,596	114,300
All other substances used only for manure	74,883	924,476	184,850	2,879,845	195,991	3,394,279	197,810	4,098,321	127,932	2,660,887
Total	249,004	2,211,060	488,581	5,918,565	1,043,994	9,520,074	1,029,375	10,762,472	999,338	8,893,090

[a] Not separately classified.
[b] From August 5 to December 31.

Even this table, strictly speaking, does not include all the material imported into the United States which goes into the fertilizer manufactured and sold in this country. To it should be added those potash salts, listed as such in the import tables of the Bureau of Foreign and Domestic Commerce, which enter largely into manufactured fertilizer. These potash salts are the chloride and the sulphate. Again, considerable imported sodium nitrate (Chile saltpeter) goes into the fertilizer industry. A large part of the sodium nitrate imported, however, is converted into nitric acid and potassium nitrate, the latter being used in the manufacture of gunpowder and other explosives, matches, pyrotechnics, in assaying and analytical operations, for curing meats, etc. The magnitude of the importation of this saline is, however, very significant. Sodium nitrate, together with potash salts, are commodities for the supply of which the United States is entirely dependent on foreign countries.

In the following table is shown the imports for consumption of materials which enter largely into the domestic fertilizer industry, limited as indicated in the statements above:

Imports for consumption of materials entering largely into the fertilizer industry in the United States for the years 1911 and 1912, in long tons.

	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Fertilizers	1,029,375	$10,762,472	999,338	$8,893,090
Potassium chloride	226,148	7,651,693	215,415	7,229,121
Potassium sulphate	54,335	2,240,631	43,856	1,783,846
Sodium nitrate	544,532	16,814,268	486,779	16,544,511
Total	1,854,390	37,469,064	1,745,388	34,450,568

Adding the production of domestic phosphate rock to the imports of fertilizer an approximate idea at least will be gained of the quantity and value of the chief imported raw materials and of the domestic phosphate rock entering as essential constituents into our manufactured fertilizers. It must not be understood that the following table includes all the materials entering into manufactured fertilizer, as this is not the case. There is included in it chiefly the mineral ingredients which in most cases have gone through preliminary processes of purification and concentration. Even this statement has exceptions. For example, calcium cyanamid is a manufactured product and other substances listed in the table of imported fertilizers are of organic origin or are by-products in the manufacture of other substances. The omissions include also such organic material as fish scrap, dried blood, tankage, etc., and also ammonium sulphate. The table follows:

Materials entering largely into the fertilizer industry in the United States for the years 1911 and 1912, in long tons.

	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Imports:[a]				
Fertilizers	1,029,375	$10,762,472	999,338	$8,893,090
Potassium chloride	226,148	7,651,693	215,415	7,229,121
Potassium sulphate	54,335	2,240,631	43,856	1,783,846
Sodium nitrate	544,532	16,814,268	486,779	16,544,511
Domestic phosphate rock	3,053,279	11,900,693	2,973,332	11,675,774
	4,907,669	49,369,757	4,718,720	46,126,342

[a] Imports are for consumption.

EXPORTS.

During 1912 there were exported 1,206,520 long tons of phosphate rock, valued at $8,996,456, a decrease in both quantity and value as compared with 1911, when 1,246,577 long tons of phosphate rock valued at $9,235,388 were exported.

The great bulk of the phosphate exported from the United States is from the Florida field. By reference to a preceding page of this report it will be seen that the production of this State in 1912 was 2,406,899 long tons, valued, according to the selling price at the mine, at $9,461,297, whereas the exports, which amounted to only 1,206,520 tons, were valued at $8,996,456. There are certain reasons for this apparent lack of correspondence in valuation.

In the first place, it is evident from the tabulated figures of the Florida production that land pebble or the lower grade Florida rock largely predominates and that the total value of the production is consequently proportionately lowered. The proportion of hard rock in the exported material is much greater than in the ordinary production; and this proportion, according to information published by the State geologist of Florida, amounted in 1911 to 39.64 per cent and in 1912, according to the same authority, to 39.12 per cent. According to United States Geological Survey figures, the hard rock constituted only 18.20 per cent of the Florida production in 1911 and 20.50 per cent in 1912.

The Survey does not collect figures of exported phosphate rock, but accepts those compiled by the Bureau of Foreign and Domestic Commerce. In the figures published by that bureau the grades of rock exported are not shown separately, nor are the sources of such rock given. The figures of exportation for 1912 include rock shipped from Tennessee and possibly from other localities of production. As the value of the exports represents "value at the time of exportation in the ports of the United States whence exported," it is assumed that the declared value at the port of shipment includes freight costs from mine to seaboard.

In the light of these facts—that is, the addition of freight charges and the large proportion of high-grade and consequently more valuable rock present in the exports as compared with the ordinary production—the apparent lack of correspondence in valuation is satisfactorily explained.

PRODUCTION IN PRINCIPAL COUNTRIES.

The production of phosphate rock in the principal producing countries of the world for the years 1909 to 1911, inclusive, was as follows:

Production of phosphate rock in principal producing countries, 1909–1911, in metric tons.

Country.	1909		1910		1911	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	345,385	$1,999,779	412,319	$1,193,664	a 332,897	(b)
Aruba (Dutch West Indies)	a 16,284	(c)	a 20,337	106,216	(b)	(b)
Australia	3,833	17,991	5,283	25,306	(b)	(b)
Belgium	205,260	460,349	202,880	366,015	196,780	$319,039
Canada	905	8,054	1,341	12,578	563	5,206
Christmas Island (Straits Settlements)	a 107,169	(c)	a 139,903	(c)	(b)	(b)
Curacao	b 2,136	3,027	b 2,165	3,621	(b)	(b)
France	397,908	1,493,099	333,506	1,253,708	(b)	(b)
French Guiana	a 9,141	57,425	a 6,925	53,074	(b)	(b)
South Africa	349	1,635	280	1,007	(b)	(b)
Tunis	1,299,985	5,529,254	1,334,264	5,714,011	a 1,566,351	(b)
United States	2,375,676	10,796,456	2,697,468	10,917,000	3,102,131	11,900,693

a Exports. b Statistics not yet available. c Value not reported.

NOTES ON THE DOMESTIC PHOSPHATE INDUSTRY.

As phosphate rock contains one of the elements necessary to the growth of plants, the occurrence of this mineral product in the United States has a most important relation to one of our fundamental industries—agriculture. Growing vegetation is constantly depleting the soil of its phosphorus, nitrogen, and potash salts, and, unless care is exercised to return to the soil these essential elements removed from it during plant growth, there comes a time when soil productivity is greatly diminished and ultimately ceases altogether to pay for the labor expended.

THE SOUTHERN FIELDS.

The Southern States Florida, Tennessee, and South Carolina for many years have been the main source of phosphate rock in the United States. In Tennessee and South Carolina the commercially important deposits of phosphate rock are privately controlled. With reference to the present condition of the industry in these States, it may be remarked that the output of Florida, the leading State in phosphate production, has about reached its maximum, particularly so far as the hard-rock industry is concerned. The land-pebble industry continues to show a vigorous growth.

In Tennessee the brown-rock deposits, which several years ago were given but a brief future existence, promise to yield as much or more phosphate than has already been extracted from them, owing to working on a large scale with modern machinery and under modern mining methods. Pioneer methods are, however, still employed in some parts of the brown-rock phosphate regions and are attended by a great waste of good material. With the passing of the brown and blue phosphate fields into the control of the larger fertilizer corporations, which practice modern mining methods and have installed expensive plants in which the mined rock is treated, a gradual change has taken place and the life of the fields is being thereby prolonged.

The South Carolina field was the first to be exploited on a commercial basis. Though mining has fallen off in this field it is quite likely that much rock remains for future use. Since the most readily accessible material has been removed, the remaining rock will be correspondingly expensive to mine. The product, moreover, being of medium grade, can not compete with higher grade rock in the manufacture of superphosphate. Hardly any rock is being exported from this field at the present time.

Arkansas entered the field as a producer of phosphate rock in 1900, and a more or less active interest has been taken in the Kentucky field since 1905. The production from these two States has not yet assumed any importance. A description of the Kentucky phosphate field is given farther on in this report. With regard to the Arkansas field the deposits are not of great importance at present, as the rock averages rather lower in grade than in the other two main eastern fields. The phosphates are, moreover, somewhat isolated, but this should prove to be an advantage, as it tends to eliminate the competition of the fields east of Mississippi River. North Carolina, Alabama, and Pennsylvania have also produced a little phosphate rock in the past, but they are of no present importance in the industry.

THE WESTERN FIELDS.

The new western phosphate field was discovered in 1906, and although for economic reasons this field has not yet produced on a large scale it is quite probable that the main production of the future will come from the West, where the principal deposits are now located on the public domain. Some of the economic reasons that retard the development of the western phosphate fields are comparative newness of the field, lack of transportation facilities, high freight rates, and remoteness from centers of consumption.

Since the discovery of the western fields systematic investigations have been prosecuted by the United States Geological Survey, and the results obtained have been published in part. The reports issued up to the present time are listed in the bibliography given at the end of this chapter. This work has resulted in the discovery of new and very important deposits by Survey geologists, and its systematic conduct has greatly added to the known extent of the deposits. Thus the geologic occurrence of the deposits has in consequence become well known, and a basis of classification of the public lands underlain by phosphate rock has gradually been built up. The factors involved in this classification have been amplified in a report recently issued by the United States Geological Survey.[1]

PHOSPHATE RESERVES.

The known phosphate lands remaining in Government ownership have been withdrawn from entry temporarily. These reserves are located in Florida, and in Idaho, Montana, Utah, and Wyoming. Regarding the reserves in the Western States the report cited above says:

> The estimated quantity of high-grade rock (containing 70 per cent or more of tricalcium phosphate) included in the area surveyed in detail to date is more than 3,000,000,000 long tons, yet it is possible that such an estimate, based solely on infor-

[1] Smith, George Otis, and others, The classification of the public lands: Bull. U. S. Geol. Survey No. 537, 1913, pp. 123-134.

mation collected along the outcrop of the beds, may be excessive. Below the surface the brown phosphate of Tennessee rapidly becomes lean and grades into the phosphatic limestone from which the phosphate is supposed to have been concentrated by weathering. The phosphate deposits of the western reserves may ultimately be found to show a similar change, although they do not exhibit clear evidence of such concentration, but in the main have the characteristics of original bedded deposits, probably in part of purely chemical and in part of organic origin. They have therefore been inferred to have practically the same richness underground that they show at the outcrop. However, in view of the unproved value of the deeper portions of the phosphate beds, it is advisable that they be sampled by deep prospecting before any plan for the final disposal of the lands is adopted. If such prospecting shows that the greater part of the rock included in the estimates is relatively of low grade it will be self-evident that the exhaustion of the phosphate resources is not so distant as it now appears, and that the value of the outcropping portions that are now known to include high-grade phosphate rock is much greater than is at present suspected.

The phosphate-rock situation is summarized as follows:

The question of the future adequacy of our phosphate resources for our own needs had been mentioned by several authorities prior to the conference of the governors in 1908, in which the discussion of this and kindred topics drew public attention to the situation. At this conference the possibility that foreign investors might acquire the better-known and supposedly richer portions of our deposits was suggested, the wisdom of permitting the exportation of so essential a quasi-public commodity was questioned, and the desirability of an early examination of the available supplies was emphasized. In part as a result of these indications of public interest, in part as a continuation of the policy already adopted in reference to coal lands, and in part because of the legal dilemma existing in the western fields through the inadequacy of the laws governing the disposal of mineral land, the Secretary of the Interior on December 10, 1908, withdrew from entry about 7,000 square miles of public land in Idaho, Utah, and Wyoming, pending an examination of their phosphate resources. In the following summer the United States Geological Survey began the examination of these lands, and the investigation has been continued up to the present time, some 4,000 square miles having been examined in a preliminary way and about 2,500 square miles surveyed in detail.

The first withdrawal was based partly on information collected by the Hayden Survey in 1877, and partly on later detailed and reconnaissance examinations made by the United States Geological Survey. Field work done subsequent to this withdrawal revealed the regularity and the character of the phosphate deposits, so that it has been possible not only to revise the estimates of the reserves in the area actually examined since the first withdrawal but also to make a closer interpretation of the information gathered by the earlier surveys. These facts and relations are brought out in the following table:

Approximate area of phosphate lands, in square miles.

Year.	Reconnaissance surveys.	Detail surveys.	Total.	Withdrawn.	Restored.
1908				7,000	75
1909	1,000	800	1,800	600	3,600
1910	1,400	500	1,900	65	90
1911	1,200	800	2,000	55	237
1912	400	400	800	1,890	495
Total	4,000	2,500	6,500	9,610	4,497

During the progress of the classification of phosphate lands to date, as a result of presidential orders 3,291,527 acres of land were included in the phosphate reserves January 1, 1913. The phosphate land withdrawn, restored, and outstanding at the end of 1912 is shown in the following table: [1]

[1] For a complete discussion of the classification of the public lands underlain not only by phosphate rock but by coal, oil, gas, salines, and other mineral deposits the reader is urged to secure a copy of Bulletin 537 of the U. S. Geological Survey, already referred to. Copies of this bulletin are now available for distribution, free of charge, by addressing the Director of the U. S. Geological Survey, Washington, D. C.

Phosphate land withdrawn, restored, and outstanding on Jan. 1, 1913.

State.	Total withdrawals.	Restorations.	Outstanding withdrawals.
	Acres.	*Acres.*	*Acres.*
Florida	45,979	2,199	43,780
Idaho	2,215,834	1,157,778	1,058,056
Montana	274,861	....	274,861
Utah	581,039	473,294	107,745
Wyoming	3,060,098	1,253,013	1,807,085
Total	6,177,811	2,886,284	3,291,527

THE PHOSPHATE INDUSTRY IN THE SOUTHERN STATES.

FLORIDA DEPOSITS.

Location.—The Florida phosphate deposits are the most extensively developed in the United States. They comprise three classes—hard rock, land pebble, and river pebble. The land-pebble industry is the most important at present. The hard-rock industry ranks next and showed a substantial growth in 1912. No river-pebble was mined in 1912, but a small amount was sold from stock on hand.

The area of hard-rock phosphate extends as a narrow strip along the western part of the Florida peninsula for a distance of approximately 100 miles from Suwanee and Columbia counties on the north to Citrus and Hernando counties on the south. The land-pebble phosphate area lies farther south in Polk and Hillsboro counties.

Hard rock.—The hard-rock phosphate occurs in a soft matrix of phosphatic sands and clays and other material, the whole resting on a limestone of lower Oligocene age. The bowlder deposits occur in the form of pockets of irregular size ranging from a few square yards to several acres in area. The bowlders themselves vary in size from a few inches up to several feet and occur embedded in all positions, surrounded by sand and clay containing phosphate of lime in finer particles.

The hard rock varies greatly in physical appearance and ranges in color through many shades between jet-black and white. Some of the material is massive and of compact texture, ringing when struck with a hammer. A great deal of it, however, is light and porous.

The phosphate content of this class of deposits ranges from less than 10 to more than 30 per cent of the mass, the marketable product being not more than 15 per cent of the total mined material. The rock itself runs as high as 85 per cent in tricalcium phosphate $Ca_3(PO_4)_2$. Practically all the rock mined is shipped abroad and sold on a guaranty of 77 per cent tricalcium phosphate.

Land pebble.—The land-pebble deposits are much more regular than the hard rock and occur in beds of varying thickness. For this reason actual mining can be carried on cheaply. Moreover, improvements in mining methods and handling material have made it possible to handle relatively low-grade rock cheaply. These reasons have contributed to the present great activity in the land-pebble industry.

The pebbles are found chiefly in a sandy but also in a clayey matrix similar to that found in the hard-rock regions. They range from the smallest size up to that of a walnut. Between the two extremes of black and white, varying shades of gray, yellow, and brown are found.

They are usually of light color and are softer than the hard-rock deposits. Owing to their porous character, they are commonly lighter bulk for bulk than the hard rock.

The land pebble is found resting on upper Oligocene limestones and marls (Alum Bluff formation). It has been regarded by some of the geologists who have studied the deposits as derived from preexisting beds. The deposits have undoubtedly been produced by leaching action on calcareous beds. The phosphate rock left has been broken into fragments with the formation of concretions. The attrition to which these fragments have been subjected along shore lines has resulted in the formation of pebbles. That erosive forces have been active seems to be shown by the relatively greater thickness of the deposits in the valleys than in the uplands. The water-worn character of the pebbles and the presence of shark's teeth and other marine remains indicate that the erosion took place near river mouths or in the shallow sea. The phosphate content of the marketed product generally ranges from 60 to 75 per cent tricalcium phosphate.

METHODS OF MINING.[1]

The methods of mining the two main classes of phosphate rock in Florida differ considerably. In working the hard-rock deposits the material is either dug out or dredged; in the pebble-phosphate field hydraulic mining is employed.

Hard-rock mining.—The first step in the mining of rock phosphate is the removal of the overburden of sand and clay. The amount of overburden varies considerably, and its character and thickness determine in great measure the expense of the mining operations. As a rule the overburden is removed by hydraulic giants, but scrapers and steam shovels are also employed.

After the phosphate rock is exposed it is removed by pick and shovel and loaded on cars. Blasting is sometimes employed to break up the larger masses of rock in the dry mines. At these latter the material undergoes a rough preliminary sorting before going to the washer. In a mine where the deposit is below water and where dredging is to be employed a great deal of very low-grade material, together with some limestone, goes to the washer, not having the advantage of the preliminary sorting that is done in working a dry mine. A dry mine does not require the outlay in capital that a dredging mine does, but it requires more labor to run it. The dry mine, moreover, often has to close down in wet weather, while the dredging mine may work continuously.

After the removal of the rock from the mine, it is hauled to the top of the washer in small cars drawn by cables, where it is dumped on an iron grating, the bars of which range from 2 to 2½ inches apart. The smaller pieces and the foreign matter pass through; the larger pieces which are held back are crushed and pass on to the washer. The washers are usually logs, two to four in number, about 30 feet long and 18 inches in diameter, arranged usually in pairs and fitted with blades arranged spirally and placed so as to just miss each other as the logs revolve. The logs rotate in opposite directions, and the pebbles

[1] The descriptions of mining methods were compiled from an unpublished manuscript by G. C. Matson, of the United States Geological Survey.

The report by W. H. Waggaman, of the Bureau of Soils, Department of Agriculture, entitled "A review of the phosphate fields of Florida," contains a great deal of valuable information on the Florida phosphate industry and was freely consulted. Bull. Bur. of Soils No. 76, U. S. Dept. Agri., 1911, 23 pp.

and broken fragments of phosphate rock are given a forward movement. The logs are inclined and the water flows in a direction opposite to the movement of the rock. Thus all the finer material is washed away to the waste heap.

From the logs the phosphate passes through two clyindrical screens 12 to 14 feet long and placed one within the other. These are perforated; the inner one with openings 1½ inches by three-eighths inch, the outer one with openings one-eighth by one-sixteenth inch. The phosphate as it passes through the screens is washed by jets of water from a perforated pipe inside the screens and by water from a similar pipe on the outside of the screens. Sand, gravel, and clay still adhering to the phosphate are thus removed.

The coarser rock held on the inner screen falls on a circular wooden table which slowly revolves and from which men and boys remove fragments of limestone, clay, and flint that are mixed with the phosphate. At the end of a complete revolution of the table the phosphate rock is automatically scraped from it and falls into the "wet" bin. The finer material from the larger screen has already passed into the "wet" bin.

Drying may be accomplished either in kilns or in mechanical rotary driers. In the hard rock regions kiln drying is still largely employed. From the "wet" bins the phosphate is conveyed to the drying sheds, which are designed to exclude the rain and to avoid loss of phosphate rock. Drying is accomplished by placing a layer of phosphate rock about 2 feet thick on the floor of the shed and stacking wood on it to a depth of 2 feet. The wood is laid so that one layer is crosswise the other. Considerable space is thus left for a draft. Phosphate rock is dumped on to the wood to a depth of 10 to 15 feet. The wood is then fired and allowed to burn until it is consumed. At the end of a burning the rock is pretty thoroughly dried; it is then ready for shipment. In the process of mining and washing the phosphate rock a great deal of material not suitable for market requirements is rejected. It is impossible to state how much actual phosphoric acid goes to the waste heap, but it has been estimated at nearly twice the quantity saved.

Pebble phosphate mining.—The first step in the mining of pebble phosphate is the removal of the overburden of sand or friable sandstone, as in the mining of hard rock. This is accomplished either by the use of hydraulic giants or by means of steam shovels. The latter are especially advantageous in those mines where the sand is partly indurated or contains hard lumps—for example, iron oxide concretions, too large to be handled by centrifugal pumps. The overburden is lifted by shovels into small cars which are then moved to the waste heap where they are dumped.

Nearly all the land pebble is removed by hydraulic methods. The rock is loosened and washed into a depression or sump from which it is removed by one or more centrifugal pumps and conveyed through pipes to the washer. At one mine a steam shovel is used in excavating the phosphate.

The washers in the land pebble phosphate region are of the same general type as those used in the rock phosphate field, differing from the latter only in details of construction. From the hoisting pumps the phosphate is forced through pipes to the washer and dumped on a cylindrical screen containing openings 1 inch in diameter. The screen is about 12 feet long and 4 feet in diameter and is inclined so that the upper end is 2 feet below the lower. The lumps of clay and other débris on the screens are discharged into a trough and are conveyed to the waste heap.

After passing through the openings in the screen the phosphate pebbles fall upon a second inclined screen about 18 feet long and 6 feet wide. The perforations on this screen occupy half its area and are one-half inch long by one-sixteenth of an inch wide. The phosphate is washed across this screen by a stream of water and in its passage it is freed from much of the fine sand and clay adhering to it, which pass through the perforations on the screen and enter the waste trough together with the clay balls and other débris from the cylindrical screen.

The rock next goes to a log washer similar to those used in washing rock phosphate. The logs are, however, shorter, being about 18 feet in length. There are usually four of them, arranged in pairs, and inclined opposite to the direction in which the rock is moving. A stream of water flows through the washer containing the logs and removes the sand and clay as the phosphate is carried along by the blades attached to the logs. From the first pair of logs the phosphate passes to a 12-foot screen made up of two cylinders, one within the other, the outer one having a diameter of 4 feet and the inner one a diameter of 3 feet. Water from perforated pipes within and without the cylindrical screens spray the rock, as in the method described under hard rock. The screens are of course perforated and are inclined in the direction in which the rock is moving, the difference in height between the two ends being about 1 foot. There are ridges on the inside of the screen which agitate the rock as the screen revolves and cause it to be more thoroughly washed.

From the screens the rock passes to the second pair of log washers, duplicates of the first pair, from which it goes to a second set of screens, likewise a duplicate of those described.

After washing the rock is sorted but the sorting table is not so important a part of the equipment in the pebble phosphate field as in the hard phosphate region. The reason for this is the fineness of the rock which makes hand picking a slow process. It is, however, carried on at some mines.

Drying is accomplished in inclined rotary kilns. The ore passes through from the higher part to the lower part of the kiln and during its passage longitudinal ridges cause it to fall through the heated air as the cylinder is rotated. The hot air is supplied at the upper end of the kiln and in passing the length of the cylinder the rock is thoroughly dried. After its removal from the driers the rock is weighed and is then conveyed to the dry bins from which it is removed for shipment.

The amount of material lost in pebble mining is probably less than that lost in mining hard rock. This is because the matrix of the former is sandy, while that of the latter is clayey and contains much soft phosphate. There is, however, considerable clay and soft phosphate associated with some of the pebble rock, and practically all of this soft phosphate goes to the waste heap.

TENNESSEE DEPOSITS.

These deposits occur in the central portion of Tennessee in Hickman, Maury, Williamson, Perry, and Lewis counties. They are of three classes as described by Hayes [1]—brown residual phosphate, blue bedded phosphate, and white phosphate.

Brown phosphate.—The brown phosphate is of Ordovician age and is the result of the leaching process to which the phosphatic limestones have been subjected. Surface waters bearing carbonic and other organic acids have dissolved and carried away a large part of the calcium carbonate forming the limestone, leaving the brown calcium phosphate as a residual product. It occurs as blanket deposits and as collar deposits—the former being a deposit which caps a small hill or slope and the latter, as the name indicates, being the leached outcropping edges of the phosphatic limestone. They occur at a number of horizons in workable quantities. The principal deposits are in the vicinity of Mount Pleasant, Tenn., where they have been worked since 1893. The brown rock as mined carries as much as 80 per cent tricalcium phosphate.

Blue phosphate.—The blue bedded phosphate is of Devonian age and shows variations from oolitic through compact and conglomeratic to shaly forms. There is also a nodular variety which occurs in a greensand formation immediately overlying a black shale. The bedded rock occurs in seams varying from 1 to 50 inches in thickness, but the high-grade rock is rarely more than 28 inches thick. The phosphatic content ranges from 30 to 85 per cent tricalcium phosphate. The nodular variety is not so high, and does not pay to work except where the bedded rock is mined by stripping off the overburden.

White phosphate.—The white phosphate is of post-Tertiary age and has been described by Hayes as occurring in three different forms—stony, brecciated, and lamellar.

The stony phase is probably the result of replacement of calcium carbonate by the phosphate in places where conditions were favorable for such a transfer of material. This phase of the rock usually carries less than 50 per cent lime phosphate.

The brecciated form of the phosphate consists of masses of calcium phosphate cementing Carboniferous chert fragments.

The lamellar variety consists of plates of irregular shape and extent which were probably deposited in layers in large or small cavities.

The brecciated and lamellar forms carry as much as 85 per cent tricalcium phosphate. None of this white phosphate of Tennessee is now being mined.

METHODS OF MINING.

In the reference cited below James A. Barr [2] gives descriptions of the practice employed at the Arrow mines of the Charleston, S. C., Mining & Manufacturing Co., in the mining of brown phosphate rock at Wales, Tenn.; also descriptions of the mining of blue phosphate rock at Mayfield, Tenn. Abstracts of these descriptions, which are of modern practice in Tennessee, are given below in considerable detail.

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[1] Hayes, C. W., and Ulrich, E. O., Columbia folio (No. 95), Geol. Atlas U. S., U. S. Geol. Survey, 1903.
[2] Modern American phosphate plants: Min. and Sci. Press, Nov. 11, 1911, pp. 623–624.

There are two definite types of phosphate rock in Tennessee which are being mined at the present time. These are the brown phosphate and the blue phosphate. No white phosphate rock has been mined in this State for some years. The uncertain character of the white phosphate rock deposits, the expense attendant on mining them, and the inaccessibility of the deposits have retarded prospecting and development work. It was reported in 1911 that plans were under way to renew mining operations, and New York capitalists were prospecting in Decatur County during that year, but no output of white phosphate rock was reported to the Survey during 1912.

Brown rock phosphate in Tennessee usually occurs in thin strata interbedded with clay and flint pebbles and occasionally with limestone. The clay must be washed away as the bases (iron and alumina) which it contains consume sulphuric acid in the subsequent manufacturing processes and thus add to the expense of treatment without any return in fertilizing effect.

The overburden is first removed. If heavy this may be removed by a drag-line excavator. Where light it may be economically removed by wheeled scrapers. The mining is done in open pits with steam shovel loading into side-dump cars. The ore after being mined goes to the washers, connected with the mines usually by narrow-gage tracks. Small locomotives pull the cars from the mining sites to and from the washer. After elevation on the incline at the washer the ore is dumped from the cars to the crusher, where it is reduced in size. At some of the modern plants the springs of the crushers are set so that the flint and limestone will pass through without being crushed to facilitate the subsequent hand picking.

From the crusher the material is elevated by a bucket elevator and then dumped into the first set of log washers, where most of the clay and mud is removed and run off at the tail gate. The first set of log washers discharges into a second set, where washing is continued with the addition of fresh water. The second set discharges on a rinsing screen with a spray pipe extending through its center.

The oversize from the rinsing screen passes to a slow moving belt where the limestone, flint, and mud balls are picked out. The undersize from the screen, together with the overflow from the tail gates of the washers, goes, by means of a series of distributing launders, to 6 riffle troughs or sand washers. These sand washers are designed to thoroughly elutriate the clay and collect the sand from the large volume of water coming in with the feed. The tail water from the riffle troughs, containing clay and a small percentage of sand of finer size, flows into a primary mud pond where the sand is settled out, the clayey water flowing off through an adjustable gate to a second pond, where the water is clarified before running to the creek or being used over again.

The sand and water from the head end of the riffle trough flows into a dewatering box, which discharges the thickened pulp on a sloping drainage platform. Here the sand collects in a pile which gradually spreads out from the launder and the remaining muddy water is given an opportunity to flow off through a screen across the foot of the drainage platform. The overflow from the dewatering box goes into a sand bin, of which there are three, 15 by 20 feet, and the sand is allowed to settle out. The overflow from the sand bin goes to the primary mud pond.

The sand from the drainage platform and the contents of the sand bins, together with the rock discharged from the picking belt, is conveyed to drainage piles in the wet storage space by a clam-shell electric monorail trolley. After standing for several days the drained material is removed to hoppers by the same electric trolley. From the hoppers the phosphate is fed automatically to two driers 5 feet in diameter and 50 feet long. The driers are driven by direct-connected motors through a system of reduction gears.

The hot rock coming from the driers is elevated to a steel storage tank by a single-strand continuous-bucket chain elevator of 82-foot centers. From the storage tank the rock is distributed into piles, according to size, in the dry storage shed by an electric-driven side-dump car. A screen is placed over the storage tank so that it can receive the discharge of the elevator and separate the phosphate into two sizes. The screen jacket is punched with ⅛-inch holes.

The rock from the storage piles is loaded for shipment by an electric clam-shell trolley, either by dumping directly into loading chutes which discharge into a box car which is placed on a 100-ton track scale, or upon a cross conveyor which loads cars on a second sidetrack. The rock from the elevator may either be run directly to the cross conveyor or carried to the loading chutes by the electric distributing car. * * *

The plant at Mayfield is used solely for handling Tennessee blue rock. This variety of phosphate is a tough, granular, bluish rock, resembling limestone. It is not amenable to washing for the purpose of removing the impurities, hence the operations are confined to mining, crushing, drying, screening, and stocking. The phosphate-bearing material occurs in comparatively flat strata, overlying blue phosphatic limestone, and overlain by a shale. The mining is done by the room and pillar system. Much of the rock near the outcrop was mined by blasting the shale and stripping with steam shovels. Underground the rock is overcut by air drills and blasted to this face. A low-grade stratum which lies between the phosphate strata and the shale makes this method of mining possible.

The rock cars are taken to the mouth of the adits by mules and are made into trains and pulled to the crusher-yard track by small locomotives. On this track the cars run by gravity to an incline, where they are hauled up to the crusher dump by an endless chain. Before being dumped the cars are weighed. The rock is crushed to 1½ inches by a gyratory crusher and fed directly into a 5 by 50 foot rotary drier. The hot rock coming from the drier is fed to a pair of rolls by a pan conveyor and crushed to ½ or ¾ inch size, according to the amount of fine material desired. The discharge from the rolls is elevated by a bucket elevator to a screen, where it is separated into three sizes.

A cable-operated end-dump car takes the rock from the storage bins under the screen and dumps it into different piles in the storage shed, according to size or grade. All of the rock is loaded by hand into box cars for shipment. In order to supply the demand for ground phosphate a dry grinding mill is operated, which receives any desired size rock issuing from the screen above the driers. The rock is ground so that 90 per cent will pass through an 80-mesh screen. The mill grinds about 6 tons per hour, with an expenditure of 100 horsepower. * * *

SOUTH CAROLINA DEPOSITS.

The phosphates of South Carolina occur in a belt along the coast running back as far as 20 miles from the ocean, and extending from the source of Wando River, in Charleston County, to the mouth of Broad River. The rock occurs in two forms—land rock and river rock.

Land rock.—The land rock is probably of Miocene age and consists of so-called pebble rock, which is, in fact, a solid mass from which the calcium carbonate has been leached out and partially replaced by phosphate, leaving cavities which connect and penetrate through the rock, giving it the appearance of being made up of separate pebbles. The bed is from 1 to 3 feet thick and is overlain by a greensand marl.

River rock.—The river rock is so called because it is mined from river channels. It consists essentially of water-rounded fragments of the land rock.

The South Carolina rock is of comparatively low grade, running from 55 to 58 per cent tricalcium phosphate.

METHODS OF MINING.

Land rock.—The land phosphate rock of South Carolina is mined in two ways, according to the thickness of overburden, which varies from 3 to 18 feet. Where the overburden is heavy it is removed by steam shovel, which runs on its own track. As a space is cleaned in front, the track is removed from behind and placed forward. Following the steam shovel, but placed upon the bank, is a steam hoist with a clamshell dipper. The dipper is let down on the phosphate rock, grabs a mouthful, and swings it over and dumps it on flat cars, which carry it to the washer.

After the phosphate rock has been mined out for a sufficient distance across a field, the steam shovel is turned around and started back, opening up another portion of the rock for mining. The overburden from this rock is dumped into the ditch left from the previous operation, and so the process is repeated until all the rock is mined out.

When the overburden is thin it is removed by steam shovel, but the rock itself is mined by hand and loaded into buckets, which are hoisted and dumped on flat cars which carry it to the washer.

The washer and kiln used in South Carolina are very similar in character to those used in the hard-rock mining in Florida.

River Rock.—The South Carolina river rock was mined by a dredge which dumped the rock into the washer. The washer was on a float and consisted usually of only one screen and a picking table. The washed rock was dumped on barges and hauled to the market. No river rock has been mined during the last two years.

ARKANSAS.

Occurrence.—Phosphate rock was mined in 1912 in only one locality in Arkansas, namely, at Anderson, near the boundary between Izard and Independence counties, the mines being located in the latter county. The work was done by the Arkansas Fertilizer Co., whose headquarters are at Little Rock. Underground mining is practiced, and the ore obtained is dried in open kilns. None of the output is sold, the property being operated by the company for its own needs.

The phosphate deposits that have been developed in Arkansas are located in northwestern Independence County along Lafferty Creek. The deposits extend over a considerable area in the north-central part of the State, and the phosphate horizon has been recognized in Stone, Izard, Searcy, Marion, Baxter, and Newton counties. This does not mean that phosphate rock will be found in all these counties of sufficiently high grade to work with profit wherever its horizon outcrops, but that an intelligent conception of its geologic position may enable it to be more readily found and prospected. In the area in which it is found only sedimentary rocks are exposed at the surface. The names and relative positions of these rocks with the phosphate-bearing formation are given below:

General section in phosphate region of northern Arkansas.

Carboniferous: Boone limestone (including St. Joe marble member).
Devonian: Chattanooga shale (including Sylamore sandstone member)
Silurian: St. Clair limestone.
Ordovician:
- Cason shale (phosphate horizon).
- Polk Bayou limestone.
- Izard limestone.

The phosphatic beds themselves vary in character, ranging from those that are brown, sandy, and of low grade to those that on fresh surfaces are bluish gray, apparently without sand, and of uniform texture and color. Manganese ore is so commonly associated with the phosphate that it is a good guide in prospecting for it. In the areas where the development has taken place the phosphate rock occurs in two layers, only the upper one of which is worked, the lower being considered of too low grade for exploitation. The upper bed is a compact, homogeneous light-gray rock, with a specific gravity of about 3. The following section of the deposit on the hillslope between Lafferty Creek and White River shows the relations of the phosphate rock. As will be seen from the section its aggregate thickness is from 8½ to 10 feet.

Section containing phosphate beds.[1]

	Feet.	Inches.
St. Clair limestone.		
Brown to black shale	2	..
Low-grade manganiferous iron ore	....	15
Green to dark-clay shale	....	14
High-grade phosphate	4½–6	..
Manganiferous iron ore	....	2
Low-grade phosphate	4	..
Polk Bayou limestone.		

Analyses made in the Survey laboratory show the best ore to run from 56 to more than 71 per cent in bone phosphate.

Mining methods.—Most of the phosphate removed from the Arkansas area is obtained in much the same manner as the blue rock in Tennessee. The rock is first stripped and mined around the hillslope until the overburden makes this method too expensive. Drifts are then run into the hill, and the rock is blasted out and hauled to the mouth of the drift for shipment. Some of the rock is dried by being piled upon ricks of wood, which are then burned. Fuel is abundant, and burning has the advantage of reducing freight charges, which are $1 a ton from Batesville to Little Rock.

KENTUCKY.[2]

For many years the phosphate rock beds in the Ordovician limestone of central Kentucky have attracted attention, but no systematic attempts have been made to investigate their economic value. During the last few years more interest has been taken in the Kentucky deposits and a small amount of phosphate rock has been produced in the State. No production, however, was reported to the Survey during the year 1912.

Perhaps the first mention of phosphate rock in Kentucky was made by Robert Peter[3] in 1877, in the statement that strongly phosphatic rock was associated with the limestone beds in the north-central counties of the State. Only since 1905, however, has prospecting really been active. In that year a negro while digging postholes on the farm of H. L. Martin, Midway, Woodford County, discovered what he considered and what was later verified to be phosphate rock.

Until the present time rock-phosphate developments have been confined to the area near Midway, but notable exposures are reported from Scott, Mercer, and Jessamine counties. The lands containing the rock-phosphate beds are fertile and possess high

[1] Purdue, A. H., Developed phosphate deposits of northeastern Arkansas: Bull. U. S. Geol. Survey No. 315, 1907, p. 469.
[2] Gardner, J. H., Rock phosphate in Kentucky: Mines and Minerals, November, 1912, pp. 207–209.
[3] Kentucky Geol. Survey, Chemical Analyses A, 1877.

value for farming purposes, constituting the best there is of the far-famed Bluegrass Region, and being worth $200 per acre for farming and grazing purposes alone. To what extent the Kentucky field may be broadened will be determined only by thorough prospecting and the attitude assumed by the farmers. The Lexington limestone comes to the surface over a large area in central Kentucky, and the outcrop of the base of the overlying Winchester follows a meandering course for a long distance around the Lexington, making an inlier of the latter on the Jessamine Dome of the Cincinnati geanticline. It seems highly probable that the deposits of rock phosphate will be confined to the western and southern portions of this inlier.

The phosphate deposits of the Kentucky field belong to the class known as brown-rock phosphate. * * * The phosphate is in the form of loose rock, consisting of thin plates and finely comminuted material mixed with some clay, the whole being of a dark-brown color. The hard-rock plates vary from light-gray to dark-brown in color and are usually rather dense. In specific gravity they average about 3. They are more resistant to weathering than limestone, although occasional pieces in freshly exposed workings are very porous and soft. These plates vary in size from the granular form up to pieces that weigh several pounds. In the mine of the Central Kentucky Phosphate Co. pieces have been found that measured 6 inches in thickness and were 3 or 4 feet long. Along the east and southeast areas of the outcrop of the Lexington limestone, a considerable distance from the phosphate field, very large deposits of chert are found at about the phosphate horizon, but in that territory there is a notable absence of commercial phosphate, though some of the chert is highly phosphatic.

In chemical composition the rock phosphate of Kentucky varies in "bone phosphate of lime" or tricalcium phosphate from about 40 to more than 80 per cent. * * *

The brown-rock phosphate in Kentucky occurs as elsewhere in the form of loose-rock deposits that lie near the surface. The commercial deposits occur in blanket form on limestone and are covered by clay and soil. The workable deposits vary from 1 to 6 feet in thickness and are very irregular; both the bottom and the top of the beds are limited by inconstant factors in their origin. The rock phosphate deposit originates from secondary concentration in the process of weathering of phosphatic limestone, consequently the mantle which it forms over the uneven surface of the limestone is similar to that of any deposit of red limestone clay. The level of unweathered rock is irregular and naturally the bottom of the phosphate conforms with it; at places it suddenly deepens and at others "rock horses" rise into the phosphate beds. The top of the phosphate bed is more regular than the bottom and more nearly parallels the surface topography; but it is by no means constant. The cover of clay and soil varies from about 2 to more than 10 feet, being thicker on the tops than on the sides of hills and ridges.[1]

VIRGINIA.

PHOSPHATE DEPOSITS IN SOUTHWESTERN VIRGINIA.

G. W. Stose[2] describes the occurrence of phosphate rock at two localities in the Abingdon quadrangle, southwestern Virginia—(1) at the foot of the southeast slope of Clinch Mountain, 5 miles west of Saltville, and (2) in the valley of Walker Creek at the east end of Brushy Mountain, 5 miles west of Marion. The geologic horizon at which the phosphate occurs has been traced from the Clinch Mountain locality for 20 miles northeast and southwest across the Abingdon quadrangle and for about 2 miles in the Brushy Mountain locality. The phosphate rock is probably of earliest Devonian age. The horizon at which it occurs has been traced across the area and its several bands are shown on a map accompanying the report. It is predicted that search along these lines will no doubt reveal the presence of phosphate rock at many other places.

Tumbling Run locality.—A detailed section of the rocks containing the phosphate bed was made at Henderson's Mill on Tumbling Run, 5 miles west of Saltville. This is the locality designated as (1) in the paragraph above. This section is as follows:

[1] Gardner, J. H., op. cit.
[2] Phosphate deposits in southwestern Virginia: Bull. U. S. Geol. Survey No. 540–L, 1913.

Geologic section near Saltville, Va.

	Feet.
Massive beds, 1 to 3 feet thick, of hard black and white flint and chert-bearing limestone, with numerous characteristic Oriskany fossils	24
Fine greenish conglomerate of rounded small white quartz pebbles, limestone pebbles, cemented by white calcite, and containing large dark phosphate nodules—about	1
Gray and reddish, finely laminated, porous calcareous sandstone, greenish toward the top, with trace of calcium phosphate	14
Concretionary calcareous sandstone with shaly limestone and wavy banding at the base	2
Thinly laminated drab limestone, weathering light, containing characteristic Cayuga Leperditia	12

The bed containing the phosphate nodules and grains in sufficient quantity to be classed as phosphate rock is a little less than a foot thick in this section, but the underlying sandstones appear also to contain a small amount of phosphate.

Valley of Walker Creek.—In the valley of Walker Creek the following section was measured:

Geologic section near Marion, Va.

	Feet.
Nodular black flint with shaly partings. Contains characteristic Oriskany fossils	40
Fine rounded grains of shiny dark-green glauconite with phosphatic matrix and layers of dense fine-grained phosphate rock	1
Light-green thin-bedded sandstone with Cayugan fossils at top	22

Here also the concentrated phosphate rock is only 1 foot thick, but the underlying sandstone seems to be more or less phosphatic.

Extent of phosphate rock.—On the southeast slope of Clinch Mountain at Tumbling Run the horizon of the phosphate bed follows the foot of Redrock Mountain and Flattop Mountain to the vicinity of Tannersville. Here it swings back around the end of Flattop Mountain into Little Valley and then northeast again, following the southeast foot of the offset of Clinch Mountain. Two outliers of the horizon occur on the mountain top around Brier Cove and Laurel Bed. Another outcrop line was traced along the southeast side of Walker Mountain from near Emory northeastward. In this belt, though the phosphate bed was not observed, careful search will probably prove its presence. The belt along the outcrop of phosphate rock on Walker Creek is of limited extent, perhaps 2 or 3 miles, as it is cut off in both directions by the Walker Mountain fault. The extent of the phosphate rock underground, of course, is not known, but the fact that it has been found at two widely separate places and across the strike of the beds makes it appear that it is more or less continuous underground between these places.

Appearance and chemical analyses.—The phosphate rock collected in this area is of four types. (1) A conglomerate of white quartz pebbles, one-fourth inch in diameter, and larger light-colored limestone pebbles with black calcium phosphate nodules of similar size in a dark greenish gray phosphatic matrix, occurs at Tumbling Run. The exposed surface of this rock is coated by the characteristic faint bluish-white film of calcium phosphate. Analysis of a phosphate nodule from this rock showed 16.72 per cent of P_2O_5 present, which is equivalent to 36.5 per cent tricalcium phosphate. (2) Another type occurring at Tumbling Run is a greenish granular sandstone made up of rounded quartz grains with scattered grains and larger nodules of calcium phosphate, cemented by a calcareous and phosphatic cement. The rock has a greenish color, due probably to disseminated phosphate, and on weathering it becomes coated with a characteristic milky film. Analysis of the granular rock, containing no phosphate nodules, showed only 0.22 per cent P_2O_5, 34 per cent $CaCO_3$, with the rest largely insoluble silica. (3) The third type is phosphatic glauconite rock from the Walker Creek area, made up of fine shiny grains of greenish-black glauconite in a light-gray phosphatic cement. The weathered rock has a mottled rusty appearance. Analysis of the glauconitic rock with little visible phosphatic matrix present gave 1.17 per cent P_2O_5. (4) This rock grades into a very compact fine-grained gray phosphate by a gradual decrease in the number of glauconite grains and an increase in the phosphatic matrix. At the surface and along the joint planes in the rock, it weathers to a thick white coating. This is the fourth variety and the richest phosphate rock in the area, an analysis showing 25.17 per cent P_2O_5, equivalent to 54.97 per cent tricalcium phosphate.

If the deposits should prove to be of commercial value, those on Walker Creek will be found to be best located for transportation. They are only 5 miles from Marion and only 3 miles by road down a gentle grade in open country to the Norfolk & Western Railway. If deposits are found along the southeast slope of Walker Mountain at the indicated horizon, they will be almost as advantageously located, as the railroad parallels the mountain at a distance of about 4 miles. The Clinch Mountain occurrence is less accessible. The exposure on Tumbling Run is about 3 miles in an air line from the Saltville branch of the Norfolk & Western, but the projected branch railroad up Poor Valley, which has already been surveyed, would make the east foot of Clinch Mountain readily accessible, and the phosphate deposits, if they prove of economic importance, could then be readily handled.

SURVEY PUBLICATIONS RELATING TO PHOSPHATES.

The following papers relating to phosphates and other mineral materials have been published by the United States Geological Survey, or by members of its staff.

The Government publications, except those to which a price is affixed, may be obtained free by applying to the Director, United States Geological Survey, Washington, D. C. The priced publications may be purchased from the superintendent of documents, Government Printing Office, Washington, D. C. The one marked "Exhausted" is not available for distribution, but may be seen at the larger libraries of the country.

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POTASH SALTS: SUMMARY FOR 1912.

Compiled by W. C. Phalen.

PROGRESS OF INVESTIGATION DURING 1912.

INVESTIGATIONS BY THE UNITED STATES GEOLOGICAL SURVEY.

In 1912, as in the preceding year, the investigations of the United States Geological Survey into sources of potash salts in the United States were not confined to any single class or area, but covered the general field wherever work might be expected to yield results. These investigations included (*a*) deep drilling in Nevada, a continuation of work begun in 1911; (*b*) the continuation of the collection of samples of rock salt, brines, and bitterns, and of the study of the salt industry of the United States; (*c*) the examination of various dried or partly dried lakes, playas, flats, or marshes in several of the Western States, both within and without the Great Basin, inlcuding Arizona, California, Nevada, New Mexico, and Nebraska; (*d*) the investigation of deposits of potassium nitrate in California and Montana; and (*e*) the investigation of certain occurrences of alunite in Arizona, Colorado, and Nevada. Information on all these investigations has either been published or is in process of publication, and some of the notes in the following pages, particularly those relating to the saline deposits of the dried lakes or playas of the desert region, are abstracts of manuscripts which are expected to appear later under the names of their respective authors in the Survey's Bulletin 540, "Contributions to economic geology, 1912, Part I."

INVESTIGATIONS BY THE BUREAU OF SOILS.

The published reports of the investigations of the Bureau of Soils of the Department of Agriculture include papers on nitrate deposits in New Mexico and California, on alunite as a source of potash salts, and on the extraction of potash salts from silicate rocks. Investigations have been carried on and publications have been prepared on the extraction of potash from feldspar and other silicate rocks, and methods suggested for utilizing such silicates in connection with phosphatic slags. The salines of the United States have been systematically investigated as to the possibility of economically extracting potash salts from them. The topography and the saline deposits of over 200 desert basins have been studied with reference to their possible exploitation as sources of potash salts. The investigation of the possible use of the giant kelps of the Pacific coast has been continued, 62 working maps have been prepared of the kelp groves from the American shore of Puget Sound to the Cedros Islands on the Mexican coast, and a report describing the characteristics of these kelps has been prepared. The results of analytical investigations of brines and bitterns have already been published in unofficial journals.

QUATERNARY LAKES OF THE GREAT BASIN AS A SOURCE OF POTASH AND OTHER SALINE DEPOSITS.[1]

A paper by H. S. Gale to appear in the economic bulletin of the Survey for the year 1912 (Bulletin 540) will discuss the possibility of the existence of potash salts in large quantities in the Great Basin region of the western United States. The following notes are abstracted from Mr. Gale's paper:

Quaternary lakes.—In certain parts of the Great Basin there formerly existed large lakes, which have now almost entirely disappeared. Though several of these lakes attained considerable depths, some of them did not rise sufficiently high to overflow and find an outlet to the sea. They were fed by drainage systems resembling those of the present, which contained the saline and alkaline constituents of the disintegrating and decomposing rocks over which they flowed. The lake waters containing the salts thus brought to them in solution disappeared, but the salts remained as such or were gathered in concentrated bitterns.

The arid climate of the Great Basin region goes back to a period more remote than the Quaternary; hence lake deposits of Tertiary age may also exist in that region. The many changes which have taken place in the configuration of the surface of the Great Basin since the formation of these older saline deposits, however, makes the search for them about as uncertain of results, so far as chance for ultimate success is concerned, as would be the search for similar buried saline beds in any other part of the United States. On account of the thus greatly limited opportunities for successful discovery of important deposits of potash salts older than the Quaternary, attention has been directed to deposits of this later and comparatively recent age in the Western States.

It has been generally believed that lakes contemporary with Lake Bonneville, the ancient Great Salt Lake, and Lake Lahontan, a corresponding prehistoric lake of northern Nevada, were generally distributed throughout the Great Basin. Recent observations in this field have seemed to indicate that this is not correct, and that many of even the larger basin areas did not contain extensive bodies of water during the so-called lake epoch. The known important Quaternary lakes are Bonneville, Utah; Lahontan, in northern Nevada; Mono, Owens, Searles, and Panamint, in southern California; and Lake LeConte, in the Imperial Valley of the Colorado Desert, Cal. There were also other, mostly shallower, lakes which are believed to have been more temporary. Of the larger lakes, Bonneville is known to have overflowed. Owens Lake likewise overflowed into Searles Lake, whence have come the important saline beds now contained in the Searles Lake basin, and Searles Lake, in turn, at its highest level overflowed into the Panamint Valley. Lake Lahontan is not known to have overflowed.

Of the other extensive drainage areas of the Great Basin, such as Death Valley, the final sink of Amargosa River, and Soda Lake, the sink of Mohave River, none show evidence of having contained important bodies of water, so it is apparent that mere size of drainage area is not the criterion that determined the existence of the

[1] Gale, H. S., Notes on the Quaternary lakes of the Great Basin, with special reference to the deposition of potash and other salines: Bull. U. S. Geol. Survey No. 540-N.

Quaternary lakes. The examples given above and the sharp contrast between valleys completely submerged on one side of a mountain range and valleys on the other side which bear no visible indications of ever having contained important bodies of water, show that climatic conditions alone can not be invoked to explain such distinctions. The evidence seems to indicate that climatic conditions of to-day are not markedly different from those of the Quaternary lake period, and the desert basin streams generally were not at that time competent to flood the sinks into which the waters drained—in fact, the general physiographic character of the region did not greatly differ from that of the present time. Hence, perhaps, there never has been a full and continuous flow of water originating within the typical desert basin region. This is believed to be true for such streams as Mohave and Amargosa rivers. The periodic lakes, therefore, of the typical basin region probably did not fill their basins deeply or for long periods, but at that time, as now, there was a delicate adjustment between the rate of inflow and that of evaporation, and although certain large lakes may have risen several hundred feet with increased precipitation, yet even these generally failed to reach a height at which they overflowed.

Deposition of salines.—It is reasoned that bedded saline deposits of great areal extent and thickness in the desert basins could have been formed only by the desiccation of large bodies of saline water. It follows, therefore, that only within the basins of former extensive lakes are deposits of large economic importance likely to be found. Intermittent or periodic lakes, to be sure, may contain saline deposits, but the likelihood of their contamination with interbedded sand and clay is very great. The salts of such periodically flooded deposits do not result from any single period of desiccation, but rather are accumulated at intervals extending over great lengths of time.

To summarize, therefore, few of the desert basin playas so common in the Great Basin present evidence of having been submerged to any considerable depths, and only in the few that have been deeply submerged does the search for a possible potash segregation in important saline deposits seem justified.

Segregation of potash salts.—Potash is commonly assumed to reach saturation later than soda during the evaporation of most natural saline solutions, chiefly because potash is generally present in such solutions in a much smaller relative quantity than soda. The potash salts of such an evaporating solution, therefore, have a tendency to remain in the residual brine, while a part of the sodium salts crystallize out. Thus the potash may be reasonably expected to be segregated, to a certain extent, in the residual brines associated with massive deposits of crystalized salts. This view finds confirmation in the occurrence of potash-enriched brine in the salt deposits at Searles Lake, Cal.

On the supposition that large deposits of buried salines exist in certain areas of concentration in the Great Basin, it still remains to be proved whether or not the potash-enriched portions of such deposits can be found. This, after all, constitutes the crucial point of the enterprise. The hypothesis that these portions can be found is based principally on the assumption that the important segregation will be in the form of a residual brine, which, if free to flow, may be tapped and pumped from any point within the saline deposit.

As nearly all the low points or areas of concentration in the desert basins are saturated with ground water, the final working out of the hypothesis must be allowed to rest with this assumption until it has been proved by practical tests.

Conclusion.—As a result of the considerations that have been discussed, the belief is expressed that most of the saline crusts, dry lake areas, salt flats, "sinks," or playas in the desert basin region offer little promise for the development of commercial sources of potash salts. Potash locations are still being reported from many parts of the desert basin country, and it is believed that in many, perhaps in most, places the staking of these claims and other expenses involved in such work are incurred without a distinct understanding of the natural limitations of the desiccated-lake theory. Most playa muds contain soluble salts, many of them a considerable quantity. These salts usually show 1 per cent or more of potash when analyzed. A small percentage of potash in such a mixture, however, probably is not commercially extractable, and there is no good reason for believing that such salts found at the surface indicate any richer potash deposits in depth.

Saline muds, even if they contain a relatively high percentage of potash, are of doubtful value as a source of potash. A mud that contains 5 per cent of total saline matter would require the digging, mixing, and draining of 20 tons of raw material for a theoretical total extraction of 1 ton of crude salts. Anything like this efficiency in practical operation could not be accomplished. From these crude salts the potash must then be extracted if it is to be marketed as potash. The low value of the final product appears to make such an undertaking impracticable.

Potassium-bearing brines derived from massive beds of crystalline salts, however, may offer greater promise. The chemistry of extracting potash from such brines seems to present difficulties that have not yet been overcome in practical tests on a large scale, and the commercial operation of such a process will doubtless require costly equipment and great technical skill. Similar problems have been successfully solved elsewhere, and there are assurances from various sources that practical means have been found for extracting potash under these conditions.

DEEP-DRILLING EXPLORATIONS.

Deep drilling.—Deep-drilling explorations in the desert or Great Basin region of the western United States are based on the assumption that soluble potassium salts will be found segregated in layers, as such, or in the mother liquors associated with sedimentary rocks in large enough quantity and of sufficiently high degree of concentration to render their profitable extraction possible. The announcement of the occurrences of considerable quantities of such salts in the residual brines of Searles Lake, San Bernardino County, Cal., and the results obtained from the Survey explorations in Columbus Marsh along the line between Esmeralda and Mineral counties, Nev., tend to confirm this assumption.

Fallon, Nev.—Deep-drilling explorations by the Survey were begun near Fallon, Nev., October 6, 1911, under the direction of H. S.

Gale.[1] Both the preliminary report and a later report containing the results of the deep-drilling explorations up to July 1, 1912, have been published.

Fallon, Nev., is located in the Great Basin region of the western United States, a region which has not now nor has had for long periods of time any outward drainage. The system of ancient lakes in this region is included chiefly within Utah, Nevada, and California, but portions extend also into Oregon, Idaho, and Wyoming. The geologic history of the region has been worked out by Russell [2] and Gilbert.[3] Russell presents evidence favoring the possible existence of saline deposits in this region.

Lake Lahontan flooded the valleys of northwestern Nevada in geologically very recent time, but it has now disappeared. It covered an area of 8,422 square miles and was 886 feet in depth in the deepest part. It is not known to have ever overflowed. It had two high-water stages, separated by a period of desiccation. During the second period of flooding the lake rose higher than during the first. It then evaporated to dryness. The present lakes of the basin are of comparatively recent date and the water is fresh, for the reason that the salts deposited when Lake Lahontan evaporated were buried or absorbed by the clays and marls that occupied the bottom of the basin.

It is a rule that all lakes which have no outlet become finally charged with mineral salts. Examples of saline deposition resulting from the evaporation of inclosed lakes are common in the Great Basin. In the Lahontan basin deposits of this character resulting directly from the evaporation of a former lake are nowhere to be found. Wherever the lake sediments have been examined, however, they have been found to be charged with salts of presumably the same character as those that were most common in the waters of the former lake. It is beneath the level floors of the valleys and lake basins that the most soluble salts formerly dissolved in the waters of Lake Lahontan are buried. As between Lake Bonneville, another ancient lake of the Great Basin, and Lake Lahontan, the latter was chosen as the site of drilling operations because it never overflowed its banks and because its waters drained an area where volcanic rocks predominated. Such rocks in contrast with sedimentary rocks contain appreciable quantities of potash and soda. The headwaters of Lake Bonneville, on the other hand, were located in the Wasatch Mountains, where limestones occur and where potash and soda compounds are therefore present in comparatively small quantity.

A consideration of the low points in the Lahontan basin narrowed the selection of a drill site to a few localities, and the one finally chosen is in sec. 30, T. 21 N., R. 30 E., at the north end of Timber Lake. The well is known as the Timber Lake well.

In the preliminary report on the Timber Lake well a summary of progress is given in considerable detail, which shows the character of the strata passed through. At the time when the second report cited above was closed (July 1, 1912) the well had reached a depth of approximately 835 feet. Drilling operations finally ceased at

[1] Gale, H. S., The search for potash in the United States: Bull. U. S. Geol. Survey No. 530–A, 1911, 29 pp. See also Gale, H. S., The search for potash in the desert basin region: Bull. U. S. Geol. Survey No. 530, 1913, pp. 303-311.

[2] Russell, I. C., Geological history of Lake Lahontan, a Quaternary lake of northwestern Nevada: Mon. U. S. Geol. Survey, vol. 11, 1885.

[3] Gilbert, G. K., Lake Bonneville: Mon. U. S. Geol. Survey, vol. 1, 1890.

Fallon October 10, 1912, when the depth of 985 feet had been reached. The log of the well shows a series of unconsolidated sands, usually water bearing, alternating with clay beds. Down to the depth reached it has been ascertained that no unusual quantity of potash salts occurs disseminated in the sediments.

Railroad Valley, Nev.[1]—The Railroad Valley Co. has done some prospecting with the drill in the salt marsh of Railroad Valley, Nev., in Dixie Valley, Nev., and elsewhere. Railroad Valley is an inclosed basin in northeastern Nye County and lies just southeast of the geographic center of the State. Along its borders at both north and south ends are small mud flats or pans in which the ground waters are generally concentrated brines. The salts of the brines and the crusts formed from their evaporation at the surface often carry 5 to 15 per cent of potash. The quantity of this surface brine is believed not to be large, and it appears to be more or less local and shows chemical differences. According to Free, "there is every reason to believe that large quantities of salts are buried somewhere in the basin, and that among these salts are large total amounts of potash." To explore for buried potash salts a drill hole was started in the valley March 17, 1912, and a depth of 1,204 feet had been reached on August 27, when drilling stopped. A complete record of the beds passed through was kept and is recorded in the report to the company.

Analyses of brines and saline crusts from Railroad Valley are given below:[2]

Analyses of brines and saline crusts from Railroad Valley, Nev.

[A. R. Merz, analyst. Total solids as grams per 100 cubic centimeters. Potassium oxide as percentage of total solids.]

Sample No.	Total solids.	Percentage K_2O.	Sample No.	Total solids.	Percentage K_2O.	Sample No.	Total solids.	Percentage K_2O.
1	33.86	9.06	91	70.97	6.97	128	62.08	6.65
2	44.08	9.87	92	74.72	8.46	129	55.22	2.73
3	55.20	12.19	93	56.37	7.54	130	20.87	8.54
4	49.10	10.02	94	16.68	3.98	131	83.40	4.53
5	58.32	7.18	95	53.00	7.39	132	40.42	2.06
6	48.32	11.03	96	71.64	9.20	133	12.63	6.14
7	42.62	8.46	97	69.12	7.72	134	13.04	6.23
26	2.07	5.25	98	55.16	9.22	135	68.64	3.39
28	13.16	4.25	99	64.96	8.52	137	14.18	1.81
30	6.22	6.52	100	66.62	5.76	138	.97	1.16
43	4.55	5.29	101	34.48	2.22	139	47.18	1.30
45	27.36	5.03	102	55.18	8.96	143	15.74	5.94
48	33.98	3.10	103	43.24	3.90	144	82.46	2.66
54	25.24	.89	104	53.96	3.78	145	41.34	2.83
55	22.74	3.28	105	72.64	6.38	146	72.06	2.26
56	53.80	1.22	106	46.38	6.73	148	58.22	9.26
57	7.58	1.65	107	76.38	5.00	149	44.22	6.58
58	33.00	5.87	108	60.02	3.41	152	29.80	4.83
59	27.56	4.10	109	58.72	2.38	153	11.62	11.92
62	24.48	4.68	110	28.54	3.90	154	12.09	11.78
64	27.56	1.05	111	59.62	6.11	155	69.00	10.17
66	12.10	1.65	112	59.16	5.45	156	7.86	11.46
71	59.92	4.35	113	56.48	6.20	158	12.82	5.03
76	4.55	8.53	114	72.22	4.23	159	67.92	3.79
80	58.22	6.85	115	41.24	1.53	162	48.92	1.48
81	56.63	2.98	116	10.56	6.02	163	13.99	5.49
82	55.72	3.67	120	5.36	6.16	164	13.97	5.82
84	14.09	4.06	122	79.56	12.10	165	64.62	3.26
87	30.46	4.53	124	68.74	1.90	166	76.58	3.42
88	24.03	2.33	125	45.42	2.94	168	41.10	1.53
89	25.58	5.71	126	56.90	5.04			
90	49.48	7.91	127	76.40	3.68			

[1] From report of E. E. Free to the company, dated Nov. 25, 1912.
[2] Jour. Ind. and Eng. Chem., vol. 5, No. 1, January, 1913, p. 22.

Another drill hole, located several miles north of the one referred to, has been sunk by the Railroad Valley Land & Water Co. to a depth of 455 feet. The Railroad Valley Co., when Free's report was submitted, was engaged in sinking a series of 100-foot holes on the main mud flat to obtain information that might prove of assistance in selecting a site for a second deep hole.

Columbus Marsh, Nev.—Columbus Marsh is located on or near the line between Esmeralda and Mineral counties, Nev. Coaldale is a railroad station at the southeast corner of the marsh, and the Tonopah & Goldfield Railroad skirts its eastern margin. It comprises an area of about 35 or 40 square miles, roughly elliptical in outline, with its longer diameter 9 miles from north to south and its shorter diameter about 6 miles.

During 1912 Columbus Marsh was explored with a hand-drill apparatus by the United States Geological Survey, six holes being sunk to depths ranging from 32 to 50 feet. Analyses of the samples obtained from these wells were made in the laboratory of the Survey, and the following results were obtained from one of the wells:

Analyses of solid or core samples from well No. 400, Columbus Marsh, sec. 8, T. 2 N., R. 36 E., Nevada.

[W. B. Hicks, analyst.]

Sample No.	Depth (feet).	Soluble (per cent).	Potash (percentage in total soluble salts).		
			As K.	As K_2O.	As KCl.
1	1	17.30	1.67	2.01	3.18
2	3	9.07	2.55	3.07	4.85
3	4½	8.88	2.48	2.99	4.73
4	9	10.15	2.95	3.55	5.62
5	12	1.93	....	Not analyzed.	....
6	18	5.17	16.64	20.05	31.72
7	27	6.30	20.90	25.18	39.83
8	30	6.17	13.69	16.49	26.09
9	33–38	6.22	17.12	20.63	32.64

It appears from this record that the average content of a 20-foot section of the core obtained between the depths of 18 and 38 feet consists of 20.59 per cent potash in the water-soluble portion of the sample. These samples averaged 5.96 per cent water-soluble salts in the dried mud and sand as received at the laboratory. Such muds therefore contain nearly 6 per cent of soluble salts, of which nearly one-third (32.57 per cent) is potassium chloride.

This amount of potassium in a natural saline playa deposit of considerable mass is believed to be unusually high. It is thought to indicate a tendency to segregation of the potash portion of the salines in the layer defined, but the practical value of such saline muds, even when containing high percentages of potash, remains problematical.

Waters associated with the saline muds of Columbus Marsh were found on testing to be not strongly saline. The flows encountered in well No. 400, quoted above, were as follows:

Analyses of water flows obtained in well No. 400, Columbus Marsh, Nev., showing percentage of potash in total dissolved salts.

[W. B. Hicks, analyst.]

Sample No.	Depth of flow (feet).	Total dissolved salts (per cent).	Potassium expressed as—		
			K.	K_2O.	KCl.
1	10	1.86	2.87	3.45	5.47
2	16	.65	3.27	3.95	6.23
3	19	.54	3.72	4.49	7.10
4	29	.42	4.17	5.03	7.94
5	32	.44	4.93	5.96	9.41
6	38	.48	4.41	5.32	8.41

The receipt of these water samples at the laboratory was accidentally delayed until after the solid samples had been analyzed, and the high potash results obtained in some of the determinations of the first set led to the hope that some of the waters encountered in drilling through the corresponding strata would also be found to be highly charged with potassium salts. These waters contain a somewhat larger percentage of potash than is usual in the dissolved salts of natural waters, but the analyses of the waters show such dilution as to indicate a doubt of their practical value, even if the potassium had been considerably higher. The test of this deposit is not, however, considered conclusive, and the unusual results found in some of the tests are believed to justify further exploration of the deposit. Pending such work or some further action by Congress regarding the rights of prospecting or locating potash deposits, these lands have been withdrawn from entry.

OTHER INVESTIGATIONS OF SALINE DEPOSITS.

SEARLES LAKE, CAL.

By H. S. Gale.

Possibly the most important prospective source of soluble potash salts at the present time is the saline deposit at Searles Lake, San Bernardino County, Cal.

Searles Lake, also known as Borax Flat, is a dry lake basin superficially much like many other desert basins of the western arid regions. It is a broad somewhat circular valley or depression lying between the Slate and Argus ranges in the extreme northwestern part of San Bernardino County, near the corner between that county and Kern and Inyo counties. The camp known as "The Borax" is about 25 miles by road from Searles post office, formerly Garden station, near the Mohave-Owenyo branch of the Southern Pacific Railroad. Searles Lake at present may be reached by the regular stage that runs from Johannesburg via Garden station, or Searles, to Searles Lake, and thence on to Ballarat and Skidoo.

The public announcement of Searles Lake as a possible source of potash was made as the result of the collection and analysis of a representative set of brine samples from this deposit early in March, 1912, by E. E. Free, then of the United States Bureau of Soils, and Hoyt S. Gale, of the United States Geological Survey. A notice was at that time given to the press stating that reports which had been received concerning the unusually high potash content of the brine in this deposit were apparently confirmed by the results of these tests. Analyses of six brine samples taken at considerable depth in old wells at points distributed over the main salt flat showed that an average of 6.78 per cent of the total dissolved salts was potash, quoted in the form of the oxide (10.73 per cent as potassium chloride). The individual results obtained were 7.63, 6.23, 6.89, 6.06, 7.27, and 6.57. The uniformity of these results was taken to indicate, although of course it did not prove, homogeneity in composition of the brine throughout the salt deposit. Based in part on the logs of the wells that had already been drilled, the statement was also made at that time that "existing data give reasonable assurance that the brine-saturated salt body is at least 60 feet thick and covers an area of at least 11 square miles. Assuming the salt to contain 25 per cent by volume of the brine, the total amount of potassium oxide available is estimated as over 4,000,000 short tons [equivalent to approximately 6,000,000 tons as potassium chloride]. This estimate is based on incomplete data but it is believed to be conservative. At any rate it appears that this locality constitutes a very important source of potash in readily available [soluble] commercial form." Whether it will be possible to recover all of this potassium commercially, however, must remain for practical experience to demonstrate. There seems to be good reason for the belief that the commercial operation of this deposit for potash and the other marketable salts that it contains will become a large and important enterprise.

The history of this locality, first as a source of borax, then as a source of soda, and finally as a likely field for the development of a potash industry, is much involved. For present purposes it is sufficient to say that the marsh has received its name from John W. Searles, pioneer and prospector, who located there and built the borax camp at the site of the present camp.

Probably the first chemist to suggest that potash might become one of the profitable products of this deposit was Whitman Symmes, a mining engineer of California and Nevada, who in 1898 was superintendent of the California Borax Co., operating at Searles Lake. Mr. Symmes is said to have at that time located nearly the whole of the salt area of this deposit with the object of working the brine for the extraction of its borax, soda, and potash. The enterprise did not find sufficient support and was allowed to lapse.

In 1908 the whole deposit (41,200 acres, or about 65 square miles) was again located and subsequently was relocated by C. E. Dolbear and seven others for the purpose of establishing there a carbonate of soda or "soda ash" industry. An extensive plant was put in at the old borax camp, but for one reason or another the whole equipment was allowed to become idle before any of the soda was shipped. Subsequent to the agitation in 1910 over the German potash situation, it appears that Mr. Dolbear renewed interest in the Searles Lake deposits, with reference to potash this time. It also appears that in nearly all the analyses of material from this deposit that had recently been made the element potassium had been neglected, being reckoned as sodium.

The saline deposit at Searles Lake resembles a typical playa, of which examples are common in the desert basin region. The salt-incrusted surface occupies the lowest part of the valley or basin in which it is situated. The drainage basin tributary to it is without outlet, so that if the basin were filled the water would rise to a height of approximately 640 feet above the level of the present salt flat before it would find an outlet and overflow into the Panamint Valley to the south and east. That the valley was thus flooded at some time in the past is attested by the series of shore lines to be seen encircling the basin, the highest clearly marked reaching the elevation of the present lowest divide on the southern margin with successively lower concentric shore lines, marking the recession of the waters as they evaporated and as the lake level subsided. The saline deposit in the lowest part of this basin is the residual product of the evaporation of natural drainage waters. It appears to be quite clear that the greater part of the water of the former higher level of Searles Lake was derived by overflow from Owens Lake and hence came chiefly from Owens River. All natural river waters contain some dissolved salts. By long-continued accumulation within a restricted basin from which little or no water is lost by overflow and the water disappears by evaporation alone, the solutions become gradually more and more concentrated with salts, and eventually if the lake approaches complete dryness these salts are deposited as a more or less massive crystalline body. This is evidently what has taken place in the basin of Searles Lake. The final evaporation of this large lake is supposed to have resulted from the failure of the principal source of its water supply, when possibly with a general lowering of humidity of climate a slight decrease in the flow of Owens River caused Owens Lake to cease to overflow the divide on its south side.

The physical status of the main saline deposit in the bed of Searles Lake to-day is revealed by a large number of borings that have been put down by private interests in various explorations of the salt beds and by the analyses that have been made from them. So far as has been determined, the main salt body appears to be a bed at least 11 or 12 square miles in extent and having a depth of 60 to 70 feet. A much greater quantity of salts doubtless exists beyond the central area of the more solid salt mass thus defined. This body of salts is chiefly crystalline, in part compact, but in general is believed to be of cellular or open crystalline structure, being really a body of salts standing in the residual brine from which it has crystallized. Experiments in the wells that have been put down appear to show that this brine is in nearly all parts of the salt bed free to flow and that it stands high in the deposit, approximately at the actual surface of the salts. Thus the brine constitutes the ground-water level of this part of the basin, occasionally after wet periods flooding to a shallow depth over the surface, but generally dispelled by the rapid evaporation of this dry climate until its level sinks below the reflecting white surface of the salt crust. Evaporation at this surface is presumably continuous, the body of the ground water being as continuously replaced by inward seepage from the marginal alluvial slopes. Little sediment other than wind-blown dust is ever spread out upon the main salt plain by the occasional floods, and the salt of the central part of the deposit appears white or tinged with pink and for the most part comparatively clean.

Many analytical data as to the composition of the mass of crystallized salts of this deposit are in existence. On the salt as distinguished from the brine, which will hereafter be discussed, the Survey has at present no original data, for they could be had only from carefully collected samples obtained during the drilling in the deposits. There is good reason to believe, however, that the salts as well as the brine contain a considerable percentage of potash. Some of the private analyses from this deposit have been made public in a recent article,[1] with the interpretations placed thereon by its author. Several analyses, chiefly of the brine, have been made by the Government bureaus and should give accurate data as to the composition of this part of the deposit. The following are the more complete analyses of the brine made from the samples collected at Searles Lake March 6, 1912, now published for the first time:

Composition of brine from Searles Lake, Cal.

[Percentage of ignited residue. Walton Van Winkle, analyst.]

	Austin well "U."	Well "W9."	Well "S. E. No. 8."	Austin well "O."	Well "S. E. No. 7."	Well "S. E. No. 4."	Average.
SiO_2	0.05	0.03	0.00	0.00	0.00	0.03	0.02
As	.06	.06	.05	.06	.06	.08	.06
Mg	.00	.00	.00	.00	.00	.00	.00
Ca	.00	.00	.00	.00	.00	.00	.00
Na	33.37	32.57	33.16	33.92	33.23	32.90	33.19
K	6.53	7.27	5.98	5.54	6.29	5.69	6.22
CO_3	7.37	7.95	6.65	6.89	6.85	6.94	7.11
SO_4	12.00	12.49	13.41	11.89	13.79	13.00	12.76
Cl	35.97	35.53	36.50	37.13	36.40	36.79	36.39
B_4O_7	3.07	1.58	1.77	2.03	2.08	4.14	2.45
Total	98.42	97.48	97.52	97.46	98.70	99.57	98.20
Total salts (ignited residue, percentage of original sample)	33.48	33.94	33.30	32.96	33.21	32.88	33.30
Specific gravity	1.3002	1.3045	1.2969	1.2935	1.2959	1.2932	1.2974

Each sample was collected by lowering a stoppered and weighted bottle to a depth of 35 to 40 feet in the brine and then, by means of a separate cord provided for the purpose, jerking out the stopper and allowing the bottle to fill.

By recalculating the average results of these six analyses to a theoretical or possible combination of salts that might be derived therefrom the following result is obtained. This is the approximate composition of the anhydrous residue which results from complete desiccation of the brine.

Hypothetical average composition of anhydrous residue of brine from Searles Lake basin.

	Per cent.
Sodium chloride (NaCl)	51.61
Sodium sulphate (Na_2SO_4)	19.22
Sodium carbonate (Na_2CO_3)	12.79
Sodium biborate ($Na_2B_4O_7$)	3.23
Potassium chloride (KCl)	12.07
Sodium arsenate (Na_3AsO_4)	.17
	99.09

The original brine contains a variable percentage of bicarbonate, which is converted to the carbonate form in the anhydrous residue and is so expressed.

[1] Dolbear, C. E., Searles Lake potash deposits: Eng. and Min. Jour., vol. 95, 1913, pp. 259-261.

As is well known, the theoretical composition of salts in the brine, as shown by the calculations from the analyses, can be accepted as a working basis only with certain reservations. Doubtless most of the salts named in the conventional method of computing the analysis of a solution may be abstracted from the brine somewhat in the proportions given, provided that satisfactory chemical processes can be devised to accomplish the desired result. It is believed that this has already been at least partly accomplished experimentally. But it is also true that no practical process of extraction on a commercial scale will derive all these salts in the amounts shown by quantitative analysis.

Estimates of other available constituents similar to the estimate of the total available potash in the deposit can be readily computed on the basis of analyses of the salts and the brine. At present the plans for working the deposit contemplate the manufacture of the salts from the brine, which, as a liquid capable of being pumped from place to place, is more readily susceptible of manipulation than the solid salts.

Preliminary estimates of quantity of production have been made on the basis of the composition of the brine and on an assumed constancy of composition under continued pumping. As to the composition of the brine the analyses here quoted are now available and as to the constancy of the brine under pumping there is opportunity for experimental verification of hypotheses.

It is of course recognized that in general composition desert basin salines are quite distinct from salines that have been produced by the desiccation of marine waters. The Stassfurt salts are similar to the deposits that would be left by the evaporation of normal sea waters. They contain soluble magnesium salts as an important constituent, especially in conjunction with the potash-rich portions of the deposits. Most of the desert basin salines in the United States are more or less of the Searles Lake type—that is, they are composed largely of chlorides, but contain considerable proportions of sulphates and carbonates, chiefly of sodium with some potassium, and little or no soluble magnesium salts. The desert basin salts may be described as salines derived by the direct leaching of continental areas, as distinguished from salts of direct marine origin. Ultimately both classes may be said to have had a common origin.

It is still too early to offer any general summary statement regarding the industrial situation at Searles Lake. An immense mass of salts and an equally great volume of saturated residual brine exist in this deposit. The compositions of the salt and brine are fairly well determined. Several of the ingredients which could be extracted have an established value in the chemical markets generally, and some, like sodium sulphate, have potential value.

It appears that financial support for carrying out a practical test of this deposit would be promptly forthcoming, if questions of control and ownership could be satisfactorily adjusted. According ao current reports it seems that little has been accomplished in this direction.

The lands at Searles Lake were withdrawn from entry by an order approved February 21, 1913. This withdrawal is not intended to interfere with any valid mining claims that existed prior to the withdrawal, a fact that is made clear in the express wording of the order itself. "This withdrawal is made subject to all rights lawfully initiated under any valid mining locations made upon such lands so long as such rights are maintained in full compliance with the law."

In order to relieve the existing uncertainties regarding the validity of "potash" or general placer locations carrying saline deposits in large area, a draft of a law has been prepared and submitted to the appropriate committee in Congress, which it is believed will provide a satisfactory title basis under which such lands can be worked. It is to be hoped that in the interest of a possible American potash production the matter may receive due consideration and that enactment of a proper measure to this end may be accomplished.

SALINE VALLEY, INYO COUNTY, CAL.

Saline Valley, Cal., was visited by H. S. Gale, of the United States Geological Survey, in October, 1912, for the purpose of sampling the salt flat with special reference to the occurrence of potassium salts and for general information on the subject of the deposition of desert-basin salines.

Saline Valley is situated in the west-central part of Inyo County, Cal., between the Inyo Mountains on the west and the Panamint Mountains on the east. The salt deposits of the valley occupy the lowest part of the depression, which is without outlet and is completely inclosed by high mountains. The central depression of the valley has, without doubt, been occasionally submerged, but perhaps to shallow depths only, as no evidence of former shore lines of considerable height has been observed in the valley. Of the central deposit of mud and salts, approximately 1 square mile is a smooth white salt crust, including a small open pond of salt water. Adjacent to this smooth crust is a rough expanse of broken and tilted salt-crust blocks, with a sharp craggy surface. A stock company, recently organized, proposes to develop this deposit for the salt it contains. The salt from the smooth crust in the lowest part of the valley was sampled as it stood piled in stacks ready for shipment, and the analysis of the samples showed it to contain 98.52 per cent of sodium chloride and thus to be of high grade for a natural product.

The complete analysis of the salt sample is as follows:

Analysis of salt sample from stacks in Saline Valley, Cal.

Sodium chloride, salt (NaCl)	98.52
Sodium sulphate (Na_2SO_4)	1.02
Potassium sulphate (K_2SO_4)	.37
Water (H_2O)	.12
Insoluble	.17
	100.20

The thickness of the deposit is not known, as no drilling to any considerable depth has been done. Shallow holes dug in the surface of the white crust showed a surface thickness of 4 inches of a loose-textured, porous white crystalline salt, below which there is a layer of dark-greenish or almost black saline mud several inches thick. Salt layers occur still farther down, but excavation is interfered with by freely flowing brine which fills the holes. Samples of the brine were collected and tested for potash salts, but the results indicated that potash is not present in quantities of commercial importance. It is quite likely that no extensive or deep lake ever existed in this valley and that the salines represent the accumulation from the surrounding and somewhat restricted drainage area. The results of the analyses of the brine collected from this region are given in the table below:

Potash analyses of brine from Saline Valley, Cal.

[Nos. 43–46, R. K. Bailey, analyst; Nos. 47 and 48, W. B. Hicks, analyst.]

Sample No.	Total salts (ignited residue).	Potassium in the total salts expressed as—		
		K.	K_2O.	KCl.
43	29.77	1.29	1.56	2.47
44	28.10	.78	.94	1.48
45	28.05	.81	.99	1.55
46	28.77	1.29	1.56	2.47
47	28.26	.95	1.15	1.82
48	.10	.05	.06	.10

CARRIZO PLAIN, SAN LUIS OBISPO COUNTY, CAL.

Carrizo Plain, San Luis Obispo County, Cal., was visited early in October, 1912, by H. S. Gale for the purpose of ascertaining whether or not soluble potassium salts occur in appreciable quantities associated with the deposits of sodium sulphate that have long been known to exist there. The results of tests made on the material collected are negative so far as the occurrence of soluble potash salts is concerned. The results of the analyses are given below:

Potash analyses of samples from Soda Lake, San Luis Obispo County, Cal.

[W. B. Hicks, analyst.]

Sample No.	Description.	Soluble portion (ignited).	Potassium in soluble portion as—		
			K.	K_2O.	KCl.
31	Concentrated brine	29.02	0.40	0.49	0.77
34	Bloedite crystals	78.10	.10	.12	.19
35	Salt crust, average sample	89.66	.05	.06	.09
36	Concentrated brine	29.16	.63	.76	1.20
37	.....do	26.39	.36	.43	.68
38	Salt crust, average sample	88.12	.06	.08	.13
39	Concentrated brine	30.19	.29	.34	.54

INVESTIGATIONS IN OTHER STATES.

The following notes are a brief summary of the results obtained by James H. Hance, of the United States Geological Survey, in 1912 on salines with special reference to the occurrence of potash salts. The different localities mentioned were visited and carefully examined for favorable indications of potash salts concentrations, but no detailed geologic work was done. Samples of brines, efflorescences, and muds were collected and were analyzed in the Survey laboratory at Washington.

ARIZONA.

Adamana.—A well was drilled at Adamana station, on the Santa Fe Railway. It is 305 feet deep and in Permian beds. The flow was estimated as approximately 25 gallons a minute. The water contains 4.9 per cent of dissolved salts, of which 0.33 per cent is potash. Most of the soluble matter is salt.

Cochise Flat.—Cochise Flat covers about 50 square miles and borders the Southern Pacific Railroad near Cochise. It is the site of a former shallow lake. The saline content is mostly "black alkali" (sodium carbonate and bicarbonate), with some salt. No notable concentration of salts seems to have taken place at the surface.

NEVADA.

Fourmile Flat.—Fourmile Flat, formerly called Alkali Valley, adjoins Carson Desert on the southeast. In the lowest portion of the flat there is a body of nearly pure salt covering more than 1 square mile. Samples of the brine underlying it were analyzed, but showed only 1.2 per cent of potash in 31.4 per cent of dissolved salts. The deposit is in an area at one time covered by the Quaternary Lake Lahontan.

Dixie Salt Marsh.—The saline deposit in Dixie Valley lies just east of Carson Desert and nearly 500 feet lower. The valley was formerly occupied by a shallow lake, the evaporation of which probably took place on the site of the present marsh, which covers about 40 square miles. Samples of the brine underlying it contain 0.22 per cent of potash in 29.1 per cent of dissolved salts. The saline deposit is nearly pure salt.

Railroad Valley.—Railroad Valley lies between Ely and Tonopah. Shore terraces along its sides indicate that it has been occupied by a lake, possibly to a depth of several hundred feet. At present Butterfield Marsh, a saline playa, occupies the lowest part of the valley and is northeast of the center. Saline efflorescences occur at the north end of the marsh, and these were carefully sampled. The potash content of the surface crust of salts is in some places unusually high, exceeding 12 per cent of the soluble material. A well 1,200 feet deep near the center of the valley was drilled in 1912, but encountered only relatively fresh waters in the underlying sands and clays. See also preceding discussion.

Silver Peak Marsh.[1]—Silver Peak Marsh comprises the lowest part of Clayton Valley, Esmeralda County, and is situated 20 miles west of Goldfield and 25 miles southwest of Tonopah. It is a salt playa containing sodium chloride of high grade. To a depth of 50 feet the formations consist chiefly of salt clays and muds with layers of crystallized salt covered irregularly by gypsum-bearing clays. It is estimated that 15,000,000 tons of salt lies within 40 feet of the surface.

The investigation into the occurrence of potash salts in this playa gave low results. Though the clays, muds, and brine showed potassium salts when tested, the quantities proved to be small in every case. The saturated brine averages a little more than 2.5 per cent in its content of potassa (K_2O), a concentration much lower than that of the

[1] Dole, R. B., Exploration of salines in Silver Peak Marsh, Nev.: Bull. U. S. Geol. Survey No. 530, 1913, pp. 330–345.

brine from Searles Lake, Cal. The results of tests made on samples collected from borings are tabulated below.

Total salts and potassium in brines from Silver Peak Marsh, Nev., June, 1912.

[Examination by A. R. Merz, Reno, Nev. Quantities in grams per 100 cubic centimeters unless otherwise designated.]

Boring No.	Depth of sample (feet).	Total solids at 105° C.	Potassium expressed as—			Percentage of potassium oxide (K_2O) in saline residue.
			Potassium (K).	Potassium chloride (KCl).	Potassium oxide (K_2O).	
3	15.5	33.28	0.91	1.74	1.10	3.30
6	21	33.13	.77	1.47	.93	2.80
6	40	33.75	.75	1.43	.90	2.67
11	27	32.25	.74	1.41	.89	2.76
11	35	32.05	.55	1.05	.66	2.07
12	10	26.56	.61	1.16	.74	2.78
12	20	32.90	.59	1.12	.71	2.15
12	27	32.97	.64	1.22	.77	2.34
13	16	4.15	.12	.23	.14	3.36
13	31.5	4.61	.13	.21	.16	3.43
13	40	3.38	.11	.21	.13	3.80
14	11	26.82	.66	1.26	.80	3.00
14	17	26.21	.66	1.26	.79	3.01
Average, exclusive of samples from boring No. 13		30.99	.69	1.31	.83	2.69

NEBRASKA.

A number of alkali ponds and lakes in Cherry, Sheridan, Morrill, Garden, and Boxbutte counties, Nebr., were examined and sampled in 1912. The salinity varies according to the season, and in some ponds the content of dissolved salts exceeds 10 per cent. In some ponds also the percentage of potash salts reaches unusual proportions, being as high as 30 per cent of the soluble material. Although the total potash in solution is large it is disseminated in the muds, and the individual lakes are small, so that profitable extraction will prove a difficult problem. Soda is present in the salts in about the same quantity as potash.

NEW MEXICO.

Estancia Valley.—The small ponds and lakes in the Estancia Valley, N. Mex., were sampled, but were found to contain only small quantities of potash. In no case does the potash content reach 1.5 per cent of the water-soluble portion of the samples collected. At some places, notably at Laguna Salina, a high-grade salt is obtained. Bloedite crystals of large size occur in distinct strata and also disseminated through some of the saline muds.

Crater Salt Lake.—Crater Salt Lake is a unique occurrence in the west-central part of the State. A brine, supposed to be derived from the underlying Permian "Red Beds," comes to the surface, forming a shallow lake in an old crater. During a part of the year salt is usually precipitated on the bottom of the lake and is collected and dried in piles on the shore. Samples of the brine from this lake were analyzed and show 0.3 per cent of potash in the water-soluble portion of the samples, the latter amounting to 16.5 per cent of the original brine sample.

Lake at Playas.—The lake at Playas was visited and sampled. Its water is nearly fresh and is used for stock at all seasons of the year.

Carlsbad.—A small salt lake about 15 miles southeast of Carlsbad was visited and sampled. The lake or pond occupies a depression in the Permian "Red Beds" about 1 square mile in extent. The water contains 11.1 per cent of dissolved salt, of which less than 1 per cent is potash.

POTASH WITHDRAWALS.

As a result of Survey investigations three tracts of land of the desert-basin type in California and Nevada have been withdrawn from entry. The first of these withdrawals covered Columbus Marsh, Nev., and was approved January 16, 1913. The second included Searles Lake, Cal., and was approved February 21, 1913. The third withdrawal included lands in the Panamint Valley, Cal. The aggregate area thus withdrawn is 133,829 acres.

The withdrawals are not destructive of any valid claims that may now exist. In fact, in order that any rights heretofore lawfully initiated may be preserved, the withdrawal order itself has been made to include the following clause: "This withdrawal is made subject to all rights lawfully initiated under any valid mining locations made upon such lands so long as such rights are maintained in full compliance with the law."

NITRATE DEPOSITS.

Nitrate deposits in the United States.—The subject of nitrate deposits in the United States has been reviewed in a recent bulletin by H. S. Gale,[1] which contains references to the literature on the deposits of Chilean nitrate, describes the mineralogy and the uses of both sodium and potassium nitrates, and gives a statement of the imports of these salts. Most of the known deposits of nitrates in the United States are reviewed briefly, and the list of occurrences will be augmented and republished as additional information may come to light or as new deposits may be found. Among the deposits visited and described in detail by Mr. Gale during the course of recent geologic work are deposits (1) in Greenwich Canyon, Grass Valley, Piute County, Utah; (2) on the south side of Humboldt Lake, southwest of Lovelock, Humboldt County, Nev.; and (3) in the northern part of the Granite Range, Washoe County, Nev. The last locality is in T. 37 N., R. 22 E., and may be reached by road and trail from Gerlach, a station on the Western Pacific Railway. An occurrence of almost pure potassium nitrate in natural form has been found in this region.

The report also contains notes on the origin of nitrates, including their primary source, occurrence in soils, hypothesis of origin, process of nitrification, and a summary concerning the value of the known nitrate deposits.

Melrose, Mont.—The niter deposits near Melrose, Mont., described by Richards,[2] are found in the face of cliffs of black limestone, presumably of Devonian age, on Camp Creek, 3½ miles northeast of Melrose. The mineral occurs as small veinlets in the limestone, as a crust on the surface of the rock, in small caves, and in the talus accumulations protected from the weather beneath the ledges, where the purest material is found. The occurrence is considered of the cave type of deposits.

[1] Gale, H. S., Nitrate deposits: Bull. U. S. Geol. Survey No. 523, 1912, 36 pp.
[2] Richards, R. W., Niter near Melrose, Mont.: Bull. U. S. Geol. Survey No. 540-Q, 1913.

The purest material was found to be 86.09 per cent soluble in water, and this soluble material has the following composition:

Composition of soluble material in niter deposits on Camp Creek, near Melrose, Mont.

CaO	4.63
SO_3	8.19
Cl	8.61
N_2O_5	40.05
Na_2O	16.72
K_2O	22.05
	99.25

Expressed in the form of salts, this composition probably corresponds closely to the following:

Composition of salts from Camp Creek, near Melrose, Mont.

$CaSO_4$		13.94
Na_2SO_4		3.30
NaCl		20.42
$NaNO_3$	21.77	61.25
KNO_3	39.48	
N_2O_5		1.19
		100.10

The water-soluble material in the six other samples collected for examination runs much lower than in the purest material (86.09 per cent), namely, from 1.16 to 7.26 per cent, containing, respectively, from 4.99 to 53.29 per cent nitric anhydride (N_2O_5). The value of the deposits can not be safely estimated from the data collected, but it is likely that the successful development of the deposits can be expected only under exceptionally favorable conditions.

As the average soluble portion of the samples is only about 1 to 5 per cent, it appears that 35 tons of rock would have to be treated to obtain 1 ton of the crude salts. This quantity, if refined, would yield, theoretically, 440 pounds of soda niter and about 790 pounds of potash niter, the former being at present worth about $24 and the latter about $41 a ton, a gross yield of about $1.80 a ton of rock treated. It is not, however, practical to estimate a theoretical total extraction either of all the salts present in the rock or of the nitrate portion to be refined from the crude salts. Better returns might be obtained by treating the loose rock fragments which lie at the base of the cliffs, but such material is very meager in quantity.

Amargosa Valley, near Tecopa, Cal.—The localities in Amargosa Valley described in a recent paper by E. E. Free[1] are Morrison's Siding and Sperry, on the Tonopah & Tidewater Railroad near the boundary between Inyo and San Bernardino counties, Cal. Tecopa is the nearest supply point. The nitrate occurs in low rounded hills made up of clay beds of Tertiary (?) age. The hills are coated with loose material 10 to 30 inches deep. The loose surface clay is seldom noticeably saline, but saline efflorescences are occasionally seen where rain water has collected. Some of the underlying stratified clays are nonsaline, but more commonly they show in their cracks thin films and crusts of salt formed by drying. The nature of the deeper-lying portions of the clay is unknown. The 19 analyses given

[1] Free, E. E., Nitrate prospects in the Amargosa Valley, near Tecopa, Cal.: Circ. Bur. Soils No. 73, U. S. Dept. Agr., Dec. 26, 1912, pp. 6.

are interpreted by the author as showing that the important content in nitrate is in the underlying clays and not in the efflorescences. The nitrates are thought to be original and to have formed in the playas or marshes of the Tertiary period when conditions were favorable for the life and growth of bacteria. These bacteria caused changes in the animal matter found in the marshes or in the air. The value of the deposits is considered problematical.

Queen, N. Mex.[1]—A nitrate prospect recently described by E. E. Free is located in Dark Canyon, on the eastern slope of the Guadalupe Mountains, in Eddy County, N. Mex., about 6 miles due east of Queen post office. It is probably in T. 24 S., R. 23 E., New Mexico principal meridian. So far as known, the prospect is on public land.

The section exposed is as follows:

Geologic section in Dark Canyon, Eddy County, N. Mex.

	Feet.
1. Limestones and sandstones	±200
2. Hard arenaceous limestone, honeycombed with many small cavities, 1 inch to 2 inches in diameter and containing crusts of crystalline calcite	1–3
3. Soft, easily weathered calcareous sandstone	2–4
4. Harder limestone, more calcareous than No. 3	1–3
5. Arenaceous limestone, with soft, easily weathered spots also showing a few of the cavities characteristic of No. 1	5–10
6. Hard oolitic limestone	4
7. Talus.	

The visible nitrate occurs as a very thin efflorescence on the surface of Nos. 3, 4, and 5 of the section. Nitrate can also be detected by taste in parts of the rock where no efflorescence is visible. Twenty-eight samples, representative of the rock rather than of the efflorescence which covered it, were collected. The average of the analyses was 1.16 per cent potassium nitrate; exclusive of the two samples containing surface efflorescences, the average was 1.04 per cent potassium nitrate.

The deposits are considered to be due possibly to bacterial alteration of excrementa from animals which have occupied stratum 2 of the section or the sheltered holes and ledges weathered into strata 3 and 5. It is also possible that the deposits may have been formed in the same way in higher beds and leached downward. The deposits are not present in sufficient quantity to have any commercial importance.

POTASH SALTS IN BRINES AND BITTERNS OF THE UNITED STATES.[2]

A systematic study of the brines, bitterns, and rock-salt deposits of the United States was attempted as a part of the potash investigations carried on by the United States Geological Survey in the summers of 1911 and 1912. The study was confined to the localities that were considered the most promising for the occurrence of potash salts. During the work samples of brines, bitterns, and calcium chloride were collected. This does not include the large number of brine samples procured through correspondence, chiefly from oil drillers throughout the country, in the year 1911. The geology of

[1] Free, E. E., A report of a reconnoissance of the Lyon nitrate prospect near Queen, N. Mex.: Circ. Bur. Soils No. 62, U. S. Dept. Agr., Apr. 8, 1912. 6 pp.

[2] See Turrentine, J. W., Jour. Ind. and Eng. Chem., vol. 4, No. 11, November, 1912, pp. 828–833; vol. 4, No. 12, December, 1912, pp. 885–889; vol. 5, No. 1, January, 1913, pp. 19–24.

the occurrences of the brine and the salt was investigated as opportunity presented itself, and many records of deep wells were obtained.

The results of the field work and of the analyses, which were made in part by R. F. Gardner and A. R. Merz, of the Bureau of Soils, Department of Agriculture, are to be incorporated in a bulletin on the salt industry of the United States, now in the course of preparation. In general it may be said that none of the artificial brines, natural brines, and rock-salt deposits so far examined contain sufficient potash salts to render them of value as commercial sources of potash. This statement does not refer to the natural bitterns associated with the playas or salt marsh deposits in the Great Basin region of the West. Many of the bitterns from the grainer process employed in the manufacture of salt in the Eastern States and those remaining in the crystallizing ponds along the coast of California, after all the salt to be extracted has been separated, contain enough potash salts to make them of interest as a possible source of potash if they could be obtained in sufficient quantity. Though these bitterns are saved at a few plants along the Pacific coast, their utilization has not been systematically attempted.

The analyses of certain artificial and natural brines and bitterns which appear to contain more than the ordinary proportion of potash salts are given below:

Analyses of brines and bitterns.

	17	24	116	95	101	6
K	11.8	12.0	3.0	2.4	3.8	9.4
Na	104.4	108.4	122.0	123.3	119.6	73.7
Ca	4.8	3.4	.2	.8	1.4	20.2
Mg	1.6	1.4	Trace.	Trace.	.9	1.6
Cl	179.1	181.9	189.4	189.3	191.4	135.0
SO_4	1.6	2.4	1.8	4.0	2.8	2.2
Br	1.1	1.1	Trace.	.9	1.0	....
Conventional combinations.						
KCl	22.5	22.9	5.7	4.6	7.2	17.9
NaCl	265.0	725.2	307.4	306.4	303.5	144.7
$CaCl_2$	11.3	6.6	.6	2.2	.5	53.4
$MgCl_2$	.8	Trace.	Trace.	Trace.	3.9	6.3
Na_2SO_4	....	....	2.7	5.9	....	....
$CaSO_4$	2.3	3.4	Trace.	Trace.	4.0	3.1
$MgBr_2$	2.5	2.5	Trace.	....	1.8	....
NaBr	....	....	....	1.6	....	....

17. Watkins Salt Co., Watkins, N. Y. Sample obtained through U. S. Geological Survey, 1910. R. F. Gardner, analyst.
24. International Salt Co., Watkins, N. Y. Sample obtained through U. S. Geological Survey, 1910. R. F. Gardner, analyst.
116. Ohio Salt Co., Wadsworth, Ohio. Composite artificial brine from two wells. 1911. R. F. Gardner, analyst.
95. Michigan Salt Works, Marine City, Mich. Brine from company's one well. 1911. R. F. Gardner, analyst.
101. Mulkey Salt Co., Detroit, Mich. Composite brine from three wells. 1911. R. F. Gardner, analyst.
6. Rock Glen Salt Co., Rock Glen, N. Y. Bittern, 6 weeks' evaporation in grainer, taken at time of run-off. 1910. R. F. Gardner, analyst.

Analyses of brines and bitterns—Continued.

	96	103	105	108	113	114
K	2.0	2.8	3.2	3.2	5.8	3.9
Na	104.6	108.4	68.0	62.7	48.0	43.4
Ca	13.8	12.8	29.0	30.8	45.6	48.6
Mg	2.7	1.6	6.4	6.4	9.8	11.2
Cl	194.6	193.0	170.2	164.8	187.0	188.4
SO_4	.6	5.0	.6	Trace.	None.	.2
Br	....	Trace.	.2	2.0	.4	....
Conventional combinations.						
KCl	3.8	5.4	6.1	6.1	11.1	7.4
NaCl	265.9	275.2	172.6	159.1	121.8	109.7
$CaCl_2$	37.3	29.6	70.3	85.2	126.1	134.2
$MgCl_2$	10.6	6.3	23.9	14.9	36.8	43.9
$CaSO_4$	.9	7.1	2.0	Trace.	None.	.3
$MgBr_2$	....	Trace.	.5	4.6	.8	....

	67	69	75	122	120	129
K	4.2	2.6	10.2	3.2	2.7	2.9
Na	78.2	76.1	42.1	2.6	....	....
Ca	36.4	32.8	192.6	145.2	135.8	143.4
Mg	11.0	9.6	35.2	42.4	48.4	43.4
Cl	202.2	195.8	427.8	348.8	355.2	346.4
SO_4	.8	1.4	None.	5.2	4.8	3.8
Br	3.3	2.2	Trace.	11.6	11.0	12.2
Conventional combinations.						
KCl	8.0	5.0	19.5	6.6	5.4	5.8
NaCl	198.4	193.0	106.9	6.7	8.4	.7
$CaCl_2$	99.8	89.1	532.6	377.9	362.5	379.0
$MgCl_2$	19.3	26.3	18.4	158.6	179.2	162.5
$CaSO_4$	1.1	2.0	None.	7.3	6.8	5.3
$MgBr_2$	9.5	5.1	Trace.	13.3	12.6	14.1

96. Michigan Salt Works, Marine City, Mich. Bittern from grainer, 6 weeks' evaporation. 1911. A. R. Merz, analyst.

103. Colonial Salt Co., Akron, Ohio. Bittern from grainer, 5½ months' evaporation. 1911. R. F. Gardner, analyst.

105. Colonial Salt Co., Akron, Ohio. Natural brine occurring in strata above rock salt horizon. 1911. R. F. Gardner, analyst.

108. Columbia Chemical Co., Barberton, Ohio. Natural brine occurring above artificial brine horizon. 1911. R. F. Gardner, analyst.

113. Diamond Alkali Co., Fairport Harbor, Ohio. Natural brine, occurring in strata 300 feet above rock salt horizon. 1911. R. F. Gardner, analyst.

114. Diamond Alkali Co., Fairport Harbor, Ohio. Natural brine. 1911. A. R. Merz, analyst.

67. Edward Germain, Saginaw, Mich. Bittern from grainer, 14 days' evaporation. 1911. R. F. Gardner, analyst.

69. Mershon, Eddy, Parker Co., Saginaw, Mich. Bittern from grainer, 4 days' evaporation. 1911. R. F. Gardner, analyst.

75. Saginaw Chemical Works (Saginaw Plate Glass Co.), Saginaw, Mich. Bittern, which had been evaporated to 8.5 per cent of the volume of the original brine before the final evaporation for the preparation of calcium chloride. Sample was taken while hot. On cooling a crystalline solid separated, which contained 1.1 per cent potassium, or 2.3 per cent potassium chloride. 1911. R. F. Gardner, analyst.

122. Pomeroy Salt Association, Pomeroy, Ohio. Bittern before going to bromine still. 1911. A. R. Merz and R. F. Gardner, analysts.

120. Dixie Salt Works, Mason, W. Va. Bittern before going to bromine still. 1911. A. R. Merz and R. F. Gardner, analysts.

129. Liverpool Salt & Coal Co., Hartford, W. Va. Bittern before going to bromine still. 1911. A. R. Merz and R. F. Gardner, analysts.

ALUNITE AS A SOURCE OF POTASH SALTS.

Alunite near Marysvale, Utah.—In the search for a commercial source of potash salts in the United States, the mineral alunite, where it occurs in large quantity, has been regarded as among the future possibilities. Interest, therefore, attaches to the finds reported by members of the United States Geological Survey during the year 1912, and to investigations having in view the utilization of the material to greatest advantage.

In Bulletin 511 of the Survey,[1] which is still available for distribution, a detailed description was given of the important deposit of alunite in the vicinity of Marysvale, Piute County, Utah. The new occurrences reported and described by members of the survey since that chapter was written are outlined briefly below.

Alunite in the San Cristobal quadrangle, Colorado.[2]—Alunite is a common, and in places an abundant, mineral in the alteration product of large areas of rock in the San Cristobal quadrangle, Colorado. The alunitized rock is generally white and usually retains the original texture of the rock in which it is found. It can be distinguished from the other altered rock of the region by its more compact, crystalline appearance and by a vitreous rather than by an earthy luster. Crystals and cleavage faces of alunite may be seen in the more coarsely crystalline rock, but most of the material is very fine grained. In some places the alunite is scattered through the altered rock, but a great deal of that derived from the more basic rocks partly replaces the plagioclase or occurs scattered throughout the groundmass.

The alunite rock consists of quartz, alunite, and pyrite. It is believed to have resulted from the alteration of igneous rocks by solutions which resulted from the mingling of hot ascending waters or gases carrying hydrogen sulphide and of surface oxidizing waters.

Alunite is known to occur in the following localities: (1) In the basin at the head of the west branch of the Middle Fork of Piedra River; (2) at the head of South River just east of Piedra Peak; (3) at the mining camp of Carson; (4) at Slumgullion Gulch; and (5) at Red Mountain, a few miles southwest of Lake City. The typical altered rock of the South River locality has been shown by analysis to contain 29 per cent alunite.

Alunite near Patagonia, Ariz.[3]—The mineral alunite has been shown by F. C. Schrader to occur disseminated in an altered granite porphyry at the 3 R mines, in the Palmetto mining district, 5 miles south of Patagonia, Santa Cruz County, Ariz.

The deposit is of interest as occurring in a plutonic rock, for most of the known deposits in the western United States, at least, are in Tertiary volcanic rocks. Quartz and orthoclase in large phenocrysts and their aggregates constitute more than two-thirds of the rock, the remainder appearing to be a fine-grained groundmass of the same minerals. Pyrite and chalcopyrite, apparently primary, are present, and apatite and zircon are accessories.

The alunite described occurs in the wall rock of the Evening Star prospect, belonging to the 3 R group of copper mines. It almost

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[1] Butler, B. S., and Gale, H. S., Alunite, a newly discovered deposit near Marysvale, Utah: Bull. U. S. Geol. Survey No. 511, 1912, 64 pp. Phalen, W. C., Alunite as a source of potash salts: Mineral Resources U. S. for 1911, pt. 2, U. S. Geol. Survey, 1912, pp. 895–896.

[2] Larsen, E. S., Alunite in the San Cristobal quadrangle, Colo.: Bull. U. S. Geol. Survey No. 530, 1913, pp. 179–183.

[3] Schrader, F. C., Bull. U. S. Geol. Survey No. 540–I. [In preparation.]

wholly replaces the orthoclase, so that the rock consists chiefly of quartz and alunite, with a little pyrite and chalcopyrite. The zone of alunitization extends several feet laterally from the alunite. Hydrothermal solutions ascending the fissure after the intrusion of the granite prophyry or later, and replacing orthoclase, are believed to have produced the alunite. "The solutions were probably sulphurous and acidic and the process was attended by some silicification," according to Schrader. The deposit is not shown to have commercial value.

Alunite at Bovard, Nev.—Bovard is the name applied to a small mining district about 2 miles square, located in Esmeralda County, southwestern Nevada, on the northeast slope of the Gabbs Valley Mountain Range. F. C. Schrader, of the United States Geological Survey, has recently reported from the district an occurrence of alunite, or rather of potassium natroalunite. The mineral occurs in the form of tabular sheets in fissures in Tertiary volcanic rocks and in Paleozoic limestone, chiefly at the Gold Pen mine, in the northern part of the district, and at the Valley View prospect, in the southern part.

The mineral, as suggested by the name applied to it above, has a large proportion of soda in it and may be considered theoretically as normal alunite with its potassa content largely replaced by soda. Its interest, therefore, is chiefly mineralogic and scientific, and the occurrence can not be considered of importance as a source of potash salts. The mineral, moreover, does not occur in sufficient quantity to be of commercial value as a source of alumina.

Method of recovering potash from alunite.—Experiments by W. T. Schaller in the laboratory of the Survey have shown that on igniting powdered alunite all the water and three-fourths of the sulphuric acid are driven off. When the residue is leached with water potassium sulphate dissolves and insoluble alumina is left. The average amount of potassium sulphate leached from the ignited mineral is 17.9 per cent of the original material used. As the coarsely crystallized alunite was found to contain 19.4 per cent potassium sulphate, 92 per cent of the total potash present was obtained by simple ignition and subsequent leaching. According to the laboratory experiments 32.7 per cent of the ignited alunite consists of available potassium sulphate which may be obtained by leaching and evaporation; the remaining 67.3 per cent is nearly pure alumina.[1]

Several foreign deposits of alunite have been successfully worked for the manufacture of alum. The Utah mineral may be used for alum, or, as suggested by the laboratory work of W. T. Schaller, as a source of potassium sulphate and alumina.

POTASH SALTS FROM SILICATE ROCKS.

Several interesting papers appeared during the year 1912 on the extraction of potash salts from the feldspars or from rocks containing them in insoluble form in appreciable quantity. Some of these will be briefly reviewed below.

In the chapter on potash for 1911 there was outlined a process patented by A. S. Cushman (patent No. 987436, dated March 21, 1911). Briefly the process is as follows: The potash-bearing rock is

[1] Bull. U. S. Geological Survey No. 511, 1912, p. 58. See also Waggaman, W. H., Alunite as a source of potash: Circ. Bur. Soils No. 70, U. S. Dept. Agr., July 31, 1912, 4 pp.

subdivided as finely as possible, preferably so finely that it will pass through a 100-mesh screen. The powder is then mixed with a suitable amount of finely pulverized quicklime, 20 parts of lime to 100 parts of rock being a proper proportion, with or without the addition of 10 to 20 parts of rock salt. The mixture is then spread on a belt or drum conveyor in a layer three-eighths to half an inch thick. A solution of calcium chloride is then applied in separate drops so that the aggregates formed shall not merge. The calcium chloride reacts with the lime, forming an oxychloride cement, and the clumps or aggregates which form on its addition harden very quickly and are separated from the rest of the mass by screening. They are then heated to a high temperature in a rotary furnace or kiln.

A large percentage of the total potash present in the feldspar is converted into potassium chloride during the heat treatment, and very little is volatilized. The dry clumps are of a pale-yellow color outside, due to the iron in the ash of the bituminous coal used, but they are snow-white inside. The clumps are finely ground, producing a pale-yellow material containing as much water-soluble K_2O as hardwood ashes, although the potash is in the form of chloride, and the product also contains considerable free lime. Up to the present time no attempt has been made on a large scale to leach out the soluble potash. The ground material is being given field tests as a straight potash fertilizer containing lime.

For successful results on a large scale of operation it has seemed to Cushman and Coggeshall[1] that a continuous process must be employed with the avoidance of fusion and with the regulation of temperature to the exact point at which appreciable quantities of potash do not volatilize. The fluxes and reacting substances must be cheap and available in large quantity, and the yields of water-soluble potash salts must be high.

In the experiments carried out the potash feldspars used were obtained from five different localities. Eleven carloads were used containing in all a total of 385 tons of material. Each carload was ground and analyzed separately. The lowest in potash ran 6 per cent in potassa (K_2O) and 3 per cent in sodium oxide (Na_2O); the highest, 11.3 per cent in potassa and 3.1 per cent sodium oxide. The bulk of the feldspar used contained 10 per cent potassa and 2 per cent sodium oxide and the results given in the paper cited were obtained on spar running 10 per cent potassa. The lime was a high-calcium quicklime containing 90 per cent CaO and 5.6 per cent MgO. The rock salt came from New York State and ran about 98 per cent pure. The calcium chloride ($CaCl_2$) was obtained from the Solvay Process Co. It was in the solid form and contained about 75 per cent calcium chloride and 25 per cent water.

During the progress of the clumps down the kiln the following reactions probably take place. At the entrance to the kiln the water begins to evaporate. As the hotter zone is approached, the temperature rises high enough to melt calcium chloride and salt. Whether the calcium chloride is free to melt is not known to us, as the exact composition of the oxychloride compound formed has not yet been determined. The results of our work seem to prove that the reacting chlorine is more readily evolved from the oxychloride compound than it is from calcium chloride alone. The melting of the salt however, continues the bond of the reacting particles, causing them to thoroughly "wet" each other, and from this point on the attack on the silicate proceeds rapidly. During the heating usually from 1 to 2 per cent of Na_2O is volatilized.

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[1] Original communications, Eighth Internat. Cong. App. Chem., vol. 5, 1912, pp. 33–49.
Cushman, A. S., and Coggeshall, G. W., The production of available potash from the natural silicates: Jour. Ind. and Eng. Chem., vol. 4, No. 11, November, 1912, pp. 821–827.
In the experiments the method of preparation of the materials before furnacing is that proposed and developed by Coggeshall (U. S. patent No. 987554).

When operating with no salt present the yield of soluble potassium chloride was 47.5 per cent of that originally present in the feldspar. On adding to the mixture 10 parts of salt to each 100 parts of spar, a test heat yielded 64 per cent, but of this 9 per cent was lost by volatilization, giving a yield of 55 per cent net in the final product. On adding 20 parts of salt to the mixture the yield grows to 69.2 per cent with no volatilization and to 75 per cent under heat conditions which caused a volatilization of 7 per cent, leaving a net yield of 68 per cent of that originally present. In the case of clumps made from a mixture of 100 parts of feldspar containing 10 per cent K_2O and 2 per cent Na_2O, 20 parts of lime, 20 parts of salt, and 20 parts of calcium chloride, the theoretical composition if no volatilization loss takes place is shown compared with the actual results obtained in the following table:

	Theory.	Analysis.	
	Per cent.	*Per cent.*	
Total K_2O	6.25	5.8	
Water-soluble K_2O		4.2	Equals 6.65 per cent KCl.
Loss of K_2O		.5	As KCl already formed.
Total Na_2O	7.62	7.1	52 per cent made into NaCl.
Water-soluble Na_2O	6.37	5.1	Showing 1.79 per cent vaporized as NaCl, or 26 per cent of that present.

This particular product contained 11.2 per cent of free lime and total lime by analysis 15.5 per cent. There was also in this sample about 5 per cent of free unchanged calcic chloride. The amount of calcic chloride in the various runs made up to the present time have been reduced gradually to about 1 per cent, and it is felt that in the future better conditions of heat treatment will make complete use of the calcic chloride and at the same time raise the yields of soluble potash. In later runs, in which only 10 parts of salt were present in the mix, the theoretical and actual analysis of the product was as follows:

	Theory.	Analysis.	
	Per cent.	*Per cent.*	
Total K_2O	6.66	5.62	
Water-soluble K_2O		4.5	Equals 7.12 per cent KCl.
Vaporization loss of soluble K_2O		1.04	As KCl already formed.
K_2O insoluble in water		1.12	
Total Na_2O	4.15		
Water-soluble Na_2O		3.7	Showing 0.45 per cent vaporized as NaCl, or 11 per cent of that present.

This product contained 12.25 per cent of free lime; the total potash rendered soluble was 5.54 per cent of the product, or 83.2 per cent of the total quantity present; but as 15.6 per cent had been volatilized, the net yield in the product amounted to 57.6 per cent.

The material which was later made continuously according to the process described above carries 4.5 per cent of water-soluble K_2O in the form of 7.12 per cent potassium chloride, and in addition to this the material carries only 1.12 per cent K_2O insoluble in water. It is well known that a 2 per cent citric-acid solution will extract, when used according to the Wagner method, somewhat more K_2O than can be made directly water soluble. This fact is of considerable interest when the product is to be used directly as a potash fertilizer. * * *

* * * The qualitative and quantitative results obtained on a number of experimental trials on a mill scale of operation show that it is possible to economically manufacture a potash fertilizer containing free lime from feldspar and for a sufficiently low cost to make worthy of consideration an industry based upon the method described.

According to Hart[1] the potash content of feldspars alone will not pay for the cost of its extraction. Therefore it becomes necessary to separate and put into marketable form the other constituents, both silica and alumina, if the method is to be put on a commercial basis.

[1] Hart Edward, Original communications, Eighth Internat. Cong. App. Chem., vol. 2, 1912, pp. 117–118; Potash, silica, and alumina from feldspar: Jour. Ind. and Eng. Chem., vol. 4, No. 11, November, 1912, pp. 827–828.

The feldspar should contain not much less than 12 per cent potash (K_2O), and feldspar of this quality ought to be obtainable in large quantity. After mixing with the proper proportion of potassium sulphate and carbon the mixture is fused. The amount of carbon is regulated so that the resulting slag contains a considerable proportion of sulphides. The slag is finely pulverized and treated in closed vessels with dilute sulphuric acids. Very pure silica is left behind, which when washed and ignited yields a marketable product. In solution is found potash alum and the sulphates of any of the other metals which may have been present. The alum in solution in a closed vessel is treated with potassium sulphide in slight excess, when aluminum hydroxide mixed with a little sulphur precipitates in a form easily washed. This is dissolved in hot sulphuric acid, run through a filter, and allowed to solidify. The potassium sulphate is obtained by evaporation. Each ton of feldspar containing 12 per cent potassa (K_2O) should yield 444 pounds potassium sulphate (K_2SO_4), 2,040 pounds commercial aluminum sulphate (18 per cent Al_2O_3), and 1,300 pounds silica (SiO_2).

It has been found by Foote and Scholes[1] that at a temperature well above 100° C., under pressure, hydrofluoric acid behaves as a catalytic agent in the presence of an aqueous solution of sulphuric acid, that considerable decomposition of the feldspars may be produced by these reagents, and that under certain conditions decomposition is nearly complete. The alumina and potash pass into solution and may be recovered as the sulphates. Very finely ground feldspar rock was used in the experiments.

W. H. Ross[2] has made a comparative study of the processes relating to the extraction of potash from the silicate rocks for which patents have been allowed, with a view of finding what methods, if any, give promise of being commercially practicable. Some of the results obtained are published in the references cited.

Other methods of obtaining potash from the silicates, for which patents have been secured during the year 1912, include a patent to Samuel Peacock (U. S. patent 1035812, dated Aug. 13, 1912). In Peacock's process the feldspar is first coarsely ground and heated with carbonate of lime. The calcined mixture is pulverized so that it will pass through a 100-mesh sieve, and enough soda or potash is added to make one chemical equivalent for each chemical equivalent of alumina present. The mixture is then boiled, preferably under pressure, with sufficient water to make a thin paste. The alumina is rendered soluble as an alkali aluminate, the silica remaining insoluble as calcium silicate. The soluble and insoluble materials are separated by filtration, and the aluminum is recovered as alumina by passing carbon dioxide through the solution. The alumina is freed from the remaining alkali by adding an equivalent of silica for each equivalent of soda or potash present in the alumina, and the mixture is treated in a digester by superheated steam at a pressure of five atmospheres. When the charge is washed with water the silica and alkali are removed as alkali silicate, leaving the alumina practically pure.

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[1] Foote, H. W., and Scholes, S. R., The extraction of potash and alumina from feldspar: Jour. Ind. and Eng. Chem., vol. 4, No. 5, May, 1912, p. 377.

[2] Ross, W. H., The extraction of potash from silicate rocks: Circ. Bur. Soils, No. 71, U. S. Dept. Agr., July 16, 1912, 10 pp.; Original communications, Eighth Internat. Cong. App. Chem., vol. 15, 1912, pp. 217–229.

POTASH SALTS AS A BY-PRODUCT IN THE MANUFACTURE OF PORTLAND CEMENT.

In connection with the problem of the control of dust by the Cottrell precipitation processes in the manufacture of Portland cement, the important question has arisen of the utilization as fertilizer of the potash salts incidentally collected. At the plant of the Riverside Portland Cement Co., Riverside, Cal., a decomposed feldspar containing considerable potassa is used instead of clay. During the burning of the cement the potash is volatilized and passes off, condensing again while passing up the stack. The greater part of the potash is caught in the electrical treater along with the dust, which, as a consequence, has an added value. Experiments have been conducted for some time with the object of either using this material directly as a fertilizer filler or of extracting the potash from it in the form of a concentrated salt. The work is not sufficiently far advanced to publish quantitative results.[1]

UTILIZATION OF KELP.

Cardiff, Cal.—A plant for the utilization of the potash salts contained in kelp has been established at Cardiff, Cal., by the Coronado Chemical Co. Cardiff is a station on the Santa Fe Railway, about 25 miles north of San Diego. The railroad hugs the coast line and the beach at this place. It is possible that the plant may be moved to the Point Loma side of San Diego Bay at some time in the future.

The seaweed used is cut from a boat or launch with cutter attached. It is then conveyed in barges close to the shore and dumped into the ocean, whence the tides drift it up on the beach. Here it is collected by means of a rake so arranged that it can be raised above the sand. The rake may be tilted and dumped like a hay rake, but the one used in this work may be raised 2 feet and carried at this distance above the ground. The kelp is then cut by hand with a "corn knife" sufficiently to allow it to be spread properly on the beach for drying. This spreading is performed by means of a pitchfork. The kelp has to be turned more or less, dependent on weather conditions, to insure drying. When the atmosphere is dry for a prolonged period turning is sometimes unnecessary. This drying on the beach is not completely satisfactory, as it entails an appreciable mechanical loss of potash salts. In the new plant proposed at San Diego the weed will be dried by artificial means. After drying the kelp is collected in wagons like hayracks, which are provided with nets, and then hauled to the plant. Ropes are attached to the nets and the load is dumped into the furnaces, where it is reduced to ashes. The yield in ash is about 45 per cent of the dried weed. The ash is sold in bulk form or is pulverized, and the product is known as "American potash." In the plans for the new plant on San Diego Bay a capacity of 65 tons of calcined kelp a day is contemplated. The method of treating the kelp described above involves a great deal of handling, and it is proposed to carry on the operations differently at the new works.

Terminal Island, Cal.—The Pacific Kelp Mulch Co. is located at Terminal Island, 1 mile east of East San Pedro, on the San Pedro, Los Angeles & Salt Lake Railroad. The company has been gathering kelp from the ocean during the last year and disposing of it to

[1] Schmidt, W. A., Original communications, Eighth Internat. Cong. App. Chem., vol. 15, 1912, pp. 117–124

farmers and fruit growers as a fertilizer. The company has developed a machine which harvests the kelp rapidly and on a large scale. The kelp is cut from 4 to 6 feet under water, care being taken not to disturb the roots of the growing plants. It is loaded on a barge and brought to the boat landing of the plant. Here it is pitchforked from the barge on a belt conveyer and conveyed to the cutter, being subjected during the passage to a steaming process, which is practically instantaneous and which, it is asserted, removes all the adhering common salt (NaCl) but none of the potash salts. The cutter chops it into pieces 6 to 8 inches long—that is, of a length to be conveniently handled with a manure fork or to be harrowed under the soil after being spread. From the cutter the kelp falls into wagons or to the floor. It is then carted to the railroad and dumped into freight cars and shipped to the centers of consumption. More than 100 carloads of the material had been shipped when the writer visited the works in October, 1912.

The material is said to have many advantages as a fertilizer, and these are explained in detail in a small pamphlet which has been issued by the company.

GERMAN POTASH AND SALT STATISTICS.[1]

Statistics have recently been published by the Ministry of the Interior giving the production of potash and salt mines in Germany for the years 1909 and 1910. The statistics show that in 1910 there were 82 establishments, employing 27,790 persons, to whom was paid $8,869,678 in salaries and wages. These figures were, respectively, advances over 1909, the record for that year being 78 establishments, 27,445 employees, and $8,400,077 paid in salaries and wages. Below is summarized the production for these two years:

Production of potash and salt in Germany in 1909 and 1910.

Potash and salt.	1909		1910	
	Quantity.	Value.	Quantity.	Value.
	Metric tons.[a]		*Metric tons.*[a]	
Raw salts:				
Rock salt	1,103,562	$1,296,045	1,136,776	$1,344,260
Potash salts:				
Carnallite, including kieserite	3,502,658	7,541,709	3,729,409	7,644,105
Kainite, sylvinite (sylvite)	3,570,286	11,508,021	4,610,152	13,862,702
Boracite	144	5,587	166	6,704
Salts to be used in further manufacture:				
Carnallite	3,353,993	7,262,482	3,569,937	7,382,753
Kainite, sylvinite	926,556	2,873,156	1,329,523	3,808,893
Products ready for sale:				
Stone salt	1,097,491	1,312,191	1,112,562	1,346,673
Carnallite with 9 to 12 per cent K_2O	328,386	734,627	402,476	908,250
Crude salt with 12 to 15 per cent K_2O	2,594,179	8,386,873	2,924,709	8,756,404
Salt with 15 to 19 per cent K_2O	33,543	151,088	153,297	437,472
Fertilizer salts:				
With 20 to 22 per cent K_2O	84,585	610,868	136,233	850,184
With 30 to 32 per cent K_2O	43,713	505,370	55,556	626,330
With 40 to 42 per cent K_2O	265,706	4,214,486	335,671	5,196,046
Potassium chloride:				
With 50 to 60 per cent K_2O	266,911	8,295,233	304,145	8,673,969
With over 60 per cent K_2O	107,537	3,662,667	130,767	4,336,013
Potassium sulphate of over 42 per cent K_2O	69,730	2,608,336	90,389	3,239,079
Potassium magnesium sulphate	40,105	729,654	39,011	688,366
Magnesium sulphate	65,771	217,908	68,862	224,623
Magnesium chloride	28,983	84,848	31,012	92,911
Sodium bisulphite	4,445	34,452	2,540	19,078
Boracite	102	3,990	135	5,412
Bromine, etc	11,390	501,623	14,293	472,496
Total	17,499,776	62,541,214	20,177,621	69,922,723

[1] Daily Cons. and Trade Rept., July 17, 1912, p. 289.

[a] A metric ton equals 2,204.6 pounds.

Among numerous references to the German potash industry that have appeared in Consular and Trade Reports are articles published September 18, 1909, on the "German potash industry"; June 25, 1910, on the "New German potash law," by Consul General Robert P. Skinner; August 30, 1910, on "German potash prices"; November 25, 1910, on "Germany's potash deposits and mines," by Consul Robert J. Thompson; December 12, 1910, on "Export prices of German potash," by Consul General Robert P. Skinner; January 26, 1911, on "Increased German production of potash," by Consul General Frank D. Hill; July 25, 1911, on "Peace in the German potash industry," by Consul Talbot J. Albert; and November 11, 1911, on "The German potash syndicate," also by Consul Talbot J. Albert.

Copies of the Daily Consular and Trade Reports may be secured from the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

CONSUMPTION OF POTASH SALTS IN UNITED STATES.

In the following table are given the total imports of potash salts, in pounds, for the years 1909–1912, inclusive:

Potash salts imported into the United States for the calendar years 1909–1912, in pounds.[a]

	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Potash:								
Carbonate of	21,023,695	$692,822	18,963,619	$616,371	20,332,990	$636,356	20,510,846	$658,343
Caustic, not including refined	8,163,128	339,564	8,304,696	346,388	7,069,837	287,116	9,578,437	365,860
Cyanide of[b]					[d] 2,114,684	[d] 316,027	1,138,569	169,627
Chloride of	298,854,649	4,780,106	381,873,875	5,252,373	509,119,193	7,651,684	482,265,665	7,229,109
Nitrate of, or saltpeter, crude	14,883,849	437,690	11,496,904	333,854	7,945,747	265,061	7,315,531	216,492
Sulphate of	70,161,832	1,301,205	86,162,874	1,426,975	121,039,192	2,227,820	97,161,010	1,769,676
All other[c]	[d] 998,685	[d] 133,801	3,389,684	387,662	4,583,940	442,042	3,509,444	316,989
Total	414,085,838	7,685,188	510,191,652	8,363,623	672,205,583	11,826,106	621,479,502	10,726,096

[a] This table is based on total imports for the calendar year, not, as nearly all the import tables in this volume, on imports for consumption for the calendar year.
[b] Included in "All other chemicals" prior to July 1, 1911.
[c] Included in "All other chemicals" prior to July 1, 1909.
[d] Figures cover period since July 1.

For comparison the following table is added, which gives the potash salts imported for consumption into the United States during the calendar years 1911 and 1912, in pounds:

Potash salts imported for consumption into the United States for the calendar years 1911 and 1912, in pounds.

	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Potash:				
Carbonate of	8,604,855	$255,096	7,625,382	$234,868
Caustic, not including refined	7,072,093	287,097	9,690,494	370,506
Cyanide of	2,649,040	394,141	726,659	109,434
Chloride of	506,570,661	7,651,693	482,529,396	7,229,121
Nitrate of, saltpeter, crude	7,944,757	265,061	6,511,208	202,899
Sulphate of	121,710,568	2,240,631	98,237,150	1,783,846
All other	15,570,411	689,662	16,858,875	761,611
Total	670,122,385	11,783,381	622,179,164	10,692,285

The importation of potash salts given in these tables is only a part of that entering the United States from Germany. To it should be added the importation of kainite and manure salts. The importation of fertilizers, including kainite and manure salts, is given in the following table:

Fertilizers imported and entered for consumption in the United States, 1908–1912, in long tons.

Fertilizer.	1908		1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Apatite	1.48	$10	2,925	$19,013	....	....	20	$300	100	$1,400
Bone dust or animal carbon, and bone ash, fit only for fertilizing purposes	6,897	145,663	29,035	685,291	48,979	$1,140,476	36,856	943,472	117,717	878,686
Calcium cyanamid or lime nitrogen	(a)	(a)	(a)	(a)	3,540	177,552	5,292	292,496	9,311	493,519
Guano	23,222	322,766	44,197	772,674	33,565	667,870	36,869	774,315	19,128	329,624
Kainite	129,063	730,934	163,943	854,998	582,197	2,798,198	563,957	2,748,140	511,976	2,386,362
Manure salts, including double manure salts	(a)	(a)	b 52,958	601,804	147,242	1,013,009	159,796	1,660,040	171,757	1,797,057
Phosphates, crude	14,311	82,863	9,983	99,060	21,706	235,040	16,153	157,394	28,821	231,255
Slag, basic, ground or unground	627	4,348	690	5,880	10,774	93,650	12,622	87,994	12,596	114,300
All other substances used only for manure	74,883	924,476	184,850	2,879,845	195,991	3,394,279	197,810	4,098,321	127,932	2,660,887
Total	249,004.48	2,211,060	488,581	5,918,565	1,043,994	9,520,074	1,029,375	10,762,472	999,338	8,893,090

a Not separately classified.

b From Aug. 5 to Dec. 31.

MATERIALS ENTERING LARGELY INTO THE FERTILIZER INDUSTRY IN THE UNITED STATES.

In the following table are given the statistics of materials entering largely into the fertilizer industry in the United States:

Materials entering largely into the fertilizer industry in the United States for the years ending Dec. 31, 1909–1912, in long tons.

	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Imported: [a]								
Fertilizers	....	$6,505,090	....	$9,438,417	....	$10,816,504	....	$8,892,802
Potassium chloride	133,427	4,780,106	170,479	5,252,373	227,285	7,651,684	215,297	7,229,109
Potassium sulphate	31,322	1,301,205	38,466	1,426,975	54,035	2,227,820	43,375	1,769,676
Sodium nitrate (Chile saltpeter)	428,429	13,608,195	529,172	16,601,328	544,878	16,814,256	486,352	16,658,404
Domestic phosphate rock	2,330,152	10,772,120	2,654,988	10,917,000	3,053,279	11,900,693	2,973,332	11,675,774
Total	....	36,966,716	....	43,636,093	....	49,410,957	....	46,225,765

[a] Imports are "total imports."

This table requires some explanation. In the first place, the imports given in it are "general imports," or total imports. General imports are those entered at the customhouse for immediate consumption and also imported articles entered for the warehouse but not necessarily removed therefrom for consumption, and hence, strictly speaking, not necessarily consumed in the year under which they are given. This, however, does not destroy the value of comparisons between different years. In the second place, all the sodium nitrate reported is not used in the fertilizer industry. A large part of it is converted into nitric acid and potassium nitrate, the latter being used for making gunpowder and other explosives, matches, pyrotechnics, in assaying, in metallurgical and analytical operations, for curing meat, etc. The magnitude of the importation of this material is, however, very significant. This sodium nitrate is another commodity for which the United States is entirely dependent on a foreign country. Lastly, it is probable that not quite all the potassium chloride and potassium sulphate are used in the fertilizer industry.

The following table shows imports for consumption of materials entering largely into the domestic fertilizer industry:

Materials entering largely into the fertilizer industry in the United States for the years 1911 and 1912, in long tons.

	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Imports: [a]				
Fertilizers	1,029,375	$10,762,472	999,338	$8,893,090
Potassium chloride	226,148	7,651,693	215,415	7,229,121
Potassium sulphate	54,335	2,240,631	43,856	1,783,846
Sodium nitrate	544,532	16,814,268	486,779	16,544,511
Domestic phosphate rock	3,053,279	11,900,693	2,973,332	11,675,774
Total	....	49,369,757	....	46,126,342

[a] Imports are for consumption.

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[1] References to papers in process of preparation or publication by the United States Geological Survey are contained in the body of this report.

SALT AND BROMINE.

By W. C. PHALEN.

SALT.

PRODUCTION.

The production of salt in the United States, including Hawaii and Porto Rico, in 1912 was 33,324,808 barrels of 280 pounds each, or 4,665,473 short tons, valued at $9,402,772. The corresponding figures for 1911 were 31,183,968 barrels, or 4,365,756 tons, valued at $8,345,692. Thus for the year 1912 there was a gain of nearly 7 per cent in quantity of salt produced and of nearly 13 per cent in value as compared with the production of 1911. The average price of salt per barrel in 1912 was 28.215 cents, or $2.02 per short ton, as compared with 26.763 cents per barrel, or $1.91 per short ton, in 1911.

In the following table are given the quantity and value of salt produced in the United States from 1893 to 1912, inclusive:

Production and value of salt in the United States, 1893–1912.

1893..barrels..	11,897,208	$4,154,668	1903..barrels..	18,968,089	$5,286,988
1894....do....	12,968,417	4,739,285	1904....do....	22,030,002	6,021,222
1895....do....	13,669,649	4,423,084	1905....do....	25,966,122	6,095,922
1896....do....	13,850,726	4,040,839	1906....do....	28,172,380	6,658,350
1897....do....	15,973,202	4,920,020	1907....do....	29,704,128	7,608,323
1898....do....	17,612,634	6,212,554	1908....do....	28,822,062	7,553,632
1899....do....	19,708,614	6,867,467	1909....do....	[1] 30,107,646	8,343,831
1900....do....	20,869,342	6,944,603	1910....do....	[1] 30,305,656	7,900,344
1901....do....	20,566,661	6,617,449	1911....do....	[1] 31,183,968	8,345,692
1902....do....	23,849,231	5,668,636	1912....do....	[1] 33,324,808	9,402,772

PRODUCTION BY GRADES AND STATES.

Production by grades.—In the following table is shown the production of salt from brine by grades during the last five years:

Production of brine salt in the United States, 1908–1912, by grades, in barrels.

Year.	Table and dairy.		Common fine.		Common coarse.		Packers'.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908......	3,202,016	$2,109,785	7,388,903	$2,455,980	2,550,333	$799,138	373,284	$147,225
1909......	3,042,824	2,240,128	7,745,204	2,736,917	2,843,393	929,111	385,802	169,744
1910......	3,514,748	2,249,827	6,153,296	2,158,386	2,602,737	799,405	327,304	147,434
1911......	3,773,798	2,528,671	6,267,850	2,048,527	2,970,492	1,041,619	408,928	162,945
1912......	3,961,450	3,164,638	6,021,052	2,109,076	2,753,375	1,096,643	751,551	296,238

[1] Includes production of Hawaii and Porto Rico.

Production of brine salt in the United States, 1908–1912, by grades, in barrels—Contd.

Year.	Coarse solar.		Other grades.		Brine.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	1,156,034	$319,185	121,065	$36,713	8,869,216	$443,638	23,660,851	$6,311,664
1909	1,283,548	508,098	97,347	33,326	8,770,807	438,540	24,168,925	7,055,864
1910	1,223,371	418,495	129,036	44,223	9,389,226	469,461	23,339,718	6,287,231
1911	1,343,046	444,324	160,233	40,365	10,027,411	501,225	24,951,758	6,767,676
1912	1,105,935	408,939	231,063	59,093	11,408,623	570,316	26,233,049	7,704,943

Production of rock salt.—In order to differentiate the rock-salt and the brine-salt industries in the United States, which are quite different, the following table is added, giving the quantity and value of the rock salt mined in the United States during the last five years:

Production of rock salt in the United States, 1908–1912, in short tons.

Year.	Rock salt.	
	Quantity.	Value.
1908	[a] 722,570	$1,241,968
1909	[b] 831,421	1,287,967
1910	[b] 975,231	1,613,113
1911	[b] 872,509	1,578,016
1912	[c] 992,846	1,697,829

[a] Includes California, Idaho, Kansas, Louisiana, New York, and Utah.
[b] Includes California, Idaho, Kansas, Louisiana, Michigan, New York, and Utah.
[c] Includes California, Kansas, Louisiana, Michigan, New York, and Utah.

Production by States.—The following table gives the production and value of the salt produced in the United States from 1909 to 1912, inclusive, by States:

Production and value of salt, 1909–1912, by States, in barrels.

State.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	[a] 10,914,255	[a] $2,646,736	[a] 11,642,520	[a] $2,585,739	[a] 11,234,928	[a] $2,538,151	10,527,221	$2,615,334
Michigan	9,966,744	2,732,556	9,452,022	2,231,262	10,320,074	2,633,155	10,946,739	2,974,429
Ohio	3,684,775	993,700	3,673,850	951,963	4,302,507	1,100,453	5,269,179	1,364,136
Kansas	2,769,849	782,676	2,811,448	947,369	2,159,859	806,027	2,573,626	844,292
Louisiana	(b)	(b)	(b)	(b)	(b)	(b)	(c)	(c)
California	886,564	558,889	937,514	519,667	1,086,163	555,359	1,090,000	620,196
West Virginia	150,492	76,463	155,625	62,955	183,379	78,805	139,121	66,023
Texas	409,315	260,286	382,164	272,568	385,200	299,537	373,064	290,328
Utah	246,935	147,318	249,850	185,869	272,420	171,268	283,293	154,734
Hawaii	7,796	5,292	11,450	9,570	8,463	11,850	8,286	9,180
Idaho	793	1,118	885	1,127	314	532	(c)	(c)
Porto Rico	166,790	26,810	(c)	(c)	(c)	(c)	(c)	(c)
Nevada	16,107	19,847	17,535	10,600	12,856	16,952	12,536	15,752
Oklahoma	(c)	(c)	2,564	881	500	431	(c)	(c)
Other States	[d] 887,231	92,140	[e] 968,229	120,774	[e] 1,217,305	133,172	[f] 2,101,770	445,868
Total	30,107,646	8,343,831	30,305,656	7,900,344	31,183,968	8,345,692	33,324,808	9,402,772

[a] Includes Louisiana.
[b] Included in New York.
[c] Included in "Other States."
[d] Includes New Mexico, Oklahoma, Pennsylvania, and Virginia.
[e] Includes New Mexico, Pennsylvania, Porto Rico, and Virginia.
[f] Includes Idaho, Louisiana, New Mexico, Oklahoma, Pennsylvania, Porto Rico, and Virginia.

The following table presents in tabular form general information of interest to the salt trade. It gives for the two years 1911 and 1912 the number of operating plants in the individual States, together with their relative rank as to both quantity and value of the salt produced; also the percentage of increase or decrease, as the case may be, in both quantity and value of salt produced.

Number of operating plants, rank of States, average price per ton in 1911 and 1912, and percentage of increase or decrease in 1912.

State.	1911				1912				Percentage of increase (+) or decrease (—).	
	Number of operating plants.	Rank of State by— Quantity.	Rank of State by— Value.	Average price per ton.	Number of operating plants.	Rank of State by— Quantity.	Rank of State by— Value.	Average price per ton.	Quantity.	Value.
California	*a*19	*a*6	*a*5	*b*$3.50 *c*3.66	*a*21	*a*5	*a*5	*b*$3.00 *c*4.09	*c*+ 0.14	*c*+ 12.04
Hawaii	5	14	14	*c*10.00	6	14	14	*c*7.91	*c*— 2.11	*c*— 22.53
Idaho	*a*6	17	16	*b*12.00 *c*12.12	2	17	17	*c*13.80	*c*—55.88	*c*— 49.76
Kansas	*a*11	*a*4	*a*4	*b*1.84 *c*3.13	*a*10	*a*4	*a*4	*b*1.32 *c*3.30	*c*— 4.36	*c*+ .96
Louisiana	*b*2	*b*5	*b*6	*b*2.06	*b*2	*b*6	*b*6	*b*1.99	*b*+ 1.09	*b*+ 2.47
Michigan	*a*25	*a*2	*a*1	*b*2.29 *c*1.80	*a*26	*a*1	*a*1	*b*2.55 *c*1.91	*c*+ 5.17	*c*+ 11.79
Nevada	5	13	13	*c*9.42	4	13	13	*c*8.98	*c*— 2.50	*c*— 7.08
New Mexico	1	15	15	*c*3.50	2	15	15	*c*7.14	*c*+12.50	*c*+135.71
New York	*a*30	*a*1	*a*2	*b*1.61 *c*1.53	*a*31	*a*2	*a*2	*b*1.59 *c*1.88	*c*+ 3.21	*c*+ 26.93
Ohio	9	3	3	*c*1.83	10	3	3	*c*1.85	*c*+22.47	*c*+ 23.96
Oklahoma	3	16	17	*c*6.16	2	16	16	*c*4.17	*c*+11.43	*c*— 24.59
Pennsylvania	1	12	11	*c*4.34	1	12	10	*c*4.70	*c*— .79	*c*+ 7.49
Porto Rico	2	11	12	*c*2.20	2	11	12	*c*2.32	*c*—11.38	*c*— 6.43
Texas	5	8	7	*c*5.55	4	8	7	*c*5.56	*c*— 3.15	*c*— 3.07
Utah	*a*7	*a*9	*a*8	*b*4.27 *c*4.53	*a*9	*a*9	*a*8	*b*3.69 *c*3.95	*c*— .05	*c*— 12.86
Virginia	1	7	10	*cd*.36	1	7	11	*cd*.36	*c*—26.02	*c*— 26.02
West Virginia	4	10	9	*c*3.07	3	10	9	*c*3.39	*c*—24.13	*c*— 16.22
Total brine and rock salt	136	....	....	*b*1.81 *c*1.94	136	....	....	*b*1.71 *c*2.10	*b*+13.79 *c*+ 5.14	*b*+ 7.59 *c*+ 13.85
Total United States	....	....	....	1.91	....	....	....	2.02	+ 6.87	+ 12.67

a Includes both rock and brine salt.
b Rock salt.
c Brine salt.
d The low value of salt in Virginia is due to the fact that the salt is in the form of brine, which is not utilized for its salt content, but is worked up into other sodium salts.

DOMESTIC CONSUMPTION.

In the following table is given the consumption of salt in the United States during 1912. In addition to the domestic production of 33,324,808 barrels there were imported 998,664 barrels. These imports were in part offset by exports, which amounted to 445,785 barrels, leaving an excess of imports over exports of 552,879 barrels. This added to the domestic production brings the total salt consumed up to 33,877,687 barrels, which is a substantial increase of 2,027,885 barrels over the consumption in 1911. The imports were 2.9 per cent of the domestic consumption for the year, which is a fraction less than the corresponding ratio for 1911. Thus the United States supplied 97.1 per cent of the salt which was consumed during the year. This country is not dependent upon any foreign country for any portion of its salt supply, as the capacity of its active mines and manufacturing plants is greatly in excess of the present output. There are many plants running at less than full capacity at the present time and some are now idle which could readily resume operations should trade conditions warrant.

Supply of salt for domestic consumption, 1890–1912, in barrels.

Source.	1890	1900	1910	1911	1912
Domestic production	8,876,991	20,869,342	30,305,656	31,183,968	33,324,808
Imports	1,838,024	1,427,921	979,305	1,014,926	998,664
Total	10,715,015	22,297,263	31,284,961	32,198,894	34,323,472
Exports	17,597	53,650	350,094	349,092	445,785
Domestic consumption	10,697,418	22,243,613	30,934,867	31,849,802	33,877,687
Comparison with preceding year	+877,610	+1,274,634	+46,032	+914,935	+2,027,885
Percentage of imports to total consumption	17.2	6.4	3.2	3.2	2.9

IMPORTS.

In 1912 there were imported into the United States 279,625,900 pounds, or 998,664 barrels of salt, valued at $370,648; the corresponding imports during 1911 were 284,179,200 pounds, or 1,014,926 barrels, valued at $375,030. There was an increase in the quantity of salt imported in bulk, but the grade usually imported in bags, barrels, and other packages and that brought in for the purpose of curing fish declined in marked manner.

According to figures obtained from the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, 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, 1908–1912, 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.		
1908	66,409,270	$219,272	153,031,808	$120,979	99,844,560	$104,439	319,285,638	$444,690
1909	65,581,839	220,503	135,735,445	132,884	97,722,473	84,440	299,039,757	437,827
1910	53,143,200	178,000	118,796,400	104,822	102,265,982	88,100	274,205,582	370,922
1911	61,648,200	181,405	108,055,700	95,801	114,475,300	97,824	284,179,200	375,030
1912	57,453,400	179,199	133,080,800	112,749	89,091,700	78,700	279,625,900	370,648

EXPORTS.

The exports of salt in 1912 were 124,819,713 pounds, or 445,785 barrels, valued at $418,525. As compared with the exports in 1911, which were 97,745,833 pounds, or 349,092 barrels, valued at $335,285, this was an increase of 96,693 barrels in quantity and of $83,240 in value. Both the quantity and the value of the domestic salt exported in 1912 were the greatest ever recorded in the history of the industry in the United States. The export of salt of domestic production from the United States from 1908 to 1912 is shown as follows:

Salt of domestic production exported from the United States, 1908–1912.

1908	pounds	53,253,739	$202,338
1909	do	80,306,820	269,273
1910	do	98,026,369	320,926
1911	pounds	97,745,833	$335,285
1912	do	124,819,713	418,525

THE SALT INDUSTRY BY STATES.

CALIFORNIA.

California ranked fifth in both the quantity and the value of the salt produced in 1912. The output for the year was 1,090,000 barrels of 280 pounds each, or 152,600 short tons, valued at $620,196. These figures represent an average of nearly 57 cents a barrel or $4.06 a short ton as compared with the figures for the whole United States, which were, respectively, 28 cents a barrel and $2.02 a short ton. It will be observed, therefore, that the California figures are just about twice as large as for the rest of the country. Of course it will be understood that the average value of the different grades of salt produced in California is quite different from the averages given above for the State. For example, the value of coarse solar salt, which constitutes a large part of the State's output, was 39 cents a barrel, while table and dairy, representing the most important grade, so far as sales go, of refined salt, was valued at $1.07 a barrel.

Of the salt produced in California more than 95 per cent originates from the solar evaporation of sea water along the coast. Most of the solar salt and the finer grades produced by its refinement come from the east and west shores of San Francisco Bay, in Alameda and San Mateo counties, but important quantities are produced near Long Beach, Los Angeles County, and near the south end of San Diego Bay, San Diego County. The general methods of procuring this salt and refining it for market will be described in a bulletin on the salt industry of the United States now in preparation.

One of the main reasons why the bulk of California salt comes from along the coast is because the main centers of population are there located. The market is therefore at hand and the cost of transportation is reduced to a minimum. These are the main reasons why the many and important occurrences of the interior have hitherto remained unexploited.

In addition to the salt produced along the coast of California, salt was produced in 1912 in (1) Kern County, 15 to 18 miles west and a little south of Randsburg; (2) near Cedarville, Modoc County; and (3) near Saltus, which is on the Atchison, Topeka & Santa Fe Railway in the southeastern part of San Bernardino County.

Kern County.—Salt was produced in 1912 in the Cane Lake playa, about 20 miles southwest of Randsburg, in the eastern part of Kern County, on the road between Mohave and Randsburg. According to an oral communication from one of the persons interested the salt occurs in the bed of a dry lake or sink 5 or 6 miles across. The playa has no outlet and the spring and fall rains flowing into it cover it generally to a depth of 10 inches. About 3,000 acres are reported under water when this depth is attained. After evaporation of the water the salt is shoveled up and piled into heaps. Generally two crops a year may be secured, but there is sometimes uncertainty about the fall crop on account of the September and October rains. Two companies have been operating here, but lately the Diamond Salt Co. bought them out. An artesian well has been sunk to procure additional water when needed in addition to that supplied by the rainfall. Only crude solar salt is now produced, but it is planned to ship the crude product to Los Angeles and there refine it.

Modoc County.—A very small quantity of coarse solar salt for stock feeding was produced near Cedarville, Modoc County, in 1912.

San Bernardino County.—In 1912 salt was produced near Saltus, a station on the Santa Fe Railway in the Southeastern part of San Bernardino County. The writer has never visited the locality and the following notes were orally communicated. The salt occurs in the bottom of an old lake bed in the form of layers of rock salt, to work which the overburden has to be removed. This is approximately 5 feet thick and is underlain by 5 to 7 feet of rock salt. The interval between the base of this upper bed and the next underlying salt bed is 20 feet. The exact thickness of the lower salt bed is unknown, as it has been penetrated to a depth of only a few feet.

IDAHO.

The production of salt in Idaho in 1912 came from Bannock County. The manufacture of salt has been discontinued by many of the men formerly engaged in the industry, and it is reported that on this account not enough was made during the past year to supply the home demand. Though the salt is produced in Bannock County, the headquarters of most of the operators are across the State line in Auburn, Wyo. A complete account of the salt resources along the Idaho and Wyoming border in this region has been prepared by C. L. Breger, and is referred to in the bibliography at the end of this chapter.

KANSAS.

Kansas ranked fourth, as usual, among the States in 1912, in both quantity and value of salt produced. The rock salt came from the mines located at Lyons, Rice County, and Kanopolis, Ellsworth County; the evaporated salt came from Hutchinson, Reno County; Ellsworth, Ellsworth County; Anthony, Harper County; and Lyons and Sterling, Rice County. The output for the year was 2,573,626 barrels or 360,308 short tons, valued at $844,292. This is a substantial increase over the production of 1911, which was 2,159,859 barrels or 302,380 short tons, valued at $806,027, but it does not equal the output of the State for the two preceding years, 1909 and 1910, and is also somewhat less than the output during 1908.

NOTES ON THE GEOLOGY OF KANSAS SALT.[1]

A large part of Kansas contains salt at the surface. The salt occurs in the form of brine in the salt marshes which on evaporation during the dry season leaves rock salt and produces the so-called salt plains. The rock salt, however, which is now worked at Lyons and Kanopolis, and from which brine is obtained at Ellsworth, Hutchinson, Sterling, Lyons, Anthony, and formerly at other places, is situated well below the surface. Salt in the form of brine also occurs in certain beds in the Permian and Pennsylvanian rocks in the eastern part of the State.

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[1] See map accompanying report on salt by M. Z. Kirk and E. Haworth, Mineral Resources of Kansas, 1898, pp. 67–123; that portion of the report relating to the geology of Kansas salt (pp. 86–97), is by E. Haworth.

The part of Kansas below the surface of which rock salt is known to exist is the south-central. It includes all of Rice and Kingman counties, nearly all of Reno County, and parts of Saline, Ellsworth, Barton, McPherson, Stafford, Harvey, Pratt, Sedgwick, and Sumner counties.

The rock salt beds of Kansas occur in rocks of Permian age. The "salt beds," the name applied to the rock-salt layers themselves and the shale layers associated with them, occur between the Wellington shale above and limestone and shales of the Marion formation below. They grow thinner to the east to beyond Wellington and Little River, and possibly die out without coming near the surface. It is thought that the salt springs at Geuda Springs, Sumner County, have their origin in these salt beds. The extent of the salt beds westward is unknown. In a north-south direction the beds are fairly well known from the records from Kanopolis, Ellsworth County on the north, to Anthony, Harper County, on the south; that is, very nearly to the Kansas-Oklahoma State line. From a north-south cross section across the State it is evident that the beds thin to the north. At Anthony they are 404 feet thick (depth 946 to 1,350 feet); at Kingman 415 feet thick (depth 665 to 1,080 feet); at Hutchinson 380 feet thick (depth 430 to 810 feet); at Lyons they are 275 feet thick (depth 793 to 1,068 feet); and at Kanopolis about 250 feet thick (depth 630 to 880 feet). If the rate of decrease in thickness from Hutchinson northward were maintained the salt beds would disappear before the north boundary of the State was reached. It must be remembered that where more than one record is obtainable at a place, for example at Hutchinson, the exact thickness of the salt beds, as well as the distances of the topmost of them below the surface, will vary somewhat and in some places considerably from the figures given above.

LOUISIANA.

The salt produced in Louisiana at the present time is rock salt. No evaporated salt has been produced in this State for some years. The localities where rock salt is produced are Grande Cote (Weeks Island) and Petite Anse (Avery Island).

Weeks Island.—Weeks Island or Grande Cote, so-called, is located on the east shore of Weeks Bay, an eastern lobe of Vermillon Bay, in Iberia Parish, La. It may be reached by means of a branch line running west from Baldwin, known as the Cypremort branch of the Southern Pacific Railroad. It is called Grande Cote on account of its size, though it is scarcely 2 miles in diameter. It is the largest of the five islands described by Veatch.[1]

The geology of Weeks Island is dependent upon the great mass of rock salt which has formed or is now forming beneath the few feet of sands, clays, and gravels constituting the superficial beds of the island. The topography is not rugged and there are very few good outcrops. Those which are made where the streams cut down the soft and yielding formations are soon covered by the rank and rapidly growing vegetation. The uppermost bed on the island is a yellow loamy clay which is visible in a few natural exposures. The records

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[1] Veatch, A. C., The five islands: Rept. Louisiana Geol. Survey for 1899; Special Rept. No. 3, pp. 209 et seq.

of more than 40 wells driven in different parts of the island also begin in clay varying in thickness to 40 to 60 feet. Below the clays are found sands, often ferruginous, sand containing chert pebbles, and gray sandy clays tilted at various angles and striking in various directions. Different sections of the wells driven on the island show gravel and sandy layers, in places several hundred feet thick. The salt is apt to be overlain by a few feet of clay, though this is by no means always the case. In some of the wells layers of lignite have been found just above the salt.

The salt mass of the island comes nearest to the surface near the mine; it slopes abruptly to the south and west, less abruptly to the east, and but slightly to the north. Its form is that of an elongated dome whose north-south diameter is longer than its east-west. It occupies the west side of the island and appears to extend a little west of the main ridge. The upper surface of the salt mass is known to be quite irregular, and to judge from the borings already made, there seems to be little in common between the surface irregularities and those at the upper surface of the salt mass. The general shape of the salt body is thought by Harris,[1] for certain reasons, to have been formed somewhat as it is at present and its main configuration is not regarded as due to erosion or to subterranean solution.

Avery Island.—Avery Island, or Petite Anse, is also the site of active salt mining in Louisiana. It is located in Iberia Parish, about 10 miles south-southwest of the city of New Iberia. Veatch and others have described the geology of this island in considerable detail. According to Harris[2] the details given in the earlier descriptions "are of no serious moment in the interpretation of the geology of this and the other salt islands. The beds here seen are admittedly of Quaternary age; none contain anything that can not be referred to inter or post glacial times."

A brownish-yellow loamy soil forms the greater part of the surface, but exposures of gravel are commoner than on the other islands. The gravel and sand exposures seem to be confined chiefly to the southern extremity of the island. In its northern part there are numerous outcrops of a variegated chocolate yellow or green jointed clay. A bed of lignite was found at the head of Iron Mine Run Hollow, and vertebrate remains of Pleistocene Mammalia (according to Veatch) have been found.

The upper surface of the salt mass is irregular here, as on Weeks Island, and in a few places it rises slightly above sea level. It is therefore higher than at any place on Grande Cote or at any other salt locality in the State. This explains the existence here of brine springs, which were well known long before rock salt was actually discovered.

MICHIGAN.

Michigan ranked first among the salt producing States in 1912. The production of salt during the year was 10,946,739 barrels, or 1,532,543 short tons, valued at $2,974,429, as compared with 10,320,074 barrels, or 1,444,810 short tons, valued at $2,633,155, in 1911.

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[1] Harris, G. D., Bull. Louisiana Geol. Survey No. 7, 1908, pp. 8–9. [2] Op. cit., pp. 15–17.

NOTES ON THE OCCURRENCE OF SALT IN MICHIGAN.

The rock salt of the Lower Peninsula of Michigan is found in the lower part of the Monroe formation, consisting of Silurian rocks which have sometimes been called Salina but which are not known to be the same as the Salina formation of New York.

In the comparison of well records obtained at different places in the southeastern part of the Lower Peninsula, for example, at Britton, Milan, Romulus, and Wyandotte, there is an increase in thickness proceeding northeast between the beds of the rock salt and what is regarded as the top of the underlying or Niagara formation. Proceeding northward the salt beds seem to occur higher up in the geological column.

The salt-bearing rocks (the lower part of the Monroe) have the following thicknesses and occur at the indicated depths below the surface at the following places in southeastern Michigan:

Thickness and occurrence of salt-bearing rocks in southeastern Michigan.

	Thickness.	Depth.
	Feet.	*Feet.*
Britton	370	1180–1550
Milan	520	1025–1545
Strasburg	0–485	485
Trenton	491	850–1341
Wyandotte	780	730–1510

In general it will be seen that the thickness of the salt-bearing rocks increases to the north, which increase holds good into Canada; to the southeast the salt disappears, and wells drilled at Trenton show the exact edge of the salt-producing area there, as salt occurs in only one of them.

It is hard to recognize the equivalent of the salt-bearing rocks where no salt exists. There is only lithologic evidence for identifying them with the New York Salina, and it is altogether unlikely that the top can be located consistently on such evidence. Taking the top of the salt or gypsum bed nearest to the horizon of 400 feet below the Sylvania sandstone member of the Monroe formation gives fairly consistent results. In the southeastern part of Michigan and to the north along St. Clair River a great many drill holes have been sunk to the salt horizon. These records are given in the reports of the Michigan Geological Survey, to which the reader is referred for details.

In the southwestern part of the State no rock salt occurs, but to the north at Ludington and Manistee the salt is obtained in the form of brine from beds occurring at approximately 2,000 feet below the surface. At Frankfort, still farther to the north in Benzie County, wells have been put down deep enough to go through the salt-bearing rocks, but they did not strike salt and not even a very strong brine. It is very likely that Frankfort was just outside the area of salt deposition. Wells at St. Ignace and Cheboygan likewise show no salt. As showing the character of the material which a typical well goes through in this region, the following log of a well put down at Ludington may be given.[1]

[1] Rept. Michigan Geol. Survey for 1908, p. 94.

Log of Stearns salt well at Ludington, Mich.

Pleistocene.	Sand	198	198	10-inch casing to 204 feet.
	Pink clay	68	266	Water at about 300 feet, T. 53°.
	Gravel	94	360	Both pink clays are calcareous.
	Pink clay	155	515	
	Gravel	61	576	8-inch casing to rock.
	Limestone	74	650	With 15 feet of porous granular limestone and salt water 35 feet below the casing.
Coldwater.	Blue shale	550	1,200	
Antrim.	Black shale	200	1,400	
Traverse group		625	2,025	Brown limestone, 25; blue shale, 35; brown limestone, oily, with H_2S 40; pure limestone, 250, possibly Dundee?; brown sandy dolomite, 160; calcareous shale, 90.
Monroe group?		279	2,304	Dolomite, 25; limestone, 25 (cf. Anderson or Dundee); dolomite, 25; Sylvania sandstone?, 100; sandy dolomite and anhydrite, 121; salt, 8.

At Manistee there are a number of wells. The depth to the salt as shown by some of the records of the Ludington and Manistee wells is as follows:

Depths to salt in Ludington and Manistee wells.

	Feet.
Ludington	2,200
One mile south of Ludington	2,242–2,260
Ludington No. 3	1,965–2,001
Manistee No. 1	1,978–1,985 1,985–1,988 1,988–2,012
Manistee No. 2	1,900–1,904 1,912–1,942
Manistee No. 3	1,988

Higher brine horizon.—The brines of the Saginaw Valley occur in the sandstones of the Marshall formation, of Mississippian age. It is these sandstones which yield the brine used so extensively in the manufacture of salt, bromine, and calcium chloride. Wells have been put down to the brine-bearing horizon at Bay City, Saginaw, Midland, Mount Pleasant, St. Charles, and possibly in other localities. The towns and cities mentioned are, however, most prominently identified with the chemical industries mentioned.

NEVADA.

The salt produced in Nevada in 1912 amounted to 12,536 barrels, or 1,755 short tons, valued at $15,752, a decrease as compared with 1911, when the quantity produced was 12,856 barrels, or 1,800 tons, valued at $16,952.

The salt was produced at Sand Springs, Leete, and Parran, Churchill County, and from the Silver Peak playa, Esmeralda County. The Buffalo Salt Works, Sheepshead, Washoe County, reported no production on account of heavy windstorms. Salt in Nevada is obtained by solar evaporation and the finer grades, like table and dairy, common, fine, etc., are prepared from the solar salt by refining processes.

CHURCHILL COUNTY.

Sand Springs.—Sand Springs is located about 25 miles southeast of Fallon, Churchill County. The occurrence of salt at Sand Springs is typical of a large class of salt deposits in Nevada and of the Great Basin region in general. The saline land occurs in the low part of an extensive alkali flat which is usually marshy and which during the wet season is covered with a few inches of water. When dry it is overspread with a thin incrustation of efflorescence of salt. The amount of this salt must be very great. To collect it the crust is broken up and scraped into heaps with broad wooden hoes, the ground being divided into long strips and gone over in regular order. The heaps thus formed are allowed to drain for a few days. The salt is then gathered up and conveyed in wheelbarrows or cars to platforms, where, after further drying, it is pulverized and sacked for shipment. After one surface incrustation has been removed another begins to form and the process takes place so rapidly that several crops may be gathered annually. As the ground below is heavily charged with salt the replacement of the removed superficial layer can go on almost indefinitely. A large part of the alkali flat outside of the depressed area is covered with a thin coating of salt during the dry season, but generally it is too impure to justify gathering. The great distance from market is one of the drawbacks to the salt industry at this place, which of necessity is purely local in nature.

Leete.—Leete is the location of the Eagle Salt Works. It is situated in northwestern Churchill County, and may be reached from Fernley, opposite the old Wadsworth station on the Southern Pacific Railroad. The locality is within the drainage boundary of the Great Basin and the deposits associated with the salt are of Quaternary age.

The salt is procured by solar evaporation from a natural brine occurring not far below the surface. The surface material is of a sandy nature and is approximately 5 feet in thickness. This is underlain by a more or less impervious clay. By drilling to an approximate depth of 20 feet a natural flow of brine is encountered. The brine on reaching the surface is conducted into vats, which are largely excavations in the earth and inclosed in low embankments. Here the water evaporates and leaves the salt. The vats are 50 or 60 feet wide and a few hundred feet long. The salt water is allowed to run into them to a depth of an inch and to evaporate to dryness, thus forming a hard foundation for the salt subsequently to be made. Subsequent additions of brine are made and the salt layer is thickened. The salt formed is hoed into piles. The salt industry at the Eagle Salt Works has been of considerable importance and a substantial production has been reported from this locality in recent years.

Parran.—Parran is located on the main line of the Southern Pacific Railroad between Ogden and San Francisco. It is situated in the northwestern part of Churchill County and about 10 miles south of the southernmost point of Humboldt Lake. A small amount of rock salt made by solar evaporation and used chiefly for stock was obtained here in 1912.

ESMERALDA COUNTY.

Silver Peak.[1]—Salt is now being produced on a small scale by Frank R. Porter, of Silver Peak, whose works are located in sec. 24, T. 2 S., R. 39 E., which is included within the Silver Peak marsh, located 30 miles southeast of Columbus and occupies the lowest part of the Clayton Valley. Practically the entire surface of the marsh or playa, 32 square miles, is covered with salt that averages in depth about one-fourth of an inch. The upper muds of the playa, averaging probably 10 feet thick, contain not less than 2 per cent of salt. It is estimated that not less than 15 square miles of the northeastern part contains a 10-foot saline bed of which at least 60 per cent is salt. From these estimates it has been calculated that 15,000,000 tons of salt lie within 40 feet of the surface. The high rate of evaporation, permitting solar concentration of the brines, the absence of long-continued rainfall to interfere with operations, the nearness of a railroad, and more especially the high degree of purity of the product, as indicated by analyses of the brine, are extremely favorable factors in considering the possibility of utilizing these deposits.

NEW MEXICO.

A small production of salt was reported from Estancia, in the Estancia Valley, Torrance County, N. Mex., in 1912.

Salt Basin of Estancia Valley.—The salt basin of Estancia Valley is located in the central part of Torrance County near the geographic center of New Mexico. It lies in a depression having no outlet. This depression has a maximum extent of about 65 miles north and south and 40 miles east and west, and has an area of about 2,000 square miles. The vicinity of the salt basin proper is traversed by two railroads, the Belen cut-off of the Santa Fe and the New Mexico Central Railroad.

The lake that occupied the central portion of the valley was at the period of its greatest extension about 35 miles long and 23 miles wide, with an area of approximately 450 square miles. Its maximum depth at this period was about 150 feet and its shore line about 150 miles long. If the ancient lake were now in existence several of the villages in this region would be under water. The theory of the existence of the ancient lake in this valley is based upon the presence of shore features, lake sediments, etc.

The salt basins in the Estancia Valley are not remnants of the ancient lake, but are rather distinct basins sunk below the level of the plain by which they are surrounded, and they are bordered, as a rule, by definite and nearly vertical walls. Their flat bottoms coincide practically with the groundwater level and consist of mud covered with crusts of salt, but after rains they may be submerged in water. The floor of one lake, namely, Dog Lake (Laguna del Perro) is about 12 miles long and covers an area nearly equal to the combined areas of all the other basins.

[1] Dole, R. B., Explorations of salines in Silver Peak Marsh, Nevada: Bull. U. S. Geol. Survey No. 530, 1912, pp. 330–345.

The most reasonable hypothesis to account for the salinity of the water is that at various horizons in the valley of the central area there are beds impregnated with salt deposited by evaporating waters at the time they were formed and that afterwards these beds were buried under later accumulations. It is likely that the shallow sheet of brine coincides approximately with the buried salt deposit laid down at the bottom of the ancient lake at a certain stage of its existence. This hypothesis would also explain the sharp boundary of the saline area. The geologic horizon from which the salt is supposed to be derived originally is the red beds of the Permian.

NEW YORK.

New York ranked second among the States in 1912 in both quantity and value of the salt produced. The production of the State was 10,527,221 barrels or 1,473,810 short tons, valued at $2,615,334. The salt came from near Syracuse, Onondaga County; Le Roy, Genesee County; Cuylerville, Piffard, and Retsof, Livingston County; Watkins, Schuyler County; Ithaca, and Myers, Tompkins County; and Rock Glen, Saltvale, and Silver Springs, Wyoming County.

OCCURRENCE OF SALT IN NEW YORK.

The district under which rock salt is known to exist in New York comprises the greater part of Genesee County south of Le Roy, the eastern half of Wyoming County, nearly the whole of Livingston County, and the part of Ontario County west of Canandaigua Lake and chiefly south of the New York Central Railroad. There can hardly be any doubt that rock salt exists west of Warsaw, but the borings put down in Erie County seem to have been beyond the western limit of the deposits. No rock salt was found in a well put down at East Aurora, but strong brine was obtained. At Gardenville, 7 miles from Buffalo, a well was sunk entirely through the Salina formation, but no rock salt was found. Likewise at Eden Valley and Gowanda only brine was obtained.

East of Canandaigua Lake the borings put down at Dundee, Watkins, Ithaca, Ludlowville, and Tully all reached the rock-salt beds. The area underlain by rock salt west of Canandaigua Lake has been computed to be over 1,000 square miles in areal extent. East of this lake this area must be as large, or even larger. The northern limit can not be assigned owing to the solution of the rock salt as it approaches the surface. The southern limit is not known and may never be accurately determined, as the cover of the Salina formation increases in thickness in this direction.

The northern limit, as shown by the outcropping Salina strata, is approximately defined by a line drawn from a point south of Oneida Lake westward to Buffalo. To the south of this line deposits are encountered at progressively increasing depths in accordance with the dip of the strata, which ranges from 40 to 50 feet per mile. The most easterly point where salt has been found is Morrisville, Madison County. Between this and Lake Erie salt has been found in almost all of the central tier of counties in the State.

The salt beds of New York belong in the Salina formation, of the Cayuga group of rocks, which are of Silurian age. This group of rocks contains not only the salt deposits, but the gypsum deposits of western New York as well. The Salina as a whole has the form of an irregular lens, the maximum thickness of which is found between Oneida Creek and Cayuga Lake. From this region the formation diminishes in thickness both eastward and westward, a fact which has been determined by plotting the sections revealed by deep drillings.

In the earlier studies of the Salina exposed at the surface no rock salt was found simply because this soluble substance can not remain at the surface in a region where the rainfall is considerable. Our knowledge of the condition and magnitude of the salt beds has been obtained entirely from mine shafts and deep wells, which, to the number of more than 200, are distributed over the entire area in which the salt beds are near enough to the surface to be reached by drilling. It may be said in general that were the salt to outcrop it would appear as a streak along a line drawn a short distance north of the south boundary of the Salina. To the north of this it is useless to expect to find rock salt by drilling. The outcrop of the Marcellus shale is about as far north as rock salt may be expected to be found by deep drilling.

The thickness and character of the salt deposits are essentially the same throughout the entire district, the only material difference being in the thickness and the number of intercalated layers of rock. In many of the wells there is a thick layer of rock separating the salt bed into two parts, each of which is subdivided in turn into other and thinner layers. No one of these layers is continuous over the whole field, and wells only a few rods apart show marked differences in stratification.

In the Oatka Valley the total thickness of the rock salt beds, including the interstratified shales and limestones, is from 100 to 135 feet. At Silver Springs it is 145 feet, and at Castile 190 feet. The salt beds gradually thin out to the north and do not reach beyond the latitude of Batavia, Le Roy, and Caledonia. In the Genesee Valley in a well on the Retsof mine property the total thickness of the salt-bearing strata was 124 feet, of which 109 feet were rock salt. At the West Bloomfield and Bristol wells in Ontario County but one bed 8 to 15 feet thick was found. At Watkins 100 feet of the salt strata were penetrated, but the bottom was not reached. From the top of the upper bed of salt in the Ithaca test well to the bottom of the seventh or lowest one is 470 feet, the salt in which measured 240 feet. The greatest thickness in the Solvay wells at Tully was 318 feet.

OHIO.

Ohio ranked third as usual among the States in both quantity and value of the salt produced in 1912, being exceeded by Michigan and New York. The production of the State was 5,269,179 barrels or 737,685 short tons, valued at $1,364,136, as compared with 4,302,507 barrels or 602,351 short tons, valued at $1,100,453, in 1911. The salt produced in Ohio comes from two districts, the northeastern district, comprising Cuyahoga, Medina, Summit, and Wayne counties, and the southeastern district, comprising Meigs and Morgan counties. Salt in the form of brine is used in the manufacture of chemicals by the Diamond Alkali Co., at Fairport Harbor, Lake County, but is not marketed as such.

The salt horizon in the northeastern part of the State is in the Monroe formation of the Silurian. The salt occurs at the same geologic horizon as does that in southeast Michigan near Detroit, Wyandotte, and along St. Clair River.

The salt-producing area in northeast Ohio is large, but not unlimited in extent. Thus far the production has been restricted to five counties, as indicated above. The salt deposits are, however, not limited to this territory. That the salt beds extend farther east is shown by the record of a well drilled in the eastern part of Trumbull County. To the west the limit of the salt field has not been determined, but it can not extend as far as Sandusky, as the record of a well in that locality does not indicate the presence of salt.

In southeastern Ohio Meigs County is by far the larger producer, and Pomeroy is the center of the industry. The surface rocks in the Ohio Valley near Pomeroy, Ohio, and Mason, W. Va., lie near the top of the Conemaugh formation, formerly known as the "Lower Barren Coal Measures." The depths of wells in this region have undergone great variation. At first wells were very shallow, but later they were extended to greater depths as the supply of brine near the surface became exhausted. When the supply from these deeper wells became inadequate they were sunk to still greater depths. At present salt works both in Ohio and in West Virginia are pumping brine from depths of 1,100 to 1,350 feet. The brine-bearing strata dip toward Pomeroy from the northwest, and as the brine has been removed from the wells the supply has been renewed from the rocks lying at higher levels in that direction. The brine was doubtless once a part of the ocean, and as the sand or gravel now constituting the salt-bearing rocks was deposited on the ocean floor sea water filled the spaces between the grains and pebbles and has since remained in that position. It must be borne in mind that the Pomeroy brines were formed very near the shore, probably within a landlocked sea, and hence might vary considerably from those formed in the open ocean. This explains the presence of the relatively large quantities of bromides and iodides, for these substances are contained in certain marine plants. It is possible that the conditions were favorable for these plants in the early sea in the vicinity of Pomeroy. The wells along Ohio River procure their brine chiefly from a horizon approximately near the base of the Salt sand of the Carboniferous.

OKLAHOMA.

The small production of salt in Oklahoma in 1912 came from Harmon County.

Harmon County salt plains.—There are salt plains in Harmon County located in small canyons in the gypsum hills south of Elm Fork of Red River, about 5 miles east of the Texas border, and 1½ miles south of the north county line. The plains are known locally as the Chaney or Salton salt plain and the Kiser salt plain. The plains are both small, neither covering an area of more than an acre and they are not more than a mile apart. The salt is contained in spring water that issues from shallow beds occurring below gypsum. Springs also boil up from the level floor of the plains. A local industry has been carried on for many years in this region at the old Kiser Salt Works and also farther west. The latter springs were worked in 1911 and 1912 and are now known as the Salton salt beds. The old Kiser salt beds have recently been worked by W. H. Stockman.

PENNSYLVANIA.

Salt, bromine, and calcium chloride are obtained on the North 1911. In one of the wells, whose record was obtained, the brine 4 wells were in operation when visited by the writer in the fall of Side, Pittsburgh, Pa. At the plant where the salt is being produced comes from a depth of 1,405 feet from a sand designated in the record as "salt sand." This sand is probably in the Pocono formation (of Mississippian age) and may possibly correspond with the Berea sandstone.

TEXAS.

The production of salt in Texas in 1912 was 373,064 barrels or 52,229 short tons, valued at $290,328, as compared with 385,200 barrels or 53,928 tons, valued at $299,537, in 1911. Texas salt came chiefly from Palestine, Anderson County, and Grand Saline, Van Zandt County, in the eastern part of the State, and from Colorado, Mitchell County, in the western part.

Palestine.—Palestine, the county seat, is located in the south-central part of Anderson County, on the International & Great Northern Railway and on the Texas State road. It is in the far eastern part of the State and about midway between Red River, the State's northern boundary, and the Gulf coast.

Palestine is located on a series of glauconitic sandy and clayey beds, the first named containing Tertiary (Claiborne) fossils. West of the town the land slopes toward Trinity River, and 6 miles to the southwest the saline itself is situated. It is a flat plain 1 mile from east to west and one-half mile from north to south. Incrustations of salt may be observed around its edge. Its surface is a dark or lead-colored clay, as is the case at Grand Saline.

The saline is surrounded by a ring of hills rising 60 feet or more above the lowland. In places on the tops and slopes of the hills white chalklike fossiliferous limestone outcrops containing specks of glauconite. The limestone is not seen continuously all around the saline, but outcrops in many places, particularly on the northwest and east sides. It is also seen in outcrops on the south side, but to the southeast the hills are 20 to 30 feet higher than elsewhere, and it is quite likely that the limestone is concealed under the overlying clay. The fossils from the limestone have been determined by R. T. Hill as belonging to the glauconitic beds of the Upper Cretaceous epoch, possibly representing the Ripley formation of Alabama. The limestone contains seams of yellow crystalline calcite. It is surrounded and often covered by lower Tertiary clay and by river alluvium.

Grand Saline.—Grand Saline is located in northeast Texas in Van Zandt County, on the main line of the Texas & Pacific Railway running east from Dallas. The Texas Short Line Railway also enters the town.

The saline itself is a small prairie-like sandy plain in which the sand is strongly impregnated with salt. It is about 1 mile long from east to west, and about one-half mile wide from north to south. From the borings made the conclusion is reached that the beds underlying it are comparatively level, though in this general region the strata have been somewhat disturbed.

The surface rocks belong to the Tertiary and in wells from which data are available the Cretaceous beds containing the rock salt are overlain by approximately 160 to 180 feet of Tertiary beds. Toward the southwest part of the saline area beds of Quaternary age cover the surface. According to Kennedy[1] the Cretaceous rocks found at Grand Saline, so far as known, nowhere approach the surface but are covered with over 180 feet of Tertiary sands, clays, and shaly clays, and are found in borings of the several wells put down for the purpose of obtaining salt. The upper part of the Cretaceous rocks found in these wells appears to be a blue limestone mixed with streaks of sand and gray limestone having a thickness of 42 feet in the Lone Star well and 28 feet in the Richardson well, a few feet below which the salt deposit of 300 feet occurs.

In all six wells have been drilled at Grand Saline, four at the plants of B. W. Carrington & Co. and two at the plant of the Grand Saline Salt Co. At the present time one well is being used at each of the two plants of the Carrington Co. and one well at the plant of the Grand Saline Salt Co. The exact thickness of the rock salt is not known, but it is known that its development is only local.

UTAH.

The production of salt in Utah in 1912 was 283,293 barrels or 39,661 short tons, valued at $154,734, as compared with a production of 272,420 barrels or 38,139 tons, valued at $171,268, in 1911. Though the production in 1912 was greater than that of 1911 the value of the product decreased appreciably. Utah salt came chiefly from along the shores of Great Salt Lake, but small quantities were produced near Nephi, Juab County, and from near Redmond in the Sevier Valley. An account of the solar salt industry as carried on along the shores of Great Salt Lake, near Salt Lake City, was given in this report for 1911 and will not be repeated here.

VIRGINIA.

Deposits of salt and gypsum are known to occur in Washington and Smythe counties, Va., in a belt of country 20 miles long running northeast from the village of Plasterco. The region is made accessible by the Saltville branch of the Norfolk & Western Railway, which joins the main line at Glade Spring. The rocks in which the deposits occur are, according to G. W. Stose,[2] of Mississippian age, and are thought to represent segregations or concentrations of salt and gypsum formerly disseminated in the associated rocks.

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[1] Kennedy, William, Third Ann. Rept. Texas Geol. Survey, 1892, pp. 46, 76–81.

[2] Stose, G. W., Geology of the salt and gypsum deposits of southwestern Virginia: Bull. U. S. Geol. Survey No. 530, 1912, pp. 232–255.

Two gypsum and one salt or alkali works are in operation in this area. The salt or soda industry is now conducted by the Mathieson Alkali Works, with offices at Saltville. Since 1895, when this company came into control of the property, the brine has been converted into soda products other than salt, chiefly bicarbonate of soda or baking soda, soda ash used in the manufacture of glass, pottery, etc., and sal soda. Caustic soda is also made and put up for the trade in hermetically sealed cans.

Over 50 wells have been drilled in the vicinity of Saltville, about 25 of which are at present in operation. They range in depth from a few hundred feet to 2,280 feet, the average being about 1,000 feet. The shallower wells are dry wells and have to be flushed with water through the outer casing. The deeper wells are wet, and the brine flows in as fast as it is pumped out. In the wet wells the rocks become honeycombed and cave in, bending the pipe in some places so as to cripple or entirely disable the well. The brine is raised by ordinary deep pumps each operated by a walking beam driven by an electric motor housed in a small shack at the well. After being first piped to an open reservoir in the town the brine is piped to the company's plant on North Fork of Holston River, about a mile distant, where it is converted into baking soda and other sodium products by the ammonia or Solvay process.

WEST VIRGINIA.

The production of salt in West Virginia in 1912 was 139,121 barrels or 19,477 short tons, valued at $66,023, as compared with 183,379 barrels or 25,673 tons, valued at $78,805, in 1911. Salt in West Virginia is obtained from natural brines carrying appreciable quantities of bromine, which, together with calcium chloride, is extracted from them. The geology of the brine-bearing beds at Mason is similar to that at Pomeroy, Ohio, on the opposite side of Ohio River, in Meigs County. The geology of these brine-bearing beds has been worked out by J. A. Bownocker and published in Bulletin 8 of the Ohio Geological Survey; it has been repeated in this report in previous years, and has been outlined under Ohio in the present report. Natural brines also occur near Malden, W. Va., which is located on Kanawha River, a few miles above Charleston, the State capital. The record of a gas well on Cool Spring Branch of Burning Springs Hollow, about 3 miles from Malden, throws some light on the geology of the beds from which the brine is obtained. The record of the well, which is known as the Edwards well No. 1, has been published in a report by I. C. White.[1] According to White the sandstone known to the oil men as the salt sand furnishes the brine in the Kanawha Valley. This sandstone belongs to the Pottsville group and lies very near the base of the coal measures.

HAWAII.[2]

The production of salt in Hawaii in 1912 amounted to 8,286 barrels or 1,160 tons, valued at $9,180, a decrease in quantity and value as compared with the production in 1911, which amounted to 8,463 barrels or 1,185 tons, valued at $11,850.

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[1] West Virginia Geol. Survey, vol. 1, p. 272.

[2] Acknowledgment is due to Mr. H. P. Wood, director and secretary of the Hawaii Promotion Committee, Honolulu, for courtesies extended in the collection of the statistics for Hawaii.

PORTO RICO.

Both the quantity and the value of salt produced in Porto Rico in 1912 were less than in 1911. Totals are suppressed in order to conceal individual output.

BROMINE.

PRODUCTION.

The following table gives the production of the bromine produced in the United States since 1880:

Production and value of bromine, 1880–1912.

1880......pounds..	404,690	....	1898......pounds..	486,979	$126,614
1883........do....	301,000	....	1899........do....	433,004	108,251
1884........do....	281,100	$67,464	1900........do....	521,444	140,790
1885........do....	310,000	89,900	1901........do....	552,043	154,572
1886........do....	428,334	141,350	1902........do....	513,893	128,472
1887........do....	199,087	61,717	1903........do....	598,500	167,580
1888........do....	307,386	95,290	1904........do....	897,100	269,130
1889........do....	418,891	125,667	1905........do....	1,192,758	178,914
1890........do....	387,847	104,719	1906........do....	1,283,250	165,204
1891........do....	343,000	54,880	1907........do....	1,379,496	195,281
1892........do....	379,480	64,502	1908........do....	760,023	73,783
1893........do....	348,399	104,520	1909........do....	569,725	57,600
1894........do....	379,444	102,450	1910........do....	245,437	31,684
1895........do....	517,421	134,343	1911........do....	651,541	110,902
1896........do....	546,580	144,501	1912........do....	647,200	136,174
1897........do....	487,149	129,094			

The bromine industry is centered in Michigan, Ohio, Pennsylvania, and West Virginia. Accounts of the bromine industry in these States have appeared in this report during previous years, and the reader is referred to these earlier chapters for detailed information.

CALCIUM CHLORIDE.

PRODUCTION.

In connection with the salt and bromine industry in Michigan, Ohio Pennsylvania, and West Virginia a considerable quantity of calcium chloride is produced.

The production of this substance in 1912 was 18,550 short tons, valued at $117,272, as compared with 14,606 short tons, valued at $91,215, in 1911.

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SULPHUR, PYRITE, AND SULPHURIC ACID.

By W. C. Phalen.

SULPHUR.

PRODUCTION.

The production of sulphur in the United States in 1912 was 303,472 long tons, valued at $5,256,422, as compared with 265,664 long tons, valued at $4,787,049 in 1911. In determining the value of most of the sulphur produced in 1912 the current market prices in New York were taken, from which the mine values were computed.

Prices remained fairly constant throughout the year at $22 to $22.50 per long ton for prime Louisiana sulphur. Quotations on rolled sulphur were from $1.85 to $2.15 per 100 pounds; for flour sulphur the prices ranged from $2 to $2.40 per 100 pounds; and for sublimed sulphur they were from $2.20 to $2.60 per 100 pounds.

The production of sulphur in the United States since 1880 is shown in the following table:

Production of sulphur in the United States, 1880–1912.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1880	536	$21,000	1897	2,031	$45,590
1881	536	21,000	1898	1,071	32,960
1882	536	21,000	1899	4,313	107,500
1883	893	27,000	1900	3,147	88,100
1884	446	12,000	1901	[a] 241,691	1,257,879
1885	638	17,875	1902	[a] 207,874	947,089
1886	2,232	75,000	1903	[a] 233,127	1,109,818
1887	2,679	100,000	1904	127,292	2,663,760
1888	....	....	1905	181,677	3,706,560
1889	402	7,850	1906	294,153	5,096,678
1890	....	....	1907	293,106	5,142,850
1891	1,071	39,600	1908	369,444	6,668,215
1892	2,400	80,640	1909	239,312	4,432,066
1893	1,071	42,000	1910	255,534	4,605,112
1894	446	20,000	1911	265,664	4,787,049
1895	1,607	42,000	1912	303,472	5,256,422
1896	4,696	87,200			

[a] Includes the production of pyrite.

NOTES ON THE SULPHUR INDUSTRY.

Sulphur was produced in Louisiana, Nevada, and Wyoming in 1912. The production of the individual States can not be given without divulging confidential information. Utah, which has produced on a small scale in previous years, reported no output in 1912. The production of Louisiana is, of course, the dominant factor in the domestic sulphur industry, the production of the Western States being insignificant.

During the last 12 years the growth of the sulphur industry in the United States has been phenomenal, as is shown by the table of production. During the last 7 years has come the destruction of the dominating position held so long by Sicily in the world's sulphur market, and within this period the United States has advanced to the position of one of the two leading sulphur producers of the world, owing entirely to the development of the sulphur deposits of Louisiana. In 1900 the sulphur production of the United States amounted to 3,147 tons; the imports during that year were 167,696 tons, of which 166,825 tons were classified as crude sulphur, chiefly from Sicily. Thus, the domestic production amounted to not quite 2 per cent (1.84) of the sulphur consumed during that year. This condition of affairs has rapidly undergone a change, and with a domestic production of 303,472 tons and an importation of 29,927 tons during 1912, the domestic production constituted more than 91 per cent of the consumption, the imports amounting to less than 9 per cent. Thus, since 1900 the figures of production and importation have undergone an almost complete reversal. Moreover, as will be seen from the table showing the imports in 1912 into the United States by countries and by customs districts, the imports of sulphur from Italy were only 8.7 per cent of the total, and Japan was the leading exporter of sulphur into the United States, 91 per cent of the foreign sulphur admitted having come from that country. It seems safe to predict that, with the completion of the Panama Canal, United States sulphur may practically displace foreign sulphur on the Pacific coast.

In the present report a detailed description is given of the sulphur industry in Louisiana as carried on by the Union Sulphur Co., and an outline of the extensions of the company in Europe. An account of the beginning of the operations of the Freeport Sulphur Co., at Freeport, near Bryan Heights, Brazoria County, Tex., is also included. This company began operations in November, 1912, when an initial run was made. The sulphur is to be obtained by a process similar to that employed in Louisiana; that is, it will be melted underground and pumped to the surface by means of an air lift. In addition to the production of sulphur in Louisiana, a small output was reported from Nevada and Wyoming. In Nevada, the sulphur came from the town of Sulphur, in Humboldt County. The Wyoming product came from the Thermopolis district, which was described in this report in 1909. The description of a new occurrence in Wyoming is given in the following pages. It is located in Park County, 12 miles south of the deposits in Sunlight Basin, which were referred to in this report for 1911. The deposits are small and it is doubtful if they will prove of commercial importance.

IMPORTS.

The table of imports of sulphur for consumption in 1912 shows 29,927 long tons, valued at $583,974. This includes imports of all varieties of sulphur, including crude, refined, flowers of sulphur, and other grades not specifically mentioned. In a following table the imports of crude sulphur alone are given by countries. This table shows that the crude sulphur imported is practically all from the two countries Italy (Sicily) and Japan, the Italian product being entered at Atlantic ports, chiefly New York, and the Japanese at the Pacific ports, San Francisco and Los Angeles, Cal., Willamette and Portland, Oreg., and Hawaii. As stated on a previous page the sulphur imported from Italy amounted to only 8.7 per cent of the total imported in 1912, that from Japan constituting the remainder. From the production of sulphur during the first five months of 1912 in Japan it is estimated that the annual output of that country can not be far from 40,000 tons. At this rate Japan can not become a serious competitor in the domestic sulphur market.

Sulphur imported and entered for consumption in the United States for the calendar years 1908–1912, by kinds, in long tons.

Year.	Crude.		Flowers of sulphur.		Refined.		All other.[a]		Total. value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
1908	19,620	$318,577	793	$22,562	693	$17,227	30	$4,013	$362,379
1909	28,800	492,962	770	23,084	966	26,021	53	7,565	549,632
1910	28,656	496,073	1,024	30,180	1,106	25,869	47	6,489	558,611
1911	24,200	434,796	3,891	83,491	985	24,906	68	9,643	552,836
1912	26,885	494,778	1,311	39,126	1,665	40,933	66	9,137	583,974

[a] Includes sulphur lac and other grades not otherwise provided for, but not pyrite.

Statement, by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each calendar year, 1910–1912, in long tons.

Countries whence exported and customs districts through which imported.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRY.						
Canada	5	$160				
United Kingdom	7	199	11	$248		
Italy	10,704	201,993	8,031	156,157	2,348	46,003
Japan	17,377	283,232	16,185	279,991	24,505	447,946
Other countries	554	10,404	23	329	32	829
Total	28,647	495,988	24,250	436,725	26,885	494,778
CUSTOMS DISTRICTS.						
Baltimore, Md	4,312	80,756	1,500	28,209		
Boston and Charlestown, Mass	5	121	20	480		
New York, N. Y	6,817	128,794	6,531	127,948	1,359	29,387
Los Angeles, Cal	754	12,424	700	11,330	850	13,757
San Francisco, Cal	7,310	116,595	9,664	85,928	15,984	280,010
Willamette and Portland, Oreg	7,623	124,643	4,661	19,274	7,646	149,612
Hawaii	1,200	21,160	1,100	161,720	1,000	20,916
All other	626	11,495	74	1,836	46	1,096
Total	28,647	495,988	24,250	436,725	26,885	494,778

EXPORTS.

In 1910 the United States exported 30,742 long tons of sulphur, valued at $552,941; in 1911 the exports amounted to 28,103 long tons, valued at $545,420; in 1912 the exports were 57,736 long tons, valued at $1,076,414. In 1912 the excess of exports over imports amounted to 27,809 tons, and the balance of trade in favor of the United States was $492,440.

OCCURRENCE AND INDUSTRY.

LOUISIANA.[1]

Union Sulphur Co.—The sulphur deposits of Louisiana and the methods by which they are worked have been briefly described in this report in previous years. The process employed in mining Louisiana sulphur is known as the Frasch process from the inventor, Herman Frasch.

Sulphur Mine, where mining is now carried on, is 3 miles from Sulphur, Calcasieu Parish, La., a town of about 1,000 inhabitants on the Southern Pacific Railroad. The sulphur deposit was discovered in 1865 in boring for petroleum, and was found to underlie a layer of quicksand several hundred feet in thickness. The sulphur and associated beds, which are some hundreds of feet in thickness, extend to a depth of 1,100 feet or more. The sulphur is associated with limestone, which is impregnated to an extent of 70 per cent more or less with sulphur. The sulphur beds are underlain by gypsum. As shown by test borings, the sulphur deposit at the locality worked is sharply defined and nearly circular in shape and has a diameter of more than half a mile.

The sulphur is melted by means of superheated water and then pumped from the ground in liquid form. To superheat the water used in the pumping there are now on the grounds 130 boilers of 150 to 300 horsepower each. "These boilers are arranged in eight batteries containing with one exception 15 to 20 boilers each. Each battery of boilers is capable of operating a well. As a rule, two batteries are placed in a group so that one foreman can oversee both. The boilers are fired entirely with fuel oil and only three men, two firemen and one water tender, are needed on each shift to attend to the firing and the feed water in each battery." The consumption of fuel oil amounts to 700 barrels a day in each battery when operating at full capacity, and more than 1,000,000 barrels of fuel oil are used each year.

The average daily consumption of water is about 7,000,000 gallons, and the problem of heating to the proper temperature this vast quantity of water required for the operation of the wells was a difficult one, but was solved by the ingenuity of Mr. Frasch. The pumps and superheaters are located in the rear of each battery. The superheaters are vertical cylindrical receptacles about 4 feet in diameter and 16 feet high, containing a series of shallow trays over which water pours, and is thus brought into intimate contact with live steam from the boilers. The total boiler capacity is 25,000 horsepower, and a unique feature of the plant is that a very small part of the steam is used for power.

The enormous amount of water required for the boilers and superheaters is provided for by means of a pumping station located on the Houston River about 6 miles from the mine. This pumping station contains a centrifugal pump having a capacity of 12,000,000 gallons per day, and the water is carried to the mine by means of a private canal. To supplement the pumping station and provide against breakdowns, there is an artificial storage reservoir covering 150 acres.

The wells are sunk in groups, the individual wells being placed 50 to 100 feet apart, and one well will sometimes produce as high as 400 to 500 tons of sulphur per day and keep up a steady flow for months at a time—in one case the output from a single well reached 73,000 tons. One well is now producing (January, 1912) considerably more than 500 tons a day and has been thus producing for some weeks. The average output is over 250,000 tons per year, but the only limitation is the market demand.

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[1] Pough, F. H., Jour. Ind. and Eng. Chemistry, February, 1912, pp. 134-137.

The liquid sulphur as it flows from the well is so pure that the company is able to guarantee a sulphur content of 99½ per cent; but the average purity is well above that figure. The sulphur is collected and stored in large bins, about 150 by 250 feet, made by setting posts into the ground and nailing to them 2-inch by 12-inch planks of suitable length. The sulphur is delivered into the center of these bins and caused to spread in thin layers about 1 inch thick, which cool so rapidly as to permit continuous operation. A separate bin is used for each well, in order to permit accurate measurement of the output, which is carefully taken and recorded daily. As the bed of sulphur grows in thickness the sides of the bins are raised by means of additional uprights and planking until they reach a height of 60 feet or more. When a bin is filled, another is built alongside of it, so that continuous blocks of sulphur may be formed several hundred feet in length by 150 feet or more in width and from 60 to 65 feet in height. Blocks of sulphur have thus been formed containing as much as 150,000 tons.

When it is desired to ship the sulphur, a movable track is laid as a spur from the main line parallel to the long side of the bin. The boards from this side are then removed and the sulphur thrown down by means of blasts placed near the bottom of the pile. The sulphur is then picked up and loaded into cars by means of locomotive cranes fitted with grab buckets capable of handling 2 tons at a time and loading a 35-ton car in 14 minutes. Shipments from the mine have frequently reached 1,000 tons per day for periods of 20 to 30 consecutive days.

A large quantity of sulphur is shipped directly from the mine in closed cars, which are loaded by box-car loaders, but by far the largest portion of the sulphur is shipped by rail in open bottom-dump cars to Sabine, Tex., in trains of about 20 cars, where it is loaded into steamers for distribution along the Atlantic coast and for export to Europe.

The loading plant at Sabine has a capacity of from 600 to 800 tons per hour, and the facilities are such that it is possible for a 7,500-ton steamer to dock, load, and sail within 12 hours. * * *

The sulphur is handled at Sabine by means of cranes and grab buckets similar to those used at the mine, which deliver the sulphur into hoppers, from which it falls upon a rapidly moving system of belts which carry it to the dock and up an incline to a height of about 10 feet above the steamer's deck. From the inclined belt it falls into an adjustable iron chute, in the form of a pipe which telescopes, from which it drops into the hold of the steamer. By turning this iron chute from side to side it is practicable to load the cargo so evenly that no trimming is required in the steamer or vessel designed for carrying bulk cargoes.

Foreign expansion of Union Sulphur Co.—The Union Sulphur Co., of Louisiana, is reported to have negotiated with the city authorities of Rotterdam, Holland, for the leasing for 25 years of a suitable tract of land having access to one of the harbors upon which to build a sulphur mill and other buildings. The firm contemplates making Rotterdam its headquarters for the grinding and refining of sulphur and its distribution in Europe. The city has offered a tract of land 330 by 420 feet, with dock facilities on the Maas Haven (harbor), for which an annual rental of $4,200 is asked.[1] A new refinery with grinding and storage facilities is under construction. During 1912 the company is reported to have acquired storage facilities at Hamburg, Germany. Besides these recent additions to its European distributing centers, the company has refineries and storage plants at Marseilles and Cette in France. These plants will be supplied by the company's own fleet of ships, to which two vessels were added in 1912.[2]

TEXAS.

NEW SULPHUR MINE AT BRYAN HEIGHTS.

Freeport Sulphur Co.—In the reports on sulphur and pyrite for the years 1909 and 1911 [3] mention was made of the occurrence of sulphur

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[1] Daily Cons. and Trade Repts., Dec. 9, 1912, p. 1261.
[2] Eng. and Min. Jour., vol. 95, No. 2, Jan. 11, 1913, p. 96.
[3] Mineral Resources U. S. for 1909, pt. 2, U. S. Geol. Survey, 1911, p. 686; Mineral Resources U. S. for 1911, pt. 2, U. S. Geol. Survey, 1912, p. 941.

near Bryan Heights at the mouth of Brazos River in Brazoria County, Tex. Actual mining operations at this place were begun in November, 1912, by the Freeport Sulphur Co., but the work has been more or less intermittent by reason of delays and minor adjustments necessarily incident to the beginning of an operation of this character. Up to the middle of February, 1913, seven wells had been sunk.

Bryan Heights is well located for the production and exploitation of the sulphur that may occur there. It is only half a mile from the Gulf coast and about 3½ miles from the harbor of Brazos River, where the town of Freeport will be established. The general location is about 40 miles southwest of Galveston. Ten thousand acres of land have been acquired by the company in the vicinity, and the general plans contemplate the establishment of a port with railroad and steamship connections, a bridge across Brazos River to Velasco, the laying out of a town, and the establishment of such necessary accessories as a bank, stores, and warehouses.

The sulphur is to be obtained by a process similar to that employed in Louisiana, that is, the sulphur is melted in the ground and is pumped to the surface by an air lift.

The Bryan Heights occurrence is in one of the structural domes characteristic of the Mississippi embayment. When these domes were being drilled for oil, both in Louisiana and in Texas, other mineral products were found in them, including gas, salt, gypsum, and sulphur. Little attention was paid to any of these products except oil and gas until the Frasch process for the extraction of sulphur was put into successful operation; then notice was immediately attracted to the other mineral products, especially to the sulphur. In the drill holes originally sunk for oil and gas at Bryan Heights, of which there were approximately 16, some gas was encountered and a little oil, but neither was found in commercial quantity. Logs of the wells revealed, however, the presence of sulphur in every well. When the present company began operations many new holes were sunk, of which 10 were made with a core drill. The sulphur revealed in the cores of these drillings appeared to represent the presence of important quantities of this mineral in the underlying territory. The detailed results of the drilling operations have not yet been given out for publication, but it is reported that 760 feet of gravel, "gumbo," and cap rock were first encountered; below this were found 150 feet of sulphur-bearing limestone, dolomite, and gypsum. The base of the sulphur was found to vary in depth from 900 to 1,100 feet, and below the sulphur-bearing beds, gypsum and rock salt were encountered. The sulphur beds themselves ranged in thickness from a few inches up to 7 feet.

The results of an earlier core drilling have been examined by Kirby Thomas, who reported on it as follows:

> This core shows 174 feet of sulphur formation, of which 35 feet is limestone and gypsum, showing sulphur estimated at less than 10 per cent; and 85 feet of gypsum and limestone with 10 to 50 per cent of sulphur; 54 feet of the core is missing, which indicates that the soft friable sulphur and gypsum in this much of the hole did not core. I examined all the 120 feet of core inch by inch and made a slight estimate by bulk that more than one-third would run 20 per cent or better, and that about 50 feet would run 10 per cent or better; about 20 feet was barren limestone or gypsum.

The driller's log of this hole, begun at a depth of 818 feet, is as follows:

Log of well No. 4, Gulf Development Co., Texas.

	Feet.
Lime rock, sulphur, and gypsum	818– 844
Gypsum and sulphur	844– 900
Gypsum and small amount of sulphur	900– 925
Including lime rock and sulphur	920– 925
Gypsum and traces of sulphur	925– 960
Lime rock and sulphur	960– 988
Lime rock and pyrite	988– 997
Gypsum	997–1,034
Lime rock and pyrite	1,034–1,039
Sandstone	1,039–1,067
Salt	1,067–1,086

The new plant will have four 750-horsepower Stirling water-tube boilers which will be operated at 100 per cent overload, delivering steam at 100 pounds pressure to 3 Blake jet-type marine heaters where the water that is to be pumped underground to melt the sulphur will be heated to about 330° F. The large supply of water necessary for regular operation, approximating 2,400,000 gallons per day, will be pumped by 13 Platt Iron Works pumps. Six water wells have been driven on the flat outside of the sulphur area and other wells are being sunk to augment the present supply of water. For compressed air there will be two Ingersoll-Rand compressors, one operating at from 350 to 700 pounds pressure and the other at 100 pounds pressure. The latter machine is to supply air for pumping water from the wells on the flat. Fuel oil will be used under the boilers, and it is expected that about 900 barrels of Tampico oil per day will be burned at the present plant. The company has erected at the mouth of the Brazos River a 55,000-barrel steel tank, from which a 4-inch pipe line leads to the steaming plant. Affiliated interests of the Freeport Sulphur Co. own oil properties in Mexico and can deliver oil at Freeport under a very small freight charge.[1]

WYOMING.

Sulphur deposits in Park County.[2]—The deposits of sulphur in Park County, Wyo., are 12 miles south of those in Sunlight Basin, described in this report for 1911.[3] They lie at an elevation of 6,500 feet along Sweetwater Creek, about 2 miles north of its junction with the North Fork of Shoshone River, near which is located the summer settlement of Wapiti, about 32 miles west of Cody on the road to the Yellowstone Park.

The deposits are in a narrow belt about 1,400 feet long, joining Sweetwater Creek on the east. The area within which sulphur has been found does not exceed 20 acres. The largest deposit occurs in the strip of débris formed by the merging of alluvial fans from two dry gulches, composed of talus washed from adjacent slopes. Several smaller deposits lie along the slope of the ridge to the east of the stream. The sulphur occurs as bands of crystalline aggregates which fill the interstices between the rock fragments. A comparison of sections dug in the trenches shows that the sulphur-bearing material occurs as one or more lenticular beds essentially parallel to the present surface, but practically covered with débris free from sulphur.

In another deposit 1,200 feet farther north the sulphur occurs in two distinct associations: (1) cementing the débris of a small alluvial

[1] Vail, R. H., Eng. and Min. Jour., Sept. 7, 1912, pp. 449–453.
[2] Hewett, D. F., Sulphur deposits in Park County, Wyo.: Bull. U. S. Geol. Survey No. 540–R, 1913. (In press.)
[3] Hewett, D. F., Sulphur deposits of Sunlight Basin, Wyo.: Bull. U. S. Geol. Survey No. 530, 1913, pp. 350–362. Phalen, W. C., Sulphur, pyrite, and sulphuric acid: Mineral Resources U. S. for 1911, pt. 2, U. S. Geol. Survey, 1912, pp. 941–943.

fan near the stream and (2) in the form of a crust coating the walls of small crevices in bedrock, the greater part of the sulphur occurring in the first form mentioned. No prospecting has been done here.

In addition to the deposits noted, the rock at the surface of the ridge east of Sweetwater Creek up to an elevation of 6,800 feet has been locally bleached and decomposed. Where the bleaching has been most intense sulphur occurs as thin crusts or in the form of minute crystals. Four such occurrences were observed, no one of which covered an area greater than 50 feet square.

The sulphur deposits, though smaller, are essentially similar to those occurring in the upper portion of Sunlight Basin. They have apparently been derived from the decomposition of hydrogen sulphide contained in gases issuing from crevices in the igneous rocks. The débris through which the gases pass, being highly porous, offers better conditions for the aeration and oxidation of hydrogen sulphide than do the massive rocks, which are believed to contain little, if any, sulphur additional to that contained in the open crevices. The thickness of the débris above water level is probably as much as 25 feet in places, and a considerable portion of this may be found to be sulphur bearing, but it is very doubtful whether any sulphur will be found below water level, as, from the theory of origin postulated, oxidation of the hydrogen sulphide and deposition of sulphur could not go on in this zone. It appears probable that the sulphur-bearing gases are of deep-seated or of igneous origin.

The sulphur deposits are small, and under the conditions existing at present in the American sulphur industry there is little chance that they can be exploited with profit. The fact that sulphur has been found in the débris where none was exposed on the surface makes it at least possible that the alluvium contains considerably more than is at present known. Even should this prove to be true it is still doubtful whether the deposits can be utilized unless the local demand becomes great.

ITALY.

NOTES ON THE SICILIAN SULPHUR INDUSTRY.

According to United States Consul Arthur Garrels, of Catania, Italy,[1] there were 476 sulphur mines and 13 refineries in operation in Sicily in 1911. The methods employed in procuring the sulphur range from the most primitive to the latest and most improved. In smelting, the sulphur itself is used as fuel, and consequently from 25 to 40 per cent of the output is thus consumed and lost.

All the crude sulphur obtained in Sicily, as is well known, must be sold to the Government monopoly—that is, the Consorzio Obbligatorio per l'Industria Zolfifera Siciliana. Prices are fixed each year by the Consorzio in July, and during 1911 they were per metric ton (2,204.6 pounds) $17.466 as the buying price and $18.225 as the selling price.

Export prices per 100 kilos (220.46 pounds) f. o. b. Catania for crude, refined, and milled sulphur ranged as follows:

Export prices of sulphur per 100 kilograms f. o. b. Catania, Sicily, 1910–11.

Kind of sulphur.	High.	Low.	Kind of sulphur.	High.	Low.
Crude	$1.93	$1.775	Refined, ground	$2.354	$2.316
Second crude, ground, best	2.196	2.161	Rolled, refined	2.161	2.123
Second crude, ground	2.161	2.123	Sublimed	2.895	2.895
Refined	2.103	2.084			

[1] Daily Cons. and Trade Repts., Aug. 21, 1912.

Comparative schedule for the years 1910 and 1911 of the exports from Sicily of crude and worked sulphur to all countries.

Country.	1910	1911	Country.	1910	1911
	Metric tons.	*Metric tons.*		*Metric tons.*	*Metric tons.*
Sicily	2,382	2,413	Sweden and Norway	19,918	29,363
Italy (Continent)	60,819	72,948	Turkey in Europe	1,671	2,394
Austria	29,598	34,135	United States and Canada	12,420	8,573
Belgium	14,305	11,770	Central America	6,354	4,943
Denmark	434	881	Egypt	475	537
France	93,232	114,865	Algiers and Tunis	5,958	6,466
Germany	30,263	28,662	Turkey in Asia	4,607	2,172
Greece	14,810	19,363	British India	4,383	5,457
England and Malta	19,085	19,763	Australia	8,283	13,385
Netherlands	10,228	12,615	South Africa	6,360	10,199
Portugal	10,806	16,358	Other countries	6,244	9,289
Russia	25,866	23,485			
Spain	7,444	6,191	Total	395,945	456,227

According to the Consorzio, the total production of sulphur during its fifth working year, ending July 31, 1911, was 391,978 metric tons as compared with 396,737 metric tons during 1910. The decrease was due to certain general conditions and in particular to the destruction by explosion of one of the more important mines, which had previously produced an average of 30,000 metric tons a year. Among the general conditions were the failure to discover new deposits of sulphur during the past decade; the continual deepening of almost all the existing mines, with the consequent increased cost of mining; the working out and inundation of a number of mines; the lack of labor and its increased cost, due to continual emigration; and, finally, the law of June 30, 1910, which restricted the granting of sulphur-mining concessions. These causes lead to the belief that the annual output will not exceed 400,000 tons in the future.[1]

The total number of persons employed at the Sicilian sulphur mines, including clerks, engineers, etc., but not Government officials, is given as 32,000.

The average cost of raw sulphur at the mine is $10.61 per metric ton, and the average cost of transportation to the various points of shipment is 96 cents per ton. Warehouse and loading charges cost an additional 96 cents per ton.

The total exports of sulphur from Sicily increased during the year 1910–11, which caused a decrease of the stocks on hand from 596,128 metric tons on July 31, 1910, to 534,603 tons on July 31, 1911. The exports were distributed at the usual points of shipment; Porto Empedocle, Catania, Licata, Termini, and Palermo. According to Emil Fogg & Sons, the stock of Sicilian sulphur on hand in Sicily at the end of May, 1912, was 445,257 metric tons.

NEW ZEALAND.

In April, 1912, work began on the deposits of sulphur located on White Island, in the Bay of Plenty, New Zealand. The deposits are reported to occur in the crater of an old volcano arising out of deep water. The volcano is on one of the lines of weakness which strike transversely across North Island, through the Hot Lakes district and the pumice zone. The activity extending seaward about 30 miles, and possibly more, found a vent in what is now White Island.[2]

[1] This paragraph and the following are from the reports of United States Consul Hernando de Soto, of Palermo.
[2] Eng. and Min. Jour., Dec. 28, 1912, p. 1238.

There is a lake of strong mineral water on the island which is fed by geysers and boiling springs. The draining of the lake that lies in the old crater has been undertaken, and as a result prospects of supplies of fine sulphur have been opened that were formerly unsuspected. New deposits have been found and fumaroles have appeared which are providing large supplies of good material. These new occurrences naturally have improved the prospects of the future considerably.

The work of prospecting and development has proceeded smoothly, and in the process about 4,000 tons of high-grade sulphur were obtained, which is now lying on the dump at the island. Work, comprising landing arrangements with a wharf and moorings for vessels of considerable size, will shortly be undertaken, and the necessary plans are now being prepared. Retorts for refining the product have been received, and the foundations and bedding for placing them in position have already been laid. The company has introduced a large amount of capital into New Zealand and of necessity will introduce more in the future. Already employment has been given to many people, and it is expected that the number will be augmented considerably in the future. The wages paid are larger than usual for such work.[1]

The tonnage of sulphur estimated in the deposits is very large.

PYRITE.

PRODUCTION.

The production of pyrite in the United States in 1912 was 350,928 long tons, valued at $1,334,259. This is an increase in quantity of 49,470 tons and in value of $169,388 as compared with the production of 1911, which was 301,458 tons, valued at $1,164,871. The figures for 1912 are the largest ever recorded by the Survey. Though low-grade sulphide ores of copper, containing considerable quantities of pyrite and pyrrhotite from Ducktown, Tenn., and elsewhere, and zinc sulphide concentrates from the Mississippi Valley as well as from Western States have been used in recent years in the manufacture of sulphuric acid, this condition of affairs does not seem to have curtailed the output of pyrite, as it was feared it might. As a matter of fact, the output of pyrite has shown a great increase during the past few years, which have been also a period of rapid development of the by-product sulphuric-acid industry. It is estimated that the quantity of sulphides other than straight pyrite used in the manufacture of sulphuric acid in 1912 is equivalent to about 260,000 long tons of pyrite, which would bring the tonnage of this mineral theoretically produced in 1912 up to more than 610,000 long tons. This does not include copper-bearing Spanish pyrite used in making sulphuric acid.

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[1] Australia Min. Standard, Feb. 6, 1913, p. 115.

In the following table is given the production of pyrite in the United States by States during the last three years:

Production of pyrite in the United States, 1910–1912, by States, in long tons.

State.	1910			1911			1912		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
California	27,158	$129,504	$4.77	48,415	$182,787	$3.78	61,812	$201,453	$3.26
Illinois	8,541	28,159	3.30	17,441	47,020	2.70	27,008	62,980	2.33
Indiana	(a)	(a)	(a)	(a)	(a)	(a)	1,462	5,684	3.89
Ohio	3,766	12,831	3.41	6,471	18,017	2.78	14,487	43,853	3.03
Virginia	140,106	525,437	3.75	150,800	558,494	3.70	162,478	621,219	3.82
Wisconsin	12,555	49,467	3.94	12,893	50,025	3.88	17,898	70,518	3.94
Other States [b]	49,486	232,580	4.70	65,438	308,528	4.71	65,783	328,552	4.99
Total	241,612	977,978	4.05	301,458	1,164,871	3.86	350,928	1,334,259	3.80

[a] Included in "Other States."
[b] 1910, Georgia, Indiana, Massachusetts, and New York; 1911, Georgia, Indiana, Massachusetts, Missouri, New York, Oklahoma, and Pennsylvania; 1912, Georgia, Missouri, New York, and Pennsylvania.

The production of pyrite in the United States since 1882 is given in the following table:

Production of pyrite in the United States, 1882–1912, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1882	12,000	$72,000	1898	193,364	$593,801
1883	25,000	137,500	1899	174,734	543,249
1884	35,000	175,000	1900	204,615	749,991
1885	49,000	220,500	1901	[a] 241,691	1,257,879
1886	55,000	220,000	1902	[a] 207,874	947,089
1887	52,000	210,000	1903	[a] 233,127	1,109,818
1888	54,331	167,658	1904	207,081	814,808
1889	93,705	202,119	1905	253,000	938,492
1890	99,854	273,745	1906	261,422	931,305
1891	106,536	338,880	1907	247,387	794,949
1892	109,788	305,191	1908	222,598	857,113
1893	75,777	256,552	1909	247,070	1,028,157
1894	105,940	363,134	1910	241,612	977,978
1895	99,549	322,845	1911	301,458	1,164,871
1896	115,483	320,163	1912	350,928	1,334,259
1897	143,201	391,541			

[a] Includes production of natural sulphur.

IMPORTS.

Though the imports of pyrite in 1912 were less than in 1911, they amounted to nearly three times the domestic output. Thus, foreign pyrite is the controlling factor in the domestic market, the domestic production being entirely insufficient to supply the demand. The imported pyrite comes chiefly from Spain, in which country the principal deposits occur, though part of them are located in Portugal. The Huelva deposits are the principal ones and occur in the Spanish Province of Huelva and the Portuguese Province of Alemtejo, between Rio Tinto and San Domingo, in a zone about 120 miles long and from 12 to 20 miles wide. The famous San Domingo, La Zarza, and Tharsis mines lie near the middle of this zone.

The ore in the Spanish deposits is compact, finely crystalline, and often banded or stratified. The color varies from a silver white in the San Telmo ores to a rich golden in the Granada. These colors depend on the relative percentages of iron, copper, and other metals present. Vogt estimates the entire area of the Huelva pyrite deposits as half a million square meters and the total mass of the deposit, omitting depletion through erosion and mining, as one billion metric tons.

The imported Spanish ore is admirably suited for the purpose of making sulphuric acid. The ores are of the compact, massive varieties and are of high grade, rarely falling under 47 per cent sulphur and reaching as high as 51 per cent. For export the ore is broken into uniform pieces about $2\frac{1}{2}$ inches in average diameter, and in this form it is sold as "furnace size" ore. Generally there is a maximum guaranty of 5 per cent "fines" or material under one-quarter inch mesh. This uniform size and weight enables the ore to be handled more easily and burned more efficiently, and its additional cost is outweighed by the fact that no breaking and rehandling are necessary at the factory. In addition to the furnace size ore, there is also quite a large quantity of lump ore imported, varying in size from that of a pea up to masses weighing 100 to 200 pounds. The lump ore is initially cheaper per ton, but before it can be burned it has to be broken by sledges to furnace size. The labor and cost involved in this operation are considerable, and a large quantity of "fines" is formed which can not be used in lump burners but must be sold for use in "fines" burners. Besides the imports of lump and furnace size ores, there is also imported a fine ore about the size of a pea for use in "fines" burners.

The ores are sold on a unit basis; that is, at a certain price for every per cent or fraction thereof of available sulphur. These prices fluctuate, depending on the demand, output, chartering of boats, etc. From the best information obtainable, the water rate from Spain to Atlantic ports is somewhat over $2 a ton, and wharfage is about 45 cents a ton exclusive of the land freight rate. Spanish pyrite is at present quoted at 13 cents per unit f. o. b. for furnace size ore. The fine ore of the same grade is usually quoted at 1 to 2 cents less per unit than the furnace size. The final cost of the furnace size is less than that of lump ore of the same grade or even of higher grade because added to the actual cost, plus freight charges, including water, rail, wharfage, etc., is the cost of breaking the lump at the factory, which is about 50 cents a ton. For this extra expense of breaking the company selling the ore usually allows about 30 cents a ton. But in addition to this added trouble and expense there are considerable fines formed which have to be disposed of at 2 cents less per unit than they cost. There are still some factories that buy lump ore and break it to furnace size at the works.[1]

[1] From paper read by W. C. Dumas before the Georgia section of the Am. Chem. Society: The Am. Fertilizer, vol. 36, No. 6, pp. 21-23. See also Beck, R., The nature of ore deposits, translated by W. H. Weed, vol. 2, 1905, pp. 483-485.

The imports of pyrite for consumption for the last five years are given in the following table:

Imports for consumption of pyrite containing not more than 3.5 per cent of copper, 1908–1912, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1908	668,117	$2,624,339	1911	1,006,310	$3,788,803
1909	688,843	2,428,580	1912	970,785	3,841,683
1910	803,551	2,748,647			

WORLD'S PRODUCTION OF PYRITE.

In the following table is given the world's production of pyrite and the quantity of pure sulphur which it is supposed to replace in the market, estimated on the assumption that the pyrite averages 45 per cent of sulphur:

Production of iron pyrite in principal producing countries and quantity of sulphur displaced, 1907–1912, in long tons.

Country.	1907	1908	1909	1910	1911	1912
North America:						
Canada	[a] 41,288	[a] 42,264	[b] 57,718	48,098	73,809	71,163
Newfoundland	19,920	....	....	....	(c)	(c)
United States	247,387	222,598	247,070	241,612	301,458	350,928
Europe:						
Belgium	391	351	211	211	120	(c)
Bosnia and Herzegovina	7,115	10,238	7,151	56	(c)	(c)
France	278,214	280,233	268,918	246,488	(c)	(c)
German Empire	193,259	216,000	195,560	212,311	214,034	(c)
Greece	....	6,759	14,506	32,767	(c)	(c)
Hungary	97,936	97,268	97,412	91,008	(c)	(c)
Italy	[a] 124,926	[a] 129,647	[a] 130,152	133,492	143,824	(c)
Norway	[a] 232,321	[a] 264,891	[a] 278,352	[a] 324,457	(c)	(c)
Portugal	[b] 359,413	[d] 104,270	[d] 268,108	289,119	(c)	(c)
Russia	21,551	57,760	(c)	(c)	(c)	(c)
Servia	....	32,211	21,286	36,255	(c)	(c)
Spain	[e] 222,274	[e] 259,308	[e] 254,853	(c)	(c)	(c)
Sweden	26,686	29,103	15,850	25,044	(c)	(c)
Turkey	[f] 62,008	[g] 57,707	[g] 77,402	[h] 148,130	(c)	(c)
United Kingdom	10,194	9,448	8,429	9,380	10,114	(c)
Asia:						
Japan	55,281	33,334	21,170	78,421	(c)	(c)
Oceania:						
Australia	....	....	....	2,916	(c)	(c)
Total	2,000,164	1,853,390	1,964,148	1,919,765	....	....
Sulphur displaced [i]	900,074	834,026	883,867	863,894	....	....

[a] Cupreous iron pyrites.
[b] Includes cupreous iron pyrites.
[c] Statistics not available.
[d] 1908: Composed of cupreous iron pyrites, 80,135 long tons, and sulphur ore, 24,136 long tons; 1909: Composed of cupreous iron pyrites, 194,861 long tons, and sulphur ore, 73,247 long tons.
[e] Also 3,132,525 long tons in 1907, 2,938,759 long tons in 1908, and 2,908,715 long tons in 1909, designated as "copper ore and cupreous iron pyrites."
[f] Exports.
[g] 1908: Year ending March, 1908; 1909: Year ending March, 1909.
[h] Exported from Stratoni.
[i] Based on estimated 45 per cent of sulphur content.

PYRITE INDUSTRY BY STATES.

ALABAMA.[1]

Pyrite has been mined near Pyriton, Clay County, Ala., but during the last three years the deposits have been idle. The town is located on the Atlanta, Birmingham & Atlantic Railroad, in the north-central

[1] From notes furnished by E. S. Bastin.

part of the county. The deposits which have been worked lie just south of the railroad and appear to trend with the schists which inclose them. Two mines are located close to the station, and two others are situated about 1 mile to the west. What is known as the No. 1 or Smith mine is located opposite Pyriton station. It was worked by means of an incline, now filled with water, except close to the surface where the rock is so badly decomposed that the relationship between schist and ore can not readily be made out. From material seen in the ore bins and on the dumps, the pyrite does not appear to constitute a true vein but occurs in the form of highly pyritic layers interbanded in quartz-chlorite schists. Most of the schist carries scattered pyrite grains, which in some layers are very abundant and in others constitute practically the whole of the rock. Pyritic layers wedge out parallel to the schistosity and their places are taken by schist. Small quartz stringers and hornblendic bands are not uncommon in the schist. The strikes observed range from approximately northeast to east, with dips of 25 to 30° S. The mill which formerly belonged to the mine has been torn down and the mine itself has been out of commission for some time. The No. 2 or Williams mine is located about a quarter of a mile west of Pyriton station. The incline or shaft is filled with water and none of the ore in place could be seen. The material observed on the dump is similar to that at the Smith mine and indicates that the two mines may have worked the same pyritic zone. The third mine is located near the railroad and about 1 mile west of Pyriton. It was also under water when visited. Like the others, it was formerly worked by an inclined shaft. The fourth mine is located a short distance southwest of the third mine.

CALIFORNIA.

The output of pyrite in California in 1912 showed a substantial increase as compared with the preceding year. The production was reported from Fruitvale and Leona Heights, Alameda County, and from near Keswick, Shasta County. At the latter place the pyrite mined contains copper values. A part of the pyrite mined in California is used in the manufacture of sulphuric acid by the companies producing it.

GEORGIA.

The pyrite mined in Georgia in 1912 came from near Bremen and Villa Rica, Carroll County. The Reed Mountain Mining Co. operated at the former place and the Sulphur Mining & Railroad Co. at the latter. The Franklin Pyrite & Power Co., of Creighton, Cherokee County, did considerable development work during 1912, such as sinking a shaft, repairing water dam, etc.

ILLINOIS.

As in 1911, Illinois ranked fourth in 1912 among the States in the production of pyrite. Notwithstanding the fact that the output of the State in 1911 showed a growth of 86 per cent as compared with the production in 1910, the increase for 1912 as compared with the record output of 1911 was a very substantial one, amounting to nearly 55 per cent. The pyrite produced in Illinois is obtained as a by-product in the mining of coal, and comes from Vermilion and Madison counties. The individual production of most of the mines is small, but the tonnage from certain mines runs into the thousands.

INDIANA.

The production of pyrite in Indiana in 1912 was greater than during 1911. It came from Vigo and Warrick counties. As in Illinois, the pyrite is obtained in connection with coal mining.

MASSACHUSETTS.

No pyrite was mined during 1912 by the Davis Sulphur Ore Co. at the Davis mine, located at Rowe, Mass. All the old machinery which has been on the property for many years has been sold and removed. The company plans to open a new pyrite lens some time during the summer of 1913. The new installation for working the ore will be entirely electrical, and power will be obtained from a transmission line carrying a high voltage which now runs across the property, thus making it unnecessary to employ steam power any longer.

MISSOURI.

Missouri again appears in the list of States producing pyrite, the Rock Island Mining Co. having reported a production from its mine located at Leslie, Franklin County.

NEW YORK.

Pyrite was produced in New York in 1912 by the Hinckley Fiber Co. and the St. Lawrence Pyrites Co. The mine of the first-named company is located at Richville, a few miles northeast of Gouverneur, St. Lawrence County. The mine is the old Cole property, and is now worked under lease by the Hinckley Fiber Co. The output of the mine is used in crude form in the manufacture of sulphite pulp at the plant of the company located at Hinckley, Oneida County. The use of low-grade pyrite for the production of sulphur dioxide for direct use in paper mills is something new in New York. This use of pyrite may be said to be only in the experimental stages at the present time, and if it is found to be successful it may have an important bearing on the pyrite industry in this State. It is reported that a Mechanicsville (N. Y.) paper firm, which uses large quantities of sulphur dioxide in the manufacture of sulphite fiber, is planning the erection of a plant for the production of that gas from pyrite.

The mines of the St. Lawrence Pyrites Co. are located near Hermon, St. Lawrence County. The equipment comprises a concentrating plant and a branch railroad to De Kalb Junction. The pyrite is sold in concentrated form to the acid trade.

No work was reported by the Oliver Iron Mining Co. in 1912. The mine of this company is located at Pyrites, St. Lawrence County, and was taken over by this company about five years ago, but has since remained inactive.

NORTH CAROLINA.

It is reported that the old Pasour Mountain pyrite mine in Gaston County is to be reopened by the Southern Sulphur Co., whose headquarters are at Scranton, Pa. This mine was once worked by the Virginia-Carolina Chemical Co.

OHIO.

The production of pyrite in Ohio in 1912 increased 124 per cent, and the value of the output 143 per cent in 1912, as compared with 1911. The pyrite is obtained as a by-product in connection with the mining of coal, and the production in 1912 came principally from Tuscarawas and Jefferson counties, with small output from Belmont and Stark counties.

PENNSYLVANIA.

A small output of pyrite was produced at Stoneboro, Mercer County, Pa., in 1912 in connection with coal mining.

VIRGINIA.

In 1912 Virginia ranked first, as usual, among the States producing pyrite. The mineral was produced at the usual places—at Dumfries, Prince William County, by the Cabin Branch Mining Co.; at Mineral, Louisa County, by the Sulphur Mining & Railroad Co. and the Arminius Chemical Co. (Inc.); and in Carroll County by the Pulaski Mining Co.

The holdings of the United States Fidelity & Guaranty Co., in Louisa County, which are located near those of the Sulphur Mining & Railroad Co. and the Arminius Co., have been sold to a new corporation, organized in the spring of 1913 under the laws of Virginia and known as the Boyd-Smith Mines, Incorporated. The pyrite mine on the property has not been operated for several years, only a caretaker having been on the ground.

Published notices regarding the incorporation of two new companies to develop Virginia pyrite have appeared within the last year. One of these, styled the Old Dominion Pyrite Mine, has been incorporated to develop 100 acres at Mineral, Va. Arthur P. Greely, the secretary of the company, has written as follows regarding the venture: [1]

> The mine is about a mile east of the Arminius mine on a lode believed to be very valuable. At present a double compartment shaft is being sunk in a lens of pyrite of excellent quality, which appears to be over 60 feet wide with good ore within 5 feet of the surface. A prospecting shaft sunk along the strike of the lens in about 35 feet of length produced upward of 25 tons of pyrite of excellent quality.

Another company, styled the Old Dominion Sulphur Co., has been incorporated with a view to developing pyrite deposits in Stafford County, 10½ miles from Fredericksburg. The company controls 300 acres of land through which Austin Run flows. It is proposed to build a plant with a capacity of 200 tons.[2]

WISCONSIN.

The production of iron sulphide in Wisconsin increased 39 per cent in quantity and 41 per cent in value in 1912, as compared with 1911. The production is obtained from the zinc ores mined in the south-

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[1] Manufacturers' Record, Sept. 9, 1912, p. 58. [2] Manufacturers' Record, Apr. 4, 1912, p. 74.

western part of the State and shipped from Platteville, Benton, Cuba City, Linden, Mifflin, and Montfort.

UTILIZATION OF PYRITE RESIDUES.

Pyrite is mined at the present time chiefly for use in the manufacture of sulphuric acid. The residue, left after burning, in the manufacture of the acid and commonly known as "blue billy," consists chiefly of iron oxide and has found but limited use unless it contains important values in copper, zinc, or the precious metals. The residue has hitherto assumed little if any importance to the iron or steel manufacture—but with the depletion of our iron-ore resources it seems reasonable to suppose that it must have an increasing value. The residue has been used, however, and a brief account of its utilization as practiced at Pulaski, Va., was given in this report for 1909.[1]

Pyrite contains 53.4 per cent sulphur and 46.6 per cent iron. Pyrrhotite, the other important iron sulphide and the mineral used at Pulaski, Va., contains usually from 38.4 to 39.6 per cent sulphur and from 60.4 to 61.6 per cent iron. Though the commercial pyrite now being placed on the market does not contain the theoretical percentages of sulphur and iron given above, the figures approach near enough to the theoretical to make them of very practical interest. The average in sulphur content of the pyrite shipped from the Virginia pyrite mines ranges from 43 to 45 per cent. The following analyses show the general character of the Louisa County (Va.) pyrite, the fourth analysis being that of pyrrhotite from the southwestern part of the same State:

Composition of Virginia pyrite and pyrrhotite.

	I. Per cent.	II. Per cent.	III. Per cent.	IV. Per cent.
Sulphur (S)	48.02	50.00	49.27	34.06
Iron (Fe)	42.01	43.00	43.62	53.15
Iron oxide (Fe_2O_3)	1.93			
Silica (SiO_2)	7.60			2.99
Insoluble		6.02	4.23	
Sulphur trioxide (SO_3)	0.44			
Copper (Cu), Arsenic (As)	None.			[a]0.866
Zinc (Zn)			0.38	
Lime (CaO), Magnesia (MgO)			1.32	
Manganese				0.306

[a] Copper.

The problem, before utilizing the iron residues in the furnace, is to get rid of the comparatively large amount of sulphur which remains in the "blue billy" after as much sulphur as possible has been burned away as sulphur dioxide in the manufacture of the acid. This sulphur content is ordinarily much too high to permit the direct use of the residue in the manufacture of pig iron. The claim that many acid plants burn pyrite until the sulphur amounts to only 0.5 to 1 per cent is scarcely ever realized in practice and the pyrite cinder on the market contains, as a rule, 2 per cent or more of sulphur. "Blue billy" is therefore regarded as an undesirable iron ore and consequently brings a low price. Still another objection is the finely divided condition in which it comes from the acid factory, making it especially unsatis-

[1] Phalen, W. C., Mineral Resources U. S. for 1909, pt. 2, U. S. Geol. Survey, 1911, p. 695.

factory where heavy blasts are used. This objection does not obtain where lump pyrite is used in the manufacture of acid, but here again such pyrite is apt to contain a larger content of sulphur than the fines.

According to Utley Wedge:[1]

The practice of nodulizing cinder from pyrites burners has become general in all localities where there is a market for the nodulized cinder as iron ore. The iron industry of Pennsylvania furnishes a good market. In Alabama, the iron manufacturers have not as yet offered prices for low phosphorus nodulized cinder such as to make profitable the installation of nodulizing kilns and there is, in the South, the accumulated cinder from years of sulphuric acid manufacture, waiting for prices which will make its utilization profitable.

At the mines of the Pulaski Mining Co. in southwest Virginia, the procedure which obtained a few years ago, and which is presumably still in use, is as follows: The pyrrhotite is dead roasted; sulphuric acid is made, and the resulting cinder is used as part of the charge in an iron blast furnace. The ore is mined from open cuts; it is crushed and then conveyed to Herreshoff roasters. The cinders from these roasters is then clinkerized in a 100-foot rotary cement kiln into which powdered coal is blown at the end opposite the feed. The pyrite cinder when fed to the kiln contains from 4 to 7 per cent sulphur; after going through the clinking process the sulphur content is reduced to 0.05 per cent. The cinder is sold to the Pulaski Iron Co., whose furnace is only a short distance away.

According to the Engineering and Mining Journal[2] it is reported that a factory is to be erected in the south (probably in Virginia) where the cinders from Spanish pyrite will be worked up into lump form for iron furnaces. A large amount of this cinder is annually produced as a by-product at many of the fertilizing plants now scattered over that part of the country. These pyrite cinders often contain a small amount of copper, and when this is present to a degree that justifies its extraction, the residues will be treated for its removal, thus leaving the iron ore in better condition for the iron furnaces and at the same time saving the copper. The development of this work should prove of considerable industrial importance.

THE SULPHURIC-ACID INDUSTRY IN THE UNITED STATES.

PRODUCTION.

The statistics of sulphuric acid have previously been collected at each census, beginning with the census of 1870; and at the censuses of 1889, 1899, and 1904 the quantity and value of each of the important grades were ascertained. The statistics of production for the years prior to 1911 have been taken from the census reports for 1889, 1899, and 1904.[3]

Under the production for 1911 and 1912 all sulphuric acid is given regardless of whether it was sold as such or consumed in the factories where it was made. It is well known that nearly all the sulphuric acid made at fertilizer works is there consumed in the manufacture of superphosphates, that in factories where explosives are manufactured the sulphuric acid is combined with nitric acid and is used in making nitroglycerin and gun cotton, and that, finally, in petroleum refineries

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[1] The sulphuric acid industry in the United States: Original communications 8th Internat. Cong. App. Chemistry, vol. 2, pp. 241-248.

[2] July 20, 1912.

[3] Census of Manufactures, 1905, Bull. 92, pp. 15 and following.

much of the acid is consumed in refining the crude oil. In the earlier census reports the sulphuric acid consumed in establishments where manufactured and that produced by establishments engaged primarily in the manufacture of other products was listed separately, which is not done in the Survey's figures for 1911 and 1912, except in the case of the sulphuric acid manufactured at smelters as a by-product, which has been separately listed.

Sulphuric acid is produced in several grades—(1) 50° Baumé acid, also known as chamber acid, containing an average of 50.76 per cent SO_3, or 62.18 per cent H_2SO_4; (2) 60° Baumé acid, containing an average of 63.41 per cent SO_3, or 77.67 per cent H_2SO_4; (3) 66° Baumé acid, known as oil of vitriol, containing approximately 76 per cent SO_3, or approximately 93.19 per cent H_2SO_4. Higher strengths of acid usually contain SO_3 dissolved in sulphuric acid, for example, pyrosulphuric acid and fuming or Nordhausen acid. Oleum is a grade which contains 30 per cent of free SO_3, or a total of 87.14 per cent of free and combined SO_3.

In the following table the quantity, value, and price per ton are given of the three main grades of acid, and also similar data for other strengths of acid combined. With the exception of the acid included under "Other grades," the output is also expressed in terms of 50° Baumé acid for the sake of comparison.

Production of sulphuric acid in the United States in 1889, 1899, 1904, 1909, 1911, and 1912, by grades, in short tons.

Grade.	1889			1899		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
50° Baumé	504,932	$4,307,067	$8.53	953,439	$7,965,832	$8.35
60° Baumé	10,190	122,940	12.06	17,012	246,284	14.47
66° Baumé	177,267	3,249,466	18.33	382,279	6,035,069	15.78
Total	692,389	7,679,473		1,352,730	14,247,185	
Total reduced to 50° Baumé acid	[a] 783,569			[b] 1,548,123		9.20

Grade.	1904			1909		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
50° Baumé	1,169,141	$8,314,646	$7.11	1,624,178	$8,494,451	$5.23
60° Baumé	48,688	581,523	11.94	186,900	1,089,350	5.78
66° Baumé	411,165	5,917,699	14.38	558,078	6,719,259	12.04
Other grades	[c] 13,268	361,018	27.20	[c] 31,349	476,135	15.18
Total	1,642,262	15,174,886		2,400,505	16,779,195	
Total reduced to 50° Baumé acid	[d] 1,869,437			[e] 2,748,527		

[a] Includes 290,708 tons, for which no value was assigned, consumed in establishments where manufactured; and also sulphuric acid produced by establishments engaged primarily in the manufacture of other products.

[b] Includes 764,355 tons, with an assigned value of $7,032,066, consumed in establishments where manufactured; and also sulphuric acid produced by establishments engaged primarily in the manufacture of other products.

[c] Reported as oleum by the census.

[d] Includes 968,445 tons, with an assigned value of $7,232,675, consumed in establishments where manufactured; and also sulphuric acid produced by establishments engaged primarily in the manufacture of other products.

[e] Includes 1,271,535 tons, with an assigned value of $6,694,436 consumed in establishments where manufactured; and also sulphuric acid produced by establishments engaged primarily in the manufacture of other products.

Production of sulphuric acid in the United States in 1889, 1999, 1894, 1909, 1911, and 1912, by grades, in shors tons—Continued.

Grade.	1911			1912		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton
50° Baumé	1,026,896	$5,447,958	$5.31	1,047,483	$5,378,411	$5.13
60° Baumé	421,165	2,624,042	6.23	451,172	2,727,764	6.05
66° Baumé	751,541	9,176,297	12.21	774,772	9,360,630	12.08
Other grades	[a] 10,728	121,575	11.33	66,166	871,214	13.17
Total	2,210,330	17,369,872	7.86	2,339,593	18,338,019	7.84
Total reduced to 50° Baumé acid	[a] 2,688,456	17,313,822	6.44	[b] 2,876,000	17,572,837	6.11

[a] Exclusive of acids of strength greater than 66° Baumé.
[b] Exclusive of electrolyte and acids of strength greater than 66° Baumé.

GENERAL USES.

Sulphuric acid is probably used in a greater variety of ways in the chemical arts than is any other substance. According to Lunge[1] the principal applications of the acid are as follows:

1. *In a more or less dilute state (say from 144° Twad. downward).*—For making sulphate of soda (salt cake) and hydrochloric acid, and therefore ultimately for soda ash, bleaching powder, soap, glass, and innumerable other products. Further, for superphosphates and other artificial manures. These two applications probably consume nine-tenths of all the sulphuric acid produced. Further applications are for preparing sulphurous, nitric, phosphoric, hydrofluoric, boric, carbonic, chromic, oxalic, tartaric, citric, acetic, and stearic acids; in preparing phosphorus, iodine, bromine, the sulphates of potassium, ammonium, barium (blanc fixe), calcium (pearl-hardening); especially also for precipitating baryta or lime as sulphates for chemical processes; sulphates of magnesium, aluminum, iron, zinc, copper, mercury (as intermediate stage for calomel and corrosive sublimate); in the matallurgy of copper, cobalt, nickel, platinum, silver; for cleaning (pickling) sheet iron to be tinned or galvanized; for cleaning copper, silver, etc.; for manufacturing potassium bichromate; for working galvanic cells, such as are used in telegraphy, in electroplating, etc.; for manufacturing ordinary ether and the composite ethers; for making or purifying many organic coloring matters, especially in the oxidizing mixture of potassium bichromate and sulphuric acid; for parchment paper; for purifying many mineral oils, and sometimes coal gas; for manufacturing starch, sirup, and sugar; for the saccharification of corn; for neutralizing the alkaline reaction of fermenting liquors, such as molasses; for effervescent drinks; for preparing tallow previously to melting it; for recovering the fatty acids from soapsuds; for destroying vegetable fibers in mixed fabrics; generally, in dyeing, calico printing, tanning, as a chemical reagent in innumerable cases; in medicine against lead poisoning, and in many other cases.

2. *In a concentrated state.*—For manufacturing the fatty acids by distillation; purifying colza oil; for purifying benzene, petroleum, paraffin oil, and other mineral oils; for drying air, especially for laboratory purposes, but also for drying gases for manufacturing processes (for this, weaker acid also, of 140° Twad., can be used); for the production of ice by the rapid evaporation of water in a vacuum; for refining gold and silver, desilvering copper, etc.; for making organo-sulphonic acids; manufacturing indigo; preparing many nitro compounds and nitric ethers, especially in manufacturing nitroglycerin, pyroxylin, nitrobenzene, picric acid, and so forth.

3. *As Nordhausen fuming oil of vitriol (anhydride).*—For manufacturing certain organo-sulphonic acids (in the manufacture of alizarin, eosin, indigo, etc.); for purifying ozokerite; for making shoe blacking; for bringing ordinary concentrated acid up to the highest strength as required in the manufacture of pyroxylin; and for other purposes.

The most important of the classes of manufacture enumerated above, so far as the consumption of the acid is involved, are in (1)

[1] Manufacture of sulphuric acid and alkali, vol. 1, pt. 2, ed. 1903, pp. 1169-1170.

the manufacture of fertilizer; (2) the refining of petroleum products; (3) the iron, steel and coke industries; (4) the manufacture of nitrocellulose, nitroglycerin, celluloid, etc.; and (5) in general metallurgical and chemical practice.

THE UTILIZATION OF SULPHUR-BEARING GASES.

The gases and waste products issuing from the flues of smelters, roasters, blast furnaces, reverberatory furnaces, and converters are made up chiefly of dust, the oxides of sulphur, carbon dioxide, and nitrogen. The flue dust may be caught by mechanical means before leaving the stack, but the gases pass into the atmosphere unless they are converted into other products, as, for example, sulphur dioxide and sulphur trioxide into sulphuric acid. These two gases are the most troublesome and, on account of their deleterious action on vegetation, they have caused almost endless litigation in some parts of the country where they were formerly allowed to pour forth into the atmosphere. The higher oxide of sulphur, sulphur trioxide (SO_3), makes up but a small fraction of the smelter and furnace gases, but sulphur dioxide (SO_2) issues in large volumes and travels great distances. Various methods have been adopted to overcome its evil effects. One of these methods is to dilute the gases by mixing them with sufficient air to meet the requirements of the law before their discharge into the atmosphere; another is to build the stacks so high that the gases on discharging will travel long distances and become thoroughly mixed with air before their descent to the ground. Neither of these methods has worked satisfactorily in practice. In view of this fact processes have been devised whereby these waste sulphur gases may be converted into sulphuric acid or into sulphur. The conversion of sulphur gases into sulphuric acid is practiced at Ducktown, Tenn., and a description of the process of manufacture was given in the report on sulphur, pyrite, and sulphuric acid for the year 1911, by F. B. Laney.[1] A description of the process has also been prepared by W. H. Freeland and C. W. Renwick and published in the Engineering and Mining Journal.[2]

Various attempts and experiments having in view the separation of the sulphur content of these gases have been made, one of the processes used for the accomplishment of this end being known as the thiogen process. The thiogen process, so called, was invented by S. W. Young, and its object is to reduce the oxides of sulphur that are usually present in the gases given off by blast furnaces, reverberatories, and roasters to elementary sulphur in such a condition that most of it can be removed from the furnace gases before their discharge into the atmosphere.

It is reported that satisfactory progress is being made with the process at the smelting plant of the Penn Mining Co., at Campo Seco, Cal. The gases from two 11½-foot McDougal roasters have been treated in the experimental apparatus and the proportion of sulphur dioxide in the discharged gases has been reduced to as low as 1 part in 50,000.

The plant comprises a brick flue 40 feet long, about 6 feet high, and 7 feet 4 inches wide, outside measurements; a condensing chamber 10 feet high and 10 feet square,

[1] Laney, F. B., The manufacture of sulphuric acid from smelter fumes at Ducktown, Tenn., Mineral Resources U. S., 1911, pt. 2, U. S. Geol. Survey, 1912, pp. 958-964.
[2] Vol. 89, 1910, pp. 1116-1120.

and a second flue 10 feet long, 6 feet high, and 4 feet wide, extending to and connected with a smokestack 3 by 3 by 65 feet high. The 40-foot flue, into which the gases pass direct from the roasters, is provided with transverse panels * * * which are of brick checkerwork 4½ feet high, 4½ feet wide, and 9 inches thick. The openings or flues in the checkerwork panels are filled with plaster of Paris, to which sawdust has been added. The sawdust burns out, leaving the plaster of Paris porous. This is the contact material. It may be cast in any desired shape, thin enough to be readily broken in small pieces and easily disposed in the open spaces in the checkerwork panels. This flue is connected to the roaster by an intake pipe about 2 feet in diameter, and to the condensing chamber by a 2½ by 2½ foot outlet through the dividing wall. The condensing chamber is provided with a partition wall, parallel with the checkerwork panels of the flue, 8 feet high and 9 inches thick. This chamber is connected to the second or after flue by a 2½ by 2½ foot outlet through the dividing wall. The second flue is connected to the smokestack by a 2 by 2 foot outlet.

* * * The whole apparatus having been previously heated to a low red heat, the gases from the roasters are caused to pass through the intake pipe into the fore chamber of the main flue, which may be designated as the contact flue, where they mix with hydrocarbon vapors from the oil vaporizer inserted through the end wall of the flue just beneath the intake pipe. The gases then pass through the checkerwork panels, which contain the contact material. By the time the gases reach the condensing chamber they no longer contain appreciable quantities of sulphur dioxide or sulphur trioxide, these having been completely reduced to elementary sulphur. From this point the remaining operation consists in condensing the sulphur to solid or liquid form. The partition wall in the condensing chamber forms two compartments, through which the gases must pass; first through the compartment adjoining the contact flue, thence over the partition wall and through the compartment adjoining the second or after flue. The condensing chamber is provided with a water spray, inserted through the roof between the dividing wall of the chamber and the contact flue. Contact with the spray cools the gases below the condensing point of sulphur. The floors of the two compartments of the condensing chamber are inclined toward the center, thus providing drainage for the water.

With devices for establishing a slight pressure in the apparatus, satisfactory results were obtained. Sulphur has been obtained from traps in the condensing chamber in the form of rubber-like clots, and as milky sulphur emulsion with the excess water. It has also been condensed on iron pipes placed within the apparatus, and when so obtained is quite pure and crystallizes readily as the characteristic yellow sulphur. Considerable quantities have been carried by the draft out of the smokestack in the form of finely divided flowers of sulphur; quantities of this have also been collected.

The experimental stages of the process are almost completed, and it will soon be possible to proceed with more pretentious construction. Since * * * April, 1912, the engineers have made an experiment which may result in the substitution of solid brick baffles in the place of the checkerwork panels, although this has not yet been definitely decided. In the construction of the checkerwork panels, the faces of the structure are coated with plaster of Paris, so that the contact is complete. It has been found that some flue dust accumulates in the after end of the contact flue. By the use of baffles coated with plaster of Paris the accumulation of flue dust descends to the bottom of the contact flue and may be more easily disposed of, but this is a detail of construction that affects the economy of operation and not the scientific principle upon which the operation is based. Another modification being considered by the engineers relates to the character of the material used in the construction. Concrete and steel may be substituted for brick. In fact there are various details to be considered in the construction of a permanent plant that could not have been clearly foreseen except through the operation of the experimental plant.[1]

PRODUCTION OF SULPHURIC ACID FROM SMELTER GASES.

In the following table is given the quantity of sulphuric acid recovered from the gases from smelters throughout the United States. By comparison with the preceding table it will be observed that this is approximately 27 per cent of the total sulphuric acid produced in the United States [2] during the year 1912; also, as already indicated, that the sulphuric acid produced from this source is equivalent to

[1] Eddy, L. H., Thiogen process demonstration, Eng. and Min. Jour., vol. 93, May 4, 1912, pp. 873-874; see also Westby, George C., Neutralization of smelter gases, Min. and Sci. Press, Oct. 26, 1912, p. 524.
[2] Percentage based on the total 50° acid, namely, 2,876,000 tons.

about 260,000 long tons of pyrite. The figures given in the table, however, do not include acid manufactured from copper-bearing Spanish pyrite.

Production of sulphuric acid from copper and zinc smelters in 1911 and 1912, in short tons. [a]

	60° Baumé acid.					
	1911			1912		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
Copper smelters	207,657	$1,056,185	$5.09	[b] 321,156	[b] $1,985,704	[b] $6.18
Zinc smelters	230,643	1,677,511	7.27	[b] 292,917	[b] 2,255,237	[b] 7.70
Total	438,300	2,733,696	6.24	[b] 614,073	[b] 4,240,941	[b] 6.91
Total acid reduced to 50° Baumé	547,875	....	....	[c] 764,237	....	....

[a] The acid reported to the Survey includes that of 50°, 53°, 60°, and 66° Baumé strengths, and a small quantity of electrolyte and oleum. All strengths, with the exception of the electrolyte, have been reduced to both 50° and 60° Baumé, as given in the table.
[b] Inclusive of a small quantity of electrolyte.
[c] Exclusive of a small quantity of electrolyte.

BARYTES.

By James M. Hill.

PRODUCTION.

The production of crude barytes in the United States in 1912 was 37,478 short tons, valued at $153,313. Compared with the production of the preceding year, which was 38,445 short tons, valued at $122,792, this was a decrease of 967 tons in quantity but an increase of $30,521 in value. Thus the average price per ton reported to the Survey in 1912 was higher than in 1911, being $4.09 compared with $3.19. The price given is that paid to the miner for his crude ore, hand cobbed, sorted, and ready for shipment to the mills. This price is not supposed to include the cost of haulage by wagon, boat, or railway, and it is believed that the cost of haulage was not included in the values reported for 1911 and 1912. The price of the crude material f. o. b. mines reported by most of the principal producers in 1912 was higher than in 1911. The average price for the State of Missouri was $4.77 per ton, which was substantially the average price in Washington County, Mo., the principal producing county in the State. At the close of 1912 6,262 short tons of crude domestic barytes remained unsold at the mines, according to reports from the producing districts, as compared with 6,162 tons in 1911. From Missouri 47 producers reported an output of crude barytes, but the production of most of them was small. From Tennessee 3 producers reported, and from Georgia, North Carolina, and Virginia 1 producer reported in each State. Six firms reported production of refined barytes, their plants being located in Missouri, North Carolina, South Carolina, Tennessee, and Virginia.

The total quantity of refined barytes reported as sold by mills in 1912 was 38,225 short tons, valued at $495,895. As compared with the production in 1911, which was 39,611 short tons, valued at $503,867, this was a decrease of 1,386 tons in quantity and of $7,972 in value. The average price per ton reported as received for refined barytes in 1911 was $12.72, as compared with $12.97 in 1912. At the close of 1912 there were 1,760 tons of refined barytes still in the hands of the various refiners. Toward the end of the year wholesale prices per short ton for ordinary wholesale lots in New York were as follows: American ground, off-color, $12.50 to $14; pure white floated, $16 to $17; foreign floated, pure white, $18 to $22.50.

The following table shows the production of crude barytes in the United States from 1910 to 1912, inclusive, together with the average price per ton:

Production of crude barytes in the United States, 1910–1912, by States, in short tons.

State.	1910			1911			1912		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Missouri	22,978	$75,598	$3.29	21,500	$81,380	$3.79	24,530	$117,035	$4.77
Tennessee and Kentucky	6,503	13,348	2.05	8,819	20,053	2.27	[a]3,718	8,682	2.34
Other States [b]	13,494	32,800	2.43	8,126	21,359	2.63	9,230	27,596	2.99
Total	42,975	121,746	2.83	38,445	122,792	3.19	37,478	153,313	4.09

[a] Production of Tennessee; no production of barytes reported for Kentucky in 1912.
[b] In 1910 and 1912, Georgia, North Carolina, and Virginia; in 1911, Georgia, North Carolina, South Carolina, and Virginia.

The following table gives the domestic production of crude barytes in short tons from 1883 to 1912, inclusive:

Production of crude barytes, 1883–1912.

	Short tons.		Short tons.		Short tons
1883	30,240	1893	28,970	1903	50,397
1884	28,000	1894	23,335	1904	65,727
1885	16,800	1895	21,529	1905	48,235
1886	11,200	1896	17,068	1906	50,231
1887	16,800	1897	26,042	1907	89,621
1888	22,400	1898	31,306	1908	38,527
1889	21,460	1899	41,894	1909	61,945
1890	21,911	1900	67,680	1910	42,975
1891	31,069	1901	49,070	1911	38,445
1892	32,108	1902	61,668	1912	37,478

IMPORTS.

The imports of barytes for consumption during the last five years and the value of imported barium compounds, from 1908 to 1912, are given in the following two tables:

Barytes imported and entered for consumption in the United States, 1908–1912, in short tons.

Year.	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
1908	3,401	$29,168	13,661	$58,822
1909	3,016	25,679	11,647	29,028
1910	3,565	29,782	21,270	48,457
1911	3,147	22,083	20,214	36,643
1912	3,679	26,848	26,186	52,467

Value of the imports of barium compounds, 1908–1912.

Barium compounds.	1908	1909	1910	1911	1912
Witherite, barium carbonate	$22,159	$31,584	$25,229	$27,351	$25,715
Barium binoxide	181,533	255,013	341,631	270,917	252,320
Barium chloride	42,291	47,352	35,614	28,896	27,655
Blanc fixe, or artificial barium sulphate	73,131	65,427	67,975	71,049	70,327
Total	319,114	399,376	470,449	398,213	376,017

The imports of barium chemicals or compounds were less in 1912 than in 1911. Of these barium compounds, witherite, the mineral form of barium carbonate, is admitted free of duty, but on manufactured barium carbonate there is a duty of 25 per cent ad valorem, amounting to about $4.37 per ton, in 1912. The duty on raw (unmanufactured) barytes is $1.50 per ton, and on prepared (manufactured) barytes is $5.25 per ton. On blanc fixe, or artificially prepared barium sulphate, the duty is half a cent per pound.

In 1912 the Bureau of Foreign and Domestic Commerce, Department of Commerce, attempted to separate the imports of natural and manufactured barium carbonate. It is thought that much manufactured barium carbonate was imported "duty free" prior to 1912 under the supposition that it was ground natural carbonate witherite. In the table above, $25,715 is the value of witherite imported into the United States. Of this amount $15,777 was the value of natural witherite, and $9,938 was the value of manufactured barium carbonate.

PRODUCTION OF BARYTES IN CANADA.

According to the preliminary report on the mineral production of Canada for 1912, revised figures for 1910 indicate that no barytes was produced in Canada during that year. The production for 1911 is given as 50 tons, valued at $400, and the production for the year 1912 is estimated to be 464 tons, valued at $5,104. The figures for 1912 are, however, subject to revision.

CHARACTER.

Barytes, or heavy spar ($BaSO_4$), is composed of 65.7 per cent barium oxide (BaO) and 34.3 per cent of sulphur trioxide (SO_3). The specific gravity of the mineral ranges from 4.3 to 4.6; its hardness varies from 2.5 to 3.5. It is usually a white opaque to translucent crystalline mineral about as hard as calcite, but differs from calcite in its greater specific gravity and in the fact that it is perfectly inert when treated with acids. Some barytes is stained reddish pink or yellow by iron oxide. In its common form it is an aggregate of straight or slightly curved cleavable plates, but it occurs also in granular, fibrous, and earthy masses, and in the form of stalactites, as well as in single and clustered crystals. Natural barytes is rarely pure, its most common impurities being silica, lime, magnesia, and the oxides of iron and aluminum. Fine particles of galena are disseminated through some of the deposits—for instance, those of Washington County, Mo. The commercial grades of the mineral as mined carry 95 to 98 per cent barium sulphate and 1 to 3 per cent of silica.

OCCURRENCE.

Barytes occurs 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 produced deposits of the mineral embedded in residual clay, such as occur near Cartersville, Ga. The mineral has a wide range in geologic age and in geographic distribution, but in the United States the principal sources of supply are the Missouri and the Appalachian districts. In 1912 the Missouri district furnished between 66 and 67 per cent of the production, almost the entire output of the State coming from Cole, Franklin, Jefferson, Morgan, St. Francois, and Washington counties, the county last named producing more than 80 per cent of the entire output reported for the State. Among the Appalachian States, Georgia, North Carolina, Tennessee, and Virginia, named in the order of amount of production, reported an output of crude barytes in 1912. Kentucky, which mined 3,712 short tons of crude barytes in 1911, reports no production for the year 1912, and the barytes mines of South Carolina were also apparently idle during 1912.

USES.

Barytes is used principally as a pigment in mixed paints and in the manufacture of lithopone, a white pigment. It is reported that barytes is used in Valsassina, Italy, in the manufacture of gorgonzola cheese, which is covered with a thick crust of the finely ground mineral, to protect it from aeration. Barytes is also used in the manufacture of white rubber goods, but it is said that lithopone has lately replaced it to some extent for this use, because it not only gives color to the rubber but aids in the vulcanizing process. Paper manufacturers formerly used a large amount of barytes for giving weight to their products, but with the advent of "Bible paper" books this use has gradually diminished, though some barytes is still used in the manufacture of wall papers. Unfortunately some leather manufacturers still use barytes to give weight to their product, but it is thought that this use will continue to decline. Barytes is used in the manufacture of asbestos cement and artificial ivory. Barium carbonate and some barium chloride are used to prevent efflorescence on bricks. According to Heinrich Ries,[1] the efflorescence is due to soluble salts, especially sulphates, which on evaporation leave a white coating on the surface of the bricks. These sulphates are formed from sulphuric acid produced by burning impure clays carrying pyrite, or from sulphurous water that acts upon the lime and magnesia of clay used in making the bricks. In order to prevent effloresence the brickmakers add to their clay mixture a quantity of barium carbonate or chloride, which forms with sulphuric acid the practically insoluble barium sulphate. Barium chloride is the cheaper of the two preventives, but its use is apparently more dangerous, for if too much of it is added to the mixture soluble chlorides are likely to be formed.

[1] Ries, Heinrich, Clay industry of New York: Bull. New York State Museum No. 37, vol. 7, 1900, pp. 679-686.

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STRONTIUM ORE AND SALTS.

PRODUCTION AND IMPORTS.

No production of strontium ore in the United States was reported to the Geological Survey in 1912 and no imports of strontium compounds during the year were reported by the Bureau of Foreign and Domestic Commerce. The imports for 1911, valued at $44, do not include the value of strontium nitrate imported into the United States for use in making so-called "red fire." In the import tables this material is included among chemicals, drugs, dyes, and medicines, under the designation "alkalies, alkaloids, and all combinations of, and chemical compounds, mixtures, and salts not specially provided for," the imports of which in 1911 amounted to $1,680,429.15. It is not known just how much of this amount represents the value of strontium nitrate imported.

SOURCES OF STRONTIUM IN THE UNITED STATES.[1]

Strontium is obtained from celestite ($SrSO_4$), a bluish-white pearly mineral, and from strontianite ($SrCO_3$), a white to pale greenish or yellowish gray brittle mineral. Strontianite is preferred, as by simple treatment with acids it can be converted into the soluble commercial salts. It is, however, not so abundant as celestite, and very little of it has been mined. Both minerals are generally associated with calcareous rocks and with gypsum.

Both celestite and strontianite have been mined from impure limestone near Schoharie, N. Y., and have also been found in small quantities in rocks of the Clinton group, near Clinton, N. Y., and at Chaumont Bay. In 1897 about 150 tons of celestite were mined from a cavern in limestone at Put in Bay, Ohio. In 1904 a deposit of celestite was opened 5 miles north of Austin, Tex., where it occurred in nodules in yellow argillaceous limestones of Cretaceous age. This property has not been worked for several years.

A deposit of celestite was recently discovered on the northeast border of the Avawatz Mountains, San Bernardino County, Cal., where it occurs in lake beds with salt and gypsum. About 15 miles south of Gila Bend, Maricopa County, Ariz., there is a deposit of celestite associated with gypsum in sandstones and conglomerates. Strontium minerals have also been found near Cedar Cliff, W. Va., Drummond, Mich., Frankstown, Pa., near Nashville, Tenn., in northeast Kansas, and in Larimer County, Colo.

USES OF STRONTIUM SALTS.

Strontium salts, particularly the nitrate, carbonate, and chlorate, and a strontium-potassium carbonate are used in the manufacture of the "red fire" used in pyrotechnics. The carbonate of strontium is used to some extent in making iridescent glass, and the hydrate in preparing beet sugar. Several salts of strontium are used in medicine, the more common being the acetate and arsenate and compounds of strontium with bromine and iodine.

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[1] Abstracted from manuscript of report by W. C. Phalen on Celestite deposits in California and Arizona, to be published in Bull. 540, U. S. Geol. Survey.

MINERAL PAINTS.

By JAMES M. HILL.

INTRODUCTION.

As heretofore, the mineral paints treated in this chapter are divided into three groups—(1) natural mineral pigments, (2) pigments made directly from ores, and (3) chemically manufactured pigments. Of these three classes the first two are included in the Survey's annual summary of the mineral production of the United States, as they represent values of crude material taken directly from the earth or material which at most has passed through simple or merely preliminary treatment. The chemically prepared pigments are not included in that statement of production because the quantity and value of the original minerals entering into their composition has, in most cases, been included elsewhere, so that the publication of the statistics of the manufactured products, including the value of the organic colors, would not only result in duplication of original quantities, but would give greater than proportionate values to the minerals concerned. Collection of the statistics of production of pigments belonging to groups 2 and 3 is undertaken chiefly for purposes of comparison, since the production of the ores and metals from which these pigments were derived is also reported elsewhere in Mineral Resources.

Group 1, or natural mineral paints, comprises ocher, umber, sienna, hematite, siderite, limonite, ground slate and shale, and whiting [1] (ground limestone and calcite). The principal bases of metallic paints and mortar colors are the three ores of iron—hematite, siderite, and limonite. Many other minerals or mineral products are used in the paint trade, such as asbestos and products derived from it, aluminum, asphalt, barytes, clay, graphite, gypsum, magnesite, pyrite, shells, silica, talc, and tripoli, and many by-products; but these are not considered here, since most of them are reported elsewhere in Mineral Resources, and for some of them statistics are not available.

Group 2, pigments made directly from ores, comprises zinc oxide, leaded zinc oxide, zinc-lead, sublimed white lead, and sublimed blue lead.

Group 3, or the chemically manufactured pigments, comprises the chemical products—basic carbonate white lead, litharge, red lead, orange mineral, lithopone, and venetian red.

The total quantity and value of pigments prepared during 1912 and considered in this report were greater than in 1911. There was an

[1] Statistics for whiting are not given in this report, as to do so would divulge confidential information.

increase in quantity and value of natural mineral paints, of chemically manufactured pigments, and of pigments made from ores. The total quantity of pigments of all these groups produced in 1912 shows an increase of 19 per cent over the total production of 1911, and the value shows an increase of about 14 per cent over the value of 1911.

Work has been continued on the paint tests conducted in various parts of the country. Certain of the results were presented at the meeting of the American Society for Testing Materials held at Atlantic City in June, 1912, and are contained in the proceedings of the society referred to in the bibliography at the end of this chapter. A brief summary of the results is included in this chapter under the heading "Paint tests." The work of the scientific section of the Paint Manufacturers' Association is being continued at the Institute of Industrial Research, in Washington, D. C., and the results of the inspection tests made in 1912 are now published as Bulletins 34, 35, and 36 of the Scientific Section, Paint Manufacturers' Association of the United States.

NATURAL MINERAL PAINTS.

PRODUCTION.

The production of the natural mineral pigments in the United States in 1912 as reported to the Survey amounted to 74,657 short tons, valued at $561,693. Compared with 1911 this was an increase of 11,918 short tons, or slightly less than 19 per cent; the increase in value was $62,872, or about 12.6 per cent. The increase in quantity was shared by all the natural pigments enumerated in the table below, except umber and sienna. The output of slate and shale in 1912 showed a gain of 4,454 short tons over that of 1911; ocher gained 3,566 short tons; metallic paint, 2,748 short tons; and mortar colors, 1,350 short tons. Two hundred short tons less of umber and sienna were produced in 1912 than in 1911. The table given below shows the prices per ton at the point of production of the different mineral paints. Advances are shown for ocher, umber, sienna, and declines are shown for metallic paint, mortar colors, and slate and shale.

Average price per short ton of natural mineral pigments, 1910–1912.

	1910	1911	1912
Ocher	$9.60	$9.35	$9.78
Umber and sienna	26.31	26.09	27.30
Metallic paint [a]	6.28	7.08	6.40
Mortar color	10.82	9.66	9.45
Slate and shale	5.81	6.39	5.79

[a] Includes crude iron ore sold for paint, which accounts in part for the low value per ton.

The following table gives the production and value of the natural pigments during the last four years:

Production of natural mineral pigments, 1909–1912, in short tons.

Pigment.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ocher	12,458	$125,349	11,711	$112,445	11,703	$109,465	15,269	$149,289
Umber, Sienna	1,276	33,472	1,015	26,700	1,005	26,225	805	21,975
Metallic paint	20,722	201,905	29,422	184,869	25,599	181,163	28,347	181,352
Mortar colors	10,820	108,126	9,960	107,780	7,922	76,517	9,272	87,595
Slate and shale, ground	14,944	98,176	16,515	96,001	16,510	105,451	20,964	121,482
Total	60,220	567,028	68,623	527,795	62,739	498,821	74,657	561,693

OCHER.

PRODUCTION.

The production of ocher in 1912 was 15,269 short tons, valued at $149,289, compared with 11,703 short tons, valued at $109,465, in 1911, an increase of 3,566 short tons in quantity and of $39,824 in value. The average price per ton in 1911 was $9.35, and in 1912 it was $9.78, an increase of 43 cents a ton.

The following table gives the production of ocher by States from 1909 to 1912, inclusive:

Production of ocher, 1909–1912, by States, in short tons.

State.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	(a)	(a)	118	$1,730	(a)	(a)	(a)	(a)
Georgia	5,838	$60,971	7,011	70,388	7,395	$69,447	10,107	$101,790
Pennsylvania	4,137	45,472	3,642	32,254	3,013	28,101	3,300	28,950
Vermont	492	4,726	609	5,935	(a)	(a)	531	6,346
Other States [b]	1,991	14,180	331	2,138	1,295	11,917	1,331	12,203
Total	12,458	125,349	11,711	112,445	11,703	109,465	15,269	149,289

[a] Included in "Other States."
[b] Includes, 1909: California, Iowa, and Virginia; 1910: Iowa, Kentucky, Oregon, and Tennessee: 1911: California, Iowa, Vermont, and Virginia; 1912: California, Iowa, and Virginia.

IMPORTS.

In the following table are given the imports of ocher for the last five years:

Imports of ocher, 1908–1912, in pounds.

Year.	Crude.		Dry.		Ground in oil or water.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	584,129	$4,954	8,663,537	$69,815	6,094	$307	9,253,760	$75,076
1909	340,593	3,501	13,337,310	106,224	17,847	939	13,695,750	110,664
1910	181,176	2,055	11,849,921	129,308	10,213	483	12,041,310	131,846
1911	128,328	1,870	11,090,798	108,205	15,406	857	11,234,532	110,932
1912	160,117	1,884	15,863,678	145,699	14,069	723	16,037,864	148,306

The imports of crude and dry ocher and that ground in oil or water amounted in all to 16,037,864 pounds, or approximately 8,019 short tons, in 1912. The imports of crude and dry ocher amounted to 8,012 tons, valued at $147,583, or a little more than half of the domestic production reported, which is supposed to be in these two forms. The value of the imported crude and dry ocher was less than that of the domestic output by $1,706.

NOTES ON OCHER.[1]

Ocher is a hydrated ferric oxide permeating a clay base. It has a specific gravity of about 3.5 and a decidedly golden-yellow color. Good grades should contain 20 per cent or more of iron oxide, though there is a wide variation in the iron content of the material sold as ocher. As viewed under the microscope and with a considerable enlargement the particles composing ocher appear flocculent and uniform.

Ocher is used as a coloring matter for tinted paints, and paints made with it as a base are often used for priming coats. It finds its most extensive use, however, as a filler in the manufacture of linoleum. Ferruginous shale is often ground and the product marketed as ocher, but unless the material is actually an ocher, as defined above, such product is classed under slate and shale in this chapter.

In 1912 ocher was produced in Georgia, Pennsylvania, Virginia, Vermont, California, and Iowa, the States being named in the order of their producing importance. The production of Georgia was about 66 per cent and of Pennsylvania about 22 per cent of the entire output of the country. Practically all of the output of Georgia is from mines located near Cartersville, Bartow County. The ocher produced in Pennsylvania came from mines located in Berks, Lehigh, and Northampton counties.

In the chapter on ochers [2] in a recent report on the mineral pigments of Pennsylvania, B. L. Miller says that ocher occurs at many places throughout the State, but has been worked mainly in the eastern part. The deposits are in the belts of limestone and are usually superficial, occupying irregular basins that vary greatly in diameter and depth, being usually found within 100 feet of the surface, but in one place a maximum depth of 257 feet is reached. They are usually in close association with the brown iron ores and occur in small pockets irregularly distributed throughout clays which vary from white to red, yellow, or black in color. Miller considers that the deposits represent replacements of the limestones by iron derived from iron sulphides, carbonates, and hydrous oxides contained in all of the rock formations of the country which were carried to their present locations by meteoric waters, and points out that many of the deposits occur along belts where the rocks have been much distributed.

The deposits are worked by open cuts where they lie within 10 or 15 feet of the surface, but below that depth by shafts. Elaborate

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[1] The commercial definitions of ocher, umber, and sienna in this chapter correspond to those published by the scientific section of the Paint Manufacturers' Association of the United States, Bull. 29, 1910. See also Paint technology and tests, by H. A. Gardner, 1911, p. 62.

[2] Miller, B. L., The mineral pigments of Pennsylvania, Rept. Top. and Geol. Survey Comm. Pennsylvania No. 4, 1911, pp. 11-43.

equipment is never used and very little timber, so most of the mines fill up in a short time after active mining ceases.

The ore as it is mined is mixed with clay, limonite nodules, and pieces of chert. The clay can not be separated from the ocher, but the hard particles are removed in log washers. The pulp from the washers is run through "settling troughs" where the sands are taken out, and is finally run into "settling ponds." The different grades of pulp are run into separate ponds, giving a rough separation of the various grades of ocher. When the ponds are filled the water is allowed to evaporate until the material can be shoveled into wheelbarrows, after which it is taken to drying sheds and dried either by steam or air; it is finally ground in burr mills and packed for shipment.

UMBER AND SIENNA.

PRODUCTION

The total quantity of umber and sienna produced in the United States in 1912 was 805 short tons, valued at $21,975, a decrease of 200 tons in quantity and of $4,250 in value, as compared with the production of 1911. The average price of umber and sienna per ton in 1912 was $27.30, as compared with $26.09 in 1911.

In the following table is given the production of umber and sienna in the United States from 1908 to 1912:

Production of umber and sienna, 1908–1912, in short tons.

Year.	Quantity.	Value.
1908	1,212	$30,705
1909	1,276	33,472
1910	1,015	26,700
1911	1,005	26,225
1912	805	21,975

IMPORTS.

In the following table are given the imports of umber and sienna for the last five years:

Imports for consumption of umber, 1908–1912, in pounds.

Year.	Dry.		Ground in oil or water.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	2,391,153	$19,461	15,556	$803	2,406,709	$20,264
1909	3,104,037	26,125	4,953	256	3,108,990	26,381
1910	3,994,286	28,819	11,813	734	4,006,099	29,553
1911	3,163,614	22,025	751	87	3,164,365	22,115
1912	4,867,706	31,408	3,179	218	4,860,885	31,626

Imports for consumption of sienna, 1908–1912, in pounds.

Year.	Dry.		Ground in oil or water.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	1,756,273	$28,407	7,621	$458	1,763,894	$28,865
1909	2,402,901	32,913	6,114	421	2,409,015	33,334
1910	3,048,203	46,866	6,233	453	3,054,436	47,319
1911	2,845,938	36,296	14,039	923	2,859,977	37,219
1912	3,056,064	45,354	6,021	440	3,062,085	45,794

The imports as given in the tables are expressed in pounds. Expressed in short tons the quantity of dry umber imported in 1912 amounted to a little less than 2,434 short tons, considerably more than the domestic production of umber and sienna combined. The imports of dry sienna, also expressed in short tons, were 1,528 tons, making the total for both products 3,962 short tons, or 3,157 tons in excess of the domestic output. The value of the imported dry ground umber and sienna in 1912 was $76,762, or more than three times as much as that of the domestic production reported for the year.

NOTES ON UMBER AND SIENNA.

Umber consists of iron and aluminum silicates, containing varying quantities of manganese oxide, which influence its color accordingly. The raw variety is drab, but becomes reddish brown on burning. A marked percentage of large-sized particles is present in this pigment. The calcined material is referred to as burnt umber. Umber is used principally as a pigment in the manufacture of tinted paints. The only State reporting a production of this pigment to the Survey in 1912 was Pennsylvania.

Sienna, like umber, is essentially composed of silicates of iron and aluminum containing manganese oxide. It contains less of the latter oxide than umber and is of a lighter color. Photomicrographs of burnt sienna show clearly the fine condition of the pigment, but large particles are present in the raw sienna. According to some authorities, sienna owes its color to hydrated ferric oxide, with small quantities of manganese oxide, and is an earthy pigment in its nature. This latter definition likewise applies to umber, but as stated above umber contains more manganese oxide than sienna. Sienna is used principally as a pigment. The only State which reported sienna in 1912 was Pennsylvania.

B. L. Miller [1] states that umber is mined at only three localities in Pennsylvania, namely, Quaker Hill, Northampton County; Doylestown, Bucks County; and Bethel, Berks County. This he considers as rather strange in view of the fact that most of the Pennsylvania ochers carry manganese oxide, though apparently in most of the deposits the quantity of this oxide is too small to give the material the necessary manganese content to be classed as an umber. The umbers are always closely associated with deposits of ocher, and the

[1] Miller, B. L., The mineral pigments of Pennsylvania, Rept. Top. and Geol. Survey Comm. Pennsylvania No. 4, 1911, pp. 44–45.

origin, method of mining, and preparation of the material for market are similar to those of the yellow pigment.

According to the same authority,[1] sienna is mined at two localities in Pennsylvania. The largest deposit is on the north slope of the Neversink Mountains, 1 mile east of Reading. The sienna occurs in a bed of "rotten quartzitic sandstone" and is remarkably free from impurities, carrying 69 per cent Fe_2O_3; 24 per cent SiO_2; 3 per cent Al_2O_3; the remaining 4 per cent represents water and undetermined oxides. The ore is a very irregular replacement of certain layers of the arkosic rock and in some places is as much as 5 feet thick.

PRODUCTION IN PRINCIPAL COUNTRIES.

The following table gives the output of ocher and umber in certain of the principal producing countries from 1907 to 1911, inclusive, as far as statistics are available:

Production of ocher and umber in principal producing countries, 1907–1911, in short tons.

Year.	United States.		United Kingdom.		France.		German Empire (Bavaria and Saxony).	
	Quantity.	Value.	Quantity.[a]	Value.	Quantity.[b]	Value.	Quantity.	Value.
1907	14,575	$157,711	16,455	$70,117	36,217	$423,830	1,679	$5,290
1908	15,266	152,319	17,244	69,012	36,442	457,072	1,938	7,443
1909	13,064	138,553	18,271	73,873	36,971	419,321	2,554	5,859
1910	12,211	123,145	18,497	74,832	36,232	428,238	3,038	6,404
1911	12,178	118,590	16,335	66,827	(c)	(c)	[d]3,077	9,974

Year.	Canada.		Belgium.		Spain.		Japan.		Cypress.	
	Quantity.[b]	Value.	Quantity.[b]	Value.	Quantity.[b]	Value.	Quantity.[b]	Value.	Quantity.[e]	Value.
1907	5,828	$35,569	220	$876	126	$282	331	$2,531	7,301	$20,279
1908	4,746	30,440	496	1,655	441	749	(c)	(c)	2,524	9,621
1909	3,940	28,093	771	1,351	461	813	(c)	(c)	3,781	20,011
1910	4,813	33,185	661	1,158	837	1,442	(c)	(c)	3,441	15,748
1911	3,622	28,333	595	965	686	1,200	(c)	(c)	(c)	(c)

a Includes oxides of iron and manganese used as pigments, lubricants, etc.
b Reported as ocher only.
c Figures not available.
d Production of Bavaria only, figures for Saxony not yet available.
e Umber exports.

METALLIC PAINT.

PRODUCTION.

The production of metallic paint reported to the Survey in 1912 was 28,347 short tons, valued at $181,352, as compared with 25,599 tons, valued at $181,163, in 1911. As stated in this report for 1910, the effort is being made to put the production as nearly as possible on the basis of the material entering into metallic paint and to credit it to the individual State in which it was originally mined and from which it was placed on the market. The production of metallic paints is reported from some States mainly in terms of the dry ground

[1] Op. cit. pp. 46-47.

product, the average price per ton of which is considerably greater than that produced in the same States as ore and sold as such to the paint mills. The maximum price, that of ground paint in the State of Washington, was $12.23 a ton. The average price per ton, as given on a preceding page, was $6.40, which shows that a large part of the production averages considerably below the latter figure, such portion being material that comes on the market originally in the form of unground iron ore. The price of the crude ore sold in that condition apparently varies between $2.39 and $4.73 a ton. The higher average value for metallic paint is probably to be explained by the fact that large producers operate their own mines, and the product is therefore not marketed in the crude state but is sent directly to the mills and is finally sold as dry ground paint, which naturally commands a higher price than the crude ore.

The following table gives the production of metallic paint from 1909 to 1912, inclusive:

Production of metallic paint, 1909–1912, by States, in short tons.

State.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Maryland	431	$1,957	(a)	(a)	(a)	(a)	562	$1,930
New York	2,553	25,533	[b] 11,085	$32,208	[b] 7,993	$28,569	[b] 10,951	29,547
Pennsylvania	[c] 8,120	105,683	8,063	91,714	7,676	100,837	8,970	107,499
Tennessee	4,075	33,369	[a] 3,907	26,680	[a] 3,282	25,381	(d)	(d)
Wisconsin	(d)	(d)	[b] 2,057	14,916	[b] 2,048	11,258	[b] 2,106	9,953
Other States [e]	5,543	35,363	4,310	19,351	4,600	15,118	5,758	32,423
Total	20,722	201,905	29,422	184,869	25,599	181,163	28,347	181,352

[a] Maryland is included with Tennessee.
[b] Principally crude iron ore sold for paint.
[c] Includes a small quantity of Venetian red.
[d] Included in "Other States."
[e] "Other States" includes in 1909: California, Michigan, Ohio, Vermont, Washington, and Wisconsin; 1910: California, Georgia, Michigan, Missouri, Washington; 1911: Georgia, Michigan, Missouri, Virginia, and Washington; 1912: Michigan, Missouri, Tennessee, Virginia, and Washington.

NOTES ON METALLIC PAINT.

Metallic paint consists chiefly of red and brown iron oxides, produced either by grinding natural iron oxides, anhydrous or hydrated, or by roasting natural iron carbonate. The beds of Clinton hematite in New York, Tennessee, and Georgia, the red hematite of the Lake Superior region in northern Michigan, and the gray siderite near Lehigh Gap, Pa., are the chief sources of the raw-ore supply. Some red iron oxide is also imported. Several other materials are also used to an important extent in the manufacture of metallic paint. Blast-furnace dust, a grayish-brown dust composed of oxide of iron and coke that is separated at many furnaces, particularly in the Pittsburgh, Pa., district, yields on grinding a seal-brown powder. In the manufacture of sulphuric acid from pyrite, large quantities of "blue billy," a purplish oxide of iron is produced, and this is ground to form a paint base. It has been claimed, however, that pigments from this material, unless carefully prepared, are unsatisfactory for structural-iron pigments, as they may contain free sulphur or sulphuric acid, which rapidly corrode metals. In 1912 there were 1,193 short tons of metallic paint powdered from pyrite cinder, which sold for $19,655, or at $16.48 a ton. Ocherous silt, deposited by water flowing from coal mines, has been roasted to a bright-red color and ground for paint material. Material of this description probably carries ferrous sulphate as well as hydrated ferric oxide. Another by-product that has been utilized as a metallic paint is the residue left after extracting aluminum salts from bauxite. This residue, judged by its appearance, is a ferruginous clay, and a sample obtained from southern bauxite showed, when analyzed in the Survey laboratory, 54.25 per cent ferric oxide (Fe_2O_3). When roasted in a rotary kiln the product was a brick-red granular material, which was subsequently ground to powder. The material is apt to retain appreciable quantities of soluble aluminum salts, which can hardly be considered as desirable ingredients in paints, and small quantities of manganese oxide are also liable to be present. Ferrous sulphate, or copperas, is roasted and sold as metallic paint. Differences in the conditions surrounding the roasting of copperas produce different shades of iron oxide, classified as Indian red, purple oxide, etc.

The metallic paints as considered here contain, therefore, both browns and reds. Commercially the browns are known as metallic brown and certain of the reds as Indian red. All the by-product substances can not strictly be classed in group 1, but, as a rule, the production of these materials is not reported to the Survey. Metallic paints, both natural and artificial, if of good grade, are practically inert to the ordinary atmospheric agencies. They are extensively used for painting structural ironwork and by railroads for box car colors.

MORTAR COLORS.

PRODUCTION.

The production of mortar colors reported to the Survey in 1912 was 9,272 short tons, valued at $87,595, an increase of 1,350 tons in quantity and of $11,078 in value as compared with 1911. The average price per ton was $9.45 in 1912, as compared with $9.66 in 1911. The material entered the market first in the dry ground condition, for which the prices are given.

In the following table is given the production of mortar colors from 1909 to 1912, inclusive:

Production of mortar colors, 1909–1912, by States, in short tons.

State.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	5,691	$53,539	5,200	$50,000	2,518	$24,723	3,309	$29,969
Pennsylvania	2,662	31,416	2,711	33,752	3,248	30,442	2,550	24,857
Other States[a]	2,467	23,171	2,049	24,028	2,156	21,352	3,413	32,769
Total	10,820	108,126	9,960	107,780	7,922	76,517	9,272	87,595

[a] Includes—1909 and 1910: Maryland, Ohio, and Tennessee; 1911 and 1912: Maryland and Tennessee.

NOTES ON MORTAR COLORS.

A wide variety of materials is used in making mortar colors, and as marketed the colors are for the most part mixtures. Chief among the substances entering into mortar colors are iron oxide, "blue billy," or the residue from burning pyrite, considerable ground slate or shale, and some culm from coal washeries. The material is used for tinting mortar, cement, and concrete, and the colors are usually of the various shades of red, brown, purple, blue, and black.

SLATE AND SHALE.

PRODUCTION.

The quantity of slate and shale ground for paints and for fillers in 1912 was 20,964 short tons, valued at $121,482, an increase of 4,454 tons in quantity and of $16,031 in value over the output of 1911. The average price per ton of the material in 1911 was $6.39, but in 1912 the average price was only $5.79 a ton, a decline of 60 cents a ton.

The following table gives the production of slate and shale ground for pigment during the last five years:

Quantity and value of slate and shale, ground for pigment, 1909–1912.

1909	short tons	14,944	$98,176
1910	do	16,515	96,001
1911	short tons	16,510	$105,451
1912	do	20,964	121,482

NOTES ON SLATE AND SHALE.

Slate and shale for use in pigments and as fillers in the manufacture of oilcloth and linoleum were produced in 1912 in Pennsylvania, New York, New Jersey, Indiana, California, and Georgia—named in the order of their production.

Pennsylvania in 1912 produced over 84 per cent of the paint slate and shale output of the United States. In his report on the mineral pigments of Pennsylvania, Miller[1] divides the shales studied, which are used in the paint trade, into three classes, black, yellow, and red shales.

Black shales.—Black shales, ground, and sold under the name "mineral black," are extensively used in the manufacture of paint in many places in Pennsylvania. * * * They are widely distributed throughout the State, occurring in a great many formations representing every Paleozoic period. In many places the material has been dug for use in paint, and in some of the slate regions the refuse about the quarries has been shipped to paint factories. A small use has been made of the culm heaps about the anthracite coal mines and the disintegrated surface coal near the outcrop. There is a tendency for most of the black-shale material to settle out of the oil, but this is not a serious objection. The durability of the paint in which black shales have been used is vouched for by many persons who have tried it. Black shale is used to some extent in paint for buildings, but chiefly in the manufacture of a black filler for ironwork.

Yellow shales.—Yellow shales occur in many places throughout the State and at several geologic horizons, but particularly in the Martinsburg and Mauch Chunk shales. In a number of places these shales have been utilized in the manufacture of paint, and when ground fine and mixed with oil they are very serviceable. Their principal use, however, is in the manufacture of oilcloth and linoleum. They are considerably lighter in color than the ochers and contain a much lower percentage of

[1] Op. cit., pp. 64–86.

hydrous iron oxide, as a rule not more than 5 per cent. Yellow shales that are worked for paint are usually called ochers, but such usage is plainly not justified.

Red shales.—Red shales have been employed in the manufacture of paint in many places in the State, but at present operations are being carried on in only three localities. The operations are not limited, however, by the distribution and amount of the shales but by the market for the product. Red shales occur in many of the geologic formations, but are especially well represented in the Martinsburg ("Hudson River"), Catskill, and Mauch Chunk of the Paleozoic era and the Brunswick shale of the Triassic.

The red coloring matter of these shales consist of ferric oxide, which forms a coating about the individual grains and was no doubt present when the shales were deposited. In some places the iron content has been changed somewhat since deposition by the precipitation of more iron oxide; in other places there has been subsequent leaching by which some of the iron has been removed. However, as shales are relatively impervious to water, they are less apt to undergo subsequent changes in composition than more pervious rocks.

DISTILLED SHALE.

A small quantity of carbonaceous shale is usually distilled in the United States each year. The resulting materials are a black residue and a dark oil, both used in the manufacture of paint. During 1912 the companies usually engaged in this work reported no production.

WHITING.

Whiting was produced in two States in 1911, Kentucky and Missouri. As only two companies reported to the Survey the statistics of production can not be given.

Whiting (calcium carbonate, $CaCO_3$) is prepared by grinding various forms of soft and hard white limestone and calcite, the forms occurring in nature. The natural form has a higher specific gravity (2.74) than the form prepared artificially by precipitation (2.5), which is much finer and more evenly grained. Whiting is used largely in the manufacture of putty, in distemper work, and in small quantities in ready-mixed paints.

In a personal letter a deposit of calc spar (calcite), from which whiting is made, is described as occurring on the south side of Kentucky River about 8 miles from the town of Harrodsburg, Ky. The deposit appears to be in the form of a vein varying from 3 to 9 feet in width; where now worked it is 6 feet wide. The walls are of limestone. The four analyses of the material furnished to the Survey show it to average 97.79 per cent calcium carbonate and 1.70 magnesium carbonate, with small quantities of moisture, silica, alumina, and iron oxide. The product is transported on barges to Highbridge or Madison, Ind., for shipment and is sold chiefly to paint manufacturers.

PIGMENTS MADE DIRECTLY FROM ORES.

PIGMENTS AND ORES.

The pigments here discussed are zinc oxide, leaded zinc oxide, zinc lead, sublimed white lead or "basic lead sulphate," and sublimed blue lead or "blue fume."

The three white pigments having zinc for a base, either wholly or in part, are zinc oxide, zinc-lead oxide, of which there was none produced in 1912, and leaded zinc oxide. In the United States these pigments are usually made directly from ore. In addition to the two first named, which are made more particularly from what are regarded essentially as zinc ores, and the last mentioned, produced from mixed lead and zinc ores, there are two lead pigments produced directly from ore—sublimed white lead or "basic lead sulphate" and sublimed blue lead or "blue fume." The ores used in making these pigments are the franklinite ores of New Jersey in the eastern part of the United States and the zinc and lead ores of the Mississippi Valley and of certain of the Western States.

In the upper Mississippi Valley lead and zinc region the zinc carbonate ore, smithsonite, locally known as "drybone," has been used almost altogether for pigment manufacture by the Mineral Point Zinc Co., but the sulphide ores of lead and zinc have also been used. In the Joplin region of Missouri, Kansas, and Oklahoma the mixed silicate and carbonate ores of zinc have been used for zinc pigment manufacture, and galena has been used for the lead pigments. Zinc carbonate ore from New Mexico and southern Nevada and mixed sulphide ores of lead and zinc from these and various other Western States have been extensively used in making zinc and zinc-lead pigments. Zinc carbonate ores imported from Mexico have also been used in the manufacture of zinc pigments. During 1912 zinc oxide and leaded zinc made directly from ores were reported from Pennsylvania, Wisconsin, Virginia, and Kansas, and lead pigments were made by sublimation in Illinois and Missouri.

PRODUCTION.

In order to conceal individual returns, the statistics of production of zinc oxide, leaded zinc, sublimed white lead or "basic lead sulphate," and sublimed blue lead or "blue fume" have to be combined for 1912. The total quantity of material produced amounted to 106,497 short tons, valued at $9,507,895. As compared with the production of 1911 this was an increase of 25,886 tons, or 32 per cent, in quantity and of $2,164,133, or nearly 30 per cent, in value.

The following table gives the production and value of pigments made directly from ores during the last four years:

Production of pigments made directly from ores, 1909–1912, in short tons.

Pigment.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Sublimed blue lead ("blue fume")	981	$101,043						
Sublimed white lead ("basic lead sulphate")	9,915	1,070,820	16,681	$1,613,859	80,611	$7,343,762	106,497	$9,507,895
Leaded zinc oxide	a 7,655	634,714						
Zinc oxide	68,974	6,156,755	58,481	5,238,945				
Total	87,525	7,963 332	75,162	6,852,804	80,611	7,343,762	106,497	9,507,895

a Includes zinc-lead.

IMPORTS OF ZINC OXIDE.

The following table gives the imports of zinc oxide into the United States during the last five years:

Imports for consumption of zinc oxide, 1908–1912, in pounds.

Year.	Dry.		In oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	4,635,101	$262,876	210,166	$16,798	4,845,267	$279,674
1909	6,119,328	342,999	535,024	54,085	6,654,352	397,084
1910	6,137,362	365,701	393,248	30,874	6,530,610	396,573
1911	5,012,308	316,972	548,708	40,494	5,561,016	357,466
1912	5,350,515	342,985	524,542	43,168	5,875,057	386,153

ZINC OXIDE.

Zinc oxide is the most important of the zinc pigments. It is represented by the symbol ZnO and is a white powder consisting, when chemically pure, of 80.34 per cent zinc and 19.66 per cent oxygen. On account of its stability, whiteness, opaque nature, and slight tendency to chalk, it is invaluable as a pigment for use as a constituent in a combination formula. Its extreme hardness renders it less resistant to temperature changes when used alone. Zinc oxide resolves itself to a clear solution in all mineral acids. When examined under the microscope, the fineness and structure of the particles composing this pigment are clearly evident. Zinc oxide is manufactured by two processes, one known as the American and the other as the French process. In the American process the prepared zinc ores are mixed with finely powdered hard coal and burned in closed furnaces over grates. The zinc is reduced to the metallic condition, volatilized, and burned. The product, zinc oxide, is collected in cloth bags. When made in this manner the product may contain a very small quantity of lead sulphate, zinc sulphate, some iron oxide, and other impurities, provided they existed in the ores. In the French process the metallic zinc is volatilized and burned in a current of air and the zinc oxide produced is collected in closed chambers. It may be further purified to improve its color.

The ores from which zinc oxide is made are the franklinite ore of New Jersey, the sulphide (sphalerite) ores of the Mississippi Valley, and the sulphide, carbonate, and silicate ores of Colorado and New Mexico. The plants which produced zinc oxide in 1912 were the New Jersey Zinc Co., of Pennsylvania, with plants located at Palmerton, South Bethlehem, and Freemansburg, Pa.; the Mineral Point Zinc Co., located at Mineral Point, Wis.; the Ozark Smelting & Mining Co., located at Coffeyville, Kans.; and the Bertha Mineral Co., located at Austinville, Va.

ZINC-LEAD AND LEADED ZINC OXIDE.

Zinc-lead is an extremely fine white pigment consisting of about equal parts of zinc oxide and lead sulphate. It is prepared from mixed lead and zinc ores and may contain as impurities small quantities of lead oxide, lead carbonate, and zinc sulphate. The present standard requires that zinc sulphate be present in quantities less than 1 per cent.[1] The pigment has a specific gravity of 4.4.

None of this pigment was produced in the United States during 1912, according to reports received by the Survey.

Leaded zinc oxides are pigments that resemble zinc-lead, but contain less lead sulphate. They are made with definite percentages of lead sulphate, usually ranging from 6 to 20 per cent, according to the purpose for which they are to be used. These oxides are produced from western ores that carry a certain proportion of lead sulphide. In fineness they are similar to zinc oxide, and in whiteness they stand between zinc oxide and zinc-lead. Leaded zinc pigment is manufactured at the Coffeyville plant of the Ozark Smelting & Mining Co., and by the Mineral Point Zinc Co., Mineral Point, Wis.

SUBLIMED WHITE LEAD AND SUBLIMED BLUE LEAD.

Sublimed white lead or "basic lead sulphate" is made directly from the lead sulphide ore, galena. It is manufactured from ore produced in the Joplin, Mo., district or from any other soft (nonargentiferous) lead ore. Briefly summarized, the method of manufacture is as follows: Cleaned lead ore (galena) is ground to a powder and charged with carbon into a furnace over an open coke fire. The charge is volatilized, and in the presence of air the lead sulphide is oxidized to a basic lead sulphate, while some free sulphur dioxide is formed. The basic lead sulphate is thought to be composed of two molecules of lead sulphate ($PbSO_4$) linked to one of lead oxide (PbO). This product, volatile while hot, is cooled by being drawn by suction through a long series of cooling pipes, or goosenecks, and some settling chambers, and then is collected in bags similar to those used for collecting zinc oxide. This material finds use not only in mixed paints, but in putty and in the manufacture of rubber. The pigment contains approximately 75 per cent of lead sulphate, 20 per cent of lead oxide, and 5 per cent of zinc oxide. Notable properties of this pigment are its great fineness, the uniform size of its particles, and its relative chemical stability or inertness in the presence of coal gas, sulphur fumes, and other noxious gases that quickly darken some paints. It has a snow-white color and is very opaque, but since it is so extremely fine and of amorphous texture it requires blending with coarser pigments to give it "tooth"—that is, to prevent it from brushing out too thin.

In the sublimation of galena a peculiar bluish-gray compound of lead is formed as a by-product, which is known commercially as sublimed blue lead or "blue fume." Analyses have shown the presence in it of about 2 per cent carbon, 4.5 to 5 per cent lead sulphide, 1 to 2.5 per cent zinc oxide, 0.36 to 1.44 per cent lead sulphite, 50 to 53 per cent lead sulphate, and 37.5 to 41.3 per cent lead oxide. It is used in the same industries as the white lead produced by sublimation.

Two firms manufacture these products in the United States. The Picher Lead Co., of Joplin, Mo., were for years the sole producers and registered the trade-mark "sublimed white lead." The St. Louis Smelting & Refining Co., whose plant is located at Collinsville, Ill., produces a similar pigment sold under the name "basic lead sulphate."

[1] Hall, C. H., The chemistry of paints and paint vehicles, 1906, p. 35.

CHEMICALLY MANUFACTURED PIGMENTS.

PRODUCTION.

The chemically manufactured pigments treated in this report include basic carbonate white lead, both dry and in oil, red lead, litharge, and orange mineral among the lead pigments, and lithopone and Venetian red. The last two pigments contain no lead, but are chemically precipitated pigments, the process of whose manufacture will be given later.

The production of chemically manufactured pigments in 1912 amounted to 228,135 short tons, valued at $26,356,232. This is an increase over the production in 1911 of 27,388 tons in quantity and of $2,375,988 in value.

The following table shows the production and value of chemically prepared pigments during the last four years:

Production of chemically manufactured pigments, 1909–1912, in short tons.

Pigment.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Basic carbonate white lead:								
In oil	115,259	$14,736,360	111,573	$15,027,993	106,778	$14,699,339	120,591	$16,041,100
Dry	32,840	3,468,722	32,237	3,378,622	25,834	2,693,902	26,242	2,642,361
Red lead	[a]19,103	2,335,799	[a]19,801	2,448,684	[a]19,540	2,345,320	[a]21,120	2,571,702
Litharge	20,690	2,363,002	23,742	2,686,159	25,190	2,773,196	29,111	3,194,194
Orange mineral	[b]590	98,723	[b]676	111,773	[b]766	119,370	[b]545	88,245
Lithopone	14,847	1,105,281	12,655	916,512	16,866	1,243,108	24,220	1,702,119
Venetian red	8,358	145,733	6,312	113,980	5,773	106,009	6,306	116,511
Total	211,687	24,253,620	206,996	24,683,723	200,747	23,980,244	228,135	26,356,232

[a] Includes a small quantity of orange mineral. [b] Some orange mineral included with red lead.

IMPORTS.

The following table gives the quantity and value of the imports of corroded white lead, red lead, litharge, orange mineral, lithopone, and Venetian red from 1908 to 1912, inclusive.

The total value of the imports of the chemically manufactured pigments in 1912 was $296,031.

Basic carbonate white lead, red lead, litharge, orange mineral, lithopone, and Venetian red imported, 1908–1912, in pounds.

Year.	Corroded white lead.		Red lead.		Litharge.		Orange mineral.		Lithopone.		Venetian red.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	540,311	$30,452	645,073	$28,155	96,184	$3,327	485,407	$26,645	1,048,109	$39,733	3,113,858	$25,745
1909	694,599	39,963	760,179	30,428	90,655	3,740	496,231	27,562	1,303,316	44,873	3,999,560	28,864
1910	686,052	38,917	822,289	32,750	48,693	2,252	600,461	32,199	3,726,135	99,954	2,490,138	21,591
1911	741,071	46,213	1,063,533	42,471	24,662	1,196	504,734	28,515	6,355,212	166,199	2,194,823	20,169
1912	687,705	46,494	757,908	50,854	32,443	1,550	334,551	20,914	5,904,475	153,303	2,828,627	22,916

BASIC CARBONATE WHITE LEAD.

Basic carbonate of lead has a specific gravity of 6.8 and contains about 85 per cent lead oxide and 15 per cent of carbon dioxide and water. Variously sized particles, both large and small, resulting from the corrosion process are present. Its opaque nature and excellent body render white lead extremely valuable as a pigment. Its life and wearing properties are considered by many paint manufacturers to be increased when mixed with zinc oxide and other pigments. Checking and chalking progress rapidly when the pigment is used alone.

The production of basic carbonate (corroded) white lead in 1912, as reported to the Survey, was 146,833 short tons, valued at $18,683,100. Of this total, 120,591 short tons, valued at $16,041,461, were reported sold in oil, and 26,242 short tons, valued at $2,642,361, were reported sold dry. The sales for 1912 represented a net increase over those for 1911 of 14,221 short tons in quantity and of $1,290,220 in value.

The average price per ton of basic carbonate white lead ground in oil was $133.02 in 1912, as compared with $137.66 in 1911, a decrease of $4.64 per ton; and the average price per ton of dry white lead was $100.69 in 1912, as compared with $104.28 in 1911, a decrease of $3.59 per ton.

This pigment is manufactured by four firms in Pennsylvania, by three firms in Illinois, by two in New York, and by one firm in each of the following States: California, Michigan, Missouri, Nebraska, New Jersey, and Ohio. The two New York plants produce more than all of the remaining manufacturers of basic carbonate white lead.

METHODS OF MAKING BASIC CARBONATE WHITE LEAD.

Dutch process.—This pigment[1] is made by stacking clay pots which contain dilute acetic acid and lead buckles in tiers and covering them with tanbark. Fermentation of the tanbark with subsequent formation of carbon dioxide acting on the acetate of lead formed within the pots produces basic carbonate of lead. After complete corrosion, the white lead is ground, floated, and dried.

Quick process.—The quick-process white lead is produced by the action on atomized metallic lead, contained within large revolving wooden cylinders, of dilute acetic acid and carbon dioxide.

Mild process.—Briefly, the mild process of manufacturing white lead consists of first melting the pig lead and converting it into the finest kind of lead powder, then mixing thoroughly with air and water. The lead takes up oxygen from the air and water, thus forming a basic hydroxide of lead. Carbon dioxide gas is next pumped slowly through cylinders which contain the basic hydroxide of lead. The result is basic carbonate of lead—the dry white lead of commerce.

The process is called "mild" because it is the mildest process possible for the manufacture of white lead. The method does not require the use of acids, alkalies, or other chemicals, every trace of which should be removed from the finished product by expensive purifying processes.

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[1] Bull. Sci. Sec. Paint Mfrs. Assoc. U. S. No. 29, 1910, pp. 5–6.

RED LEAD.

The production of red lead in 1912 was 21,120 short tons, valued at $2,571,702, an increase of 1,580 short tons in quantity and of $226,382 in value over the output of 1911. The average price per ton increased from $120.03 in 1911 to $121.77 in 1912, an increase of $1.74.

By the continued oxidation of litharge [1] in reverberatory furnaces, red lead is produced as a brilliant red pigment. It has found wide application as an inhibitive pigment for the protection of iron and steel. In many cases the admixture of red lead with other pigments is of great value. The pigment particles appear to be of many sizes, showing a slight tendency to form a compact mass. Red lead is produced at 4 plants in Pennsylvania, at 2 plants each in Missouri and New York, and at 1 plant each in California, Massachusetts, Michigan, New Jersey, and Ohio.

LITHARGE.

The production of litharge in 1912 as reported to the Survey was 29,111 short tons, valued at $3,194,194, as compared with 25,190 short tons, valued at $2,773,196, in 1911, an increase in quantity of 3,921 tons and in value of $420,998. The average price per ton was $110.09 in 1911, but this decreased to $109.72 per ton in 1912.

Litharge, or lead monoxide, is made directly by rapid oxidation of pig lead or by the oxidation of molten lead, or indirectly in the metallurgy of silver, and also from acetate of lead. Litharge is a buff-colored powder. It is used in paints, in glazes, in storage batteries, and for assaying. It is produced in New York, Missouri, Pennsylvania, Massachusetts, New Jersey, Michigan, Ohio, and California, named in the order of their producing importance.

ORANGE MINERAL.

The production of orange mineral as reported to the Survey was 545 short tons, valued at $88,245 in 1912, as compared with 766 short tons, valued at $119,370, in 1911. The apparent average price per ton was $161.92 in 1912, as compared with $155.84 in 1911.

Orange mineral is a form of red lead and is one of the higher oxides of lead. It is prepared by calcining a more or less basic carbonate of lead. It is valued according to the depth and color of its bright orange shade.

LITHOPONE.

The production of lithopone in 1912 was reported as 24,220 short tons, valued at $1,702,119, as compared with 16,866 short tons, valued at $1,243,108, in 1911, an increase in quantity of 7,354 tons and in value of $459,011. The apparent price per ton in 1912 was $72.28, as compared with $73.70 in 1911.

Lithopone,[2] a very white pigment, is precipitated by the double decomposition of zinc sulphate and barium sulphide, thereby forming an intimate mixture of zinc sulphide and barium sulphate. It

[1] Bull. Sci. Sec. Paint Mfrs. Assoc. U. S. No. 29, 1910, p. 24.
[2] Idem, p. 10.

contains approximately 70 per cent barium sulphate, 25 to 28 per cent zinc sulphide, and as high as 5 per cent of zinc oxide and has a specific gravity of about 4.25. It has a characteristic flocculent, noncrystalline appearance when examined under the microscope. The peculiar property which it possesses, of darkening under the actinic rays of the sun, makes it essential that it be combined with other more stable pigments to prolong its life when exposed to weather. One company in the United States is marketing a lithopone which it guarantees to be absolutely sun-proof. It is excellently suited for interior use in the manufacture of enamels and wall finishes.

VENETIAN RED

The production of Venetian red in 1912, as reported to the Survey, was 6,306 short tons, valued at $116,511, compared with 5,773 short tons, valued at $106,009, in 1911, an increase in quantity of 533 tons and in value of $10,502. The apparent average price per ton was $18.48 in 1912, as compared with $18.36 in 1911.

Venetian red is made in different ways, such as by grinding red iron oxide with gypsum, or by roasting ferrous sulphate with lime and grinding the residue—in either case the red is a mixture of iron oxide and calcium sulphate—or by grinding red iron oxide with calcium carbonate, or by calcining pyrite and ferrous sulphate with terra alba, and in sundry other ways.

PAINT TESTS.

In this report in previous years brief notices and descriptions have been given of the paint tests of the scientific section of the Paint Manufacturers' Association of the United States, of the work of the Institute of Industrial Research, and of the publications regarding the tests in the Proceedings of the American Society for Testing Materials. The most recent publication on the result of these tests known to the writer is contained in volume 13 of the proceedings of the society just referred to and in Bulletins 34, 35, and 36 of the scientific section of the Paint Manufacturers' Association of the United States, which are cited in the bibliography at the end of this chapter.

The American Society for Testing Materials did not discuss the subject of paint materials at its meeting at Atlantic City the last week in June, 1912. At the meeting of the society held June 24–28, 1913, at the same place, several important reports were presented which are summarized below, being the reports of Committee D–1 on preservative coatings for structural materials for the years 1911 and 1912.

Subcommittee B reported on the condition of the Pennsylvania Railroad bridge located at Havre de Grace, Md. The 19 paints were examined for the same points as in previous years.

> Three paints (Nos. 6, 10, and 11) in Class I may well be designated as excellent.
>
> Three paints (Nos. 12, 14, and 18) in Class I and six (Nos. 1, 3, 5, 8, 16, and 17) in Class II show generally effective protection in the bridge structure.

Subcommittee C on paint vehicles submitted a report on an exhaustive study of the tests for soya-bean and tung oils.

Soya-bean oil.—The following tests were made upon various commercial grades of soya-bean oil by different observers:

(1) *Analytical constants.*—(*a*) Specific gravity at $\frac{15.5°}{15.5°}$ C.; (*b*) saponification number; (*c*) iodine number (Hanus); (*d*) acid number.

(2) *Heat tests.*—Heat 2 ounces of the oil at 450° F. in a glass receptacle until bleaching is noticed. Then blow a slow current of air through the oil until the specific gravity has increased to 0.950. This may require a period of seven hours. The blowing should be conducted at a temperature between 300° and 370° F. The oil should become light and should dry fairly rapidly.

(3) *Drying test.*—Place on a table a white sheet of paper 10 centimeters square (100 square centimeters in area). Upon this piece of paper place a weighted and marked piece of ordinary clean window glass about 15 centimeters square. On the white area outlined on the paper below the glass drop about 10 drops of the oil to be tested (approximately 200 milligrams). Brush out the oil with a clean camel's-hair brush so that it will cover the white area. Reweigh the glass to determine the amount of oil thereon. The plate may then be lifted by the edge which is uncoated and placed in a convenient place for drying. The number of hours required for the oil to dry to a firm film should be noted. The change in weight should be determined by reweighing the piece at the end of the third day.

The results of these tests of the committee's report showed that the analytical constants of soya-bean oil are fairly uniform and that the oils "have a fairly well-defined chemical constitution." The heat tests, they say, "did not in any case seem to increase the drying value of the oils." Most of the oils bleach under heat, but those that do not bleach are not, however, to be considered unsuitable paint oils.

The drying tests on soya-bean oils did not give entirely satisfactory results, but seemed to show that such oil is not well adapted to use as a paint oil, unless treated with a drier.

Tung oil.—Various commercial grades of tung oil were submitted to the following tests:

(1) *Analytical constants to be determined.*—(*a*) Specific gravity at $\frac{15.5°}{15.5°}$ C.; (*b*) saponification number; (*c*) iodine number (Hubb, 18 hours); (*d*) acid number.

(2) *Heat test.*—Heat 2 ounces of the oil at 420° F. for 20 minutes in a glass beaker of 150 cubic centimeters capacity. The oil should polymerize. Raise the temperature to 520° F. and hold 10 minutes. The oil should be converted into a spongy, semisolid mass. Cut the mass with a knife to see whether it will cut clean without adhering to the knife.

The tests of tung oils, the committee reports, showed that these oils have "definite constants of slight variations" and that the variations in constants "are of value in determining the purity of the oil." The heat test they consider, however, to be "a most valuable asset in determining the purity" of tung oil. At a temperature of 540° instead of 520° used in these tests, however, "much better results are obtained."

Subcommittee C reported on specifications for turpentine, including color, specific gravity, boiling point, distillation test, polymerization, evaporation test. No recommendation for final specifications is to be made, however, until the tests on commercial turpentines have been made by the subcommittee.

Subcommittee D reported on the condition of the Atlantic City steel paint tests, examined on April 1, 1912, and April 16, 1913.

Subcommittee E reported on linseed oil, showing that the constants of that oil crushed from South American seed do not agree with North American oils, while oils from Calcutta and Bombay, India, agree closely with the specifications of North American oils, except that the iodine number is lower. They give "proposed standard specifications for the purity of raw linseed oil from North American seed," which should conform to the following requirements:

Standard specifications for purity of raw linseed oil.

	Maximum.	*Minimum.*
Specific gravity at $\frac{15.5°}{15.5°}$ C	0.936	0.932
Specific gravity at $\frac{25°}{25°}$ C	.931	.927
Acid number	6	
Saponification number	192	189
Unsaponifiable matter, per cent	1.50	
Refractive index at 25° C	1.4805	1.4790
Iodine number (Hanus)		178

Subcommittee F added to its list of definitions of terms used in paint specifications.

Subcommittee J, on the testing of white paints, gave a report on 13 white pigments exposed on the new test fence erected at the experimental farm of the United States Department of Agriculture at Arlington, Va., as outlined in the report on Mineral Resources of the United States, 1911, p. 20. The pigments used were:

Pigments used on test fence at Arlington, Va., 1912.

		Trade name.
1.	Basic lead carbonate	Dutch process white lead.
2.	Basic lead carbonate	Carter white lead.
3.	Basic lead carbonate	Mild process white lead.
4.	Zinc oxide	Florence Green seal, French process.
5.	Zinc oxide	X X American process.
6.	Basic lead sulphate	Sublimed white lead.
7.	Leaded zinc oxide	Leaded oxide of zinc.
8.	Siliceous material	Silica.
9.	Silicate	Asbestine.
10.	Clay	L. G. V. China clay.
11.	Calcium carbonate	Extra gilder's whiting, bolted.
12.	Calcium sulphate	Calcium sulphate.
13.	Barium sulphate	Cream-floated lead bloom. (Water-floated barytes.)

Complete analyses of these pigments made by the Bureau of Standards, Department of Commerce, and by the Bureau of Chemistry, Department of Agriculture, are quoted in full, and photomicrographs of the pigments are shown. Paints made of each of the 13 pigments alone and 34 paints made of a combination of two or more of the above pigments have been painted on the yellow poplar panels. These paints were mixed under the direction of Prof. Allen Rogers, of Pratt Institute, Brooklyn, N. Y.

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ASBESTOS.

By J. S. Diller.

PRODUCTION.

The domestic production of asbestos in 1912, although somewhat greater than that of 1910, was less than the output of 1911. The total production in 1912 was 4,403 short tons, valued at $87,959, a decline of 42 per cent in quantity, but of only 27 per cent in value, owing to the larger proportion of higher grades produced in 1912 as compared with the output in 1911.

There were three producing States—Georgia, Vermont, and Wyoming. Georgia produced asbestos of the amphibole variety (anthophyllite) and Vermont and Wyoming asbestos of the serpentine variety (chrysotile). Vermont ranked first in quantity produced and Georgia second.

The following table shows the quantity and value of asbestos produced in the United States annually since 1890:

Annual production of asbestos in the United States, 1890–1912.

Year.	Production.			Year.	Production.		
	Quantity (short tons).	Value.	Average price per ton.		Quantity (short tons).	Value.	Average price per ton.
1890	71	$4,560	$64.23	1902	1,005	$16,200	$16.12
1891	66	3,960	60.00	1903	887	16,760	18.90
1892	104	6,416	61.69	1904	1,480	25,740	17.39
1893	50	2,500	50.00	1905	3,109	42,975	13.82
1894	325	4,463	13.73	1906	1,695	28,565	16.85
1895	795	13,525	17.01	1907	653	11,899	8.22
1896	504	6,100	12.10	1908	936	19,624	20.97
1897	580	6,450	11.12	1909	3,085	62,603	20.29
1898	605	10,300	17.02	1910	3,693	68,357	18.51
1899	681	11,740	17.24	1911	7,604	119,935	15.77
1900	1,054	16,310	15.47	1912	4,403	87,959	19.98
1901	747	13,498	18.07				

In the preparation of this table the production of the amphibole and of the serpentine (chrysotile) varieties of asbestos could not be noted separately without disclosing confidential information.

The insignificance of the asbestos production of the United States compared with that of Canada is shown in the accompanying table giving the world's production for the years 1900–1911. The nearness and reliability of the Canadian supply, largely owned in the United States, evidently constitute the basis for the American supremacy in the development of asbestos manufactures.

World's production of asbestos, 1900–1911, in short tons.

Country.	1900 [a]	1901 [a]	1902 [a]	1903 [a]	1904 [a]	1905 [a]
United States	1,054	747	1,005	887	1,480	3,109
Africa:						
Cape Colony	174	99	45	305	411	501
Natal						1
Rhodesia						
Transvaal						
Australia	101	52				
Canada:						
Asbestos	21,621	32,892	30,219	31,129	35,635	50,669
Asbestic	7,520	7,325	10,197	10,548	13,011	17,594
Cyprus						
India						
Russia	4,238	4,927	4,968	5,803	8,269	8,009

Country.	1906 [a]	1907 [a]	1908 [a]	1909 [a]	1910 [a]	1911
United States	1,695	653	936	3,085	3,693	7,604
Africa:						
Cape Colony	522	604	1,267	1,674	1,403	(b)
Natal					3	(b)
Rhodesia			55	272	332	(b)
Transvaal					77	(b)
Australia			45	3		(b)
Canada:						
Asbestos	60,761	62,130	66,548	63,349	77,508	c 100,893
Asbestic	21,425	28,296	24,225	23,951	24,707	c 26,021
Cyprus	21	99	521	172	487	(b)
India					3	(b)
Russia	10,142	11,497	13,129	d 14,654	d 12,193	d 17,071

a Statistics taken from mines and quarries: General Report with Statistics, pt. 4, London.
b Statistics not available.
c Report on the mineral production of Canada, calendar year 1911, Ottawa.
d Min. Jour., London, Mar. 9, 1912, p. 228.

PRICES.

The average price per ton of asbestos in 1912, including all grades produced in the United States, was $19.98, the material sold ranging from $6 to $100 a ton. The high-priced material is all chrysotile. The price of the amphibole asbestos, of which there is only one grade, is in the lower portion of the scale but not the lowest. The bulk of the asbestos manufactured and sold in the United States comes from Canada, where there is a wider range in the values of the grades sold. In the United States Canadian asbestos crude No. 1 sells from $300 to $325 a short ton; crude No. 2 sells from $175 to $200 a short ton; fibers sell from $10 to $100 a short ton. The demand is said to be "brisk." A special product known as "asbestic," made of serpentine sand and the shortest asbestos fiber pulverized, averaged nearly 80 cents a ton in 1912.

IMPORTS.

The imports given in the accompanying tables are total imports for calendar years and are almost identical with the imports for consumption for the same period.

Canada is by far the most important source of the asbestos used in the United States. Unmanufactured asbestos, including ground, is admitted free, but manufactured asbestos is dutiable at from 25 to 40 per cent ad valorem.

The Canadian exports of asbestos during the 12 months ending December 31, 1912, are reported by the customs department of the

Dominion[1] as 88,008 short tons, valued at $2,349,353. Of this quantity 71,426 short tons were shipped to the United States; that is more than 81 per cent of all that was exported by Canada and more than 67 per cent of all that Canada produced in 1912.

As is shown in the accompanying table, the total imports of unmanufactured asbestos other than that from Canada amounted in 1912 to only 97 short tons, or about 0.14 per cent of the imports from Canada. The greater portion of this asbestos came from Russia, in part by way of Germany. A few tons came from Italy and a few tons came by way of Great Britain and Belgium, probably from South Africa.

The comparatively small imports of manufactured asbestos come mainly from Europe, in particular from England, Germany, and Austria-Hungary.

Imports of asbestos into the United States, calendar year 1912, in short tons.

Country.	Unmanufactured.		Manufactures of.
	Quantity.	Value.	Value.
Austria-Hungary			$72,772
Belgium	6	$146	22,957
Canada	71,426	1,441,475	348
England	3	510	173,095
France			1,366
Germany	29	4,684	84,742
Italy	6	918	7,661
Netherlands			119
Russia in Europe	53	8,279	
Scotland			699
Total	71,523	1,456,012	363,759

The value of the manufactured and unmanufactured asbestos imported into the United States during the calendar years 1908 to 1912 is shown in the following table:

Value of asbestos imported into the United States, 1908–1912.

Year.	Unmanufactured.	Manufactured.	Total.
1908	$1,068,322	$127,548	$1,195,870
1909	993,254	240,381	1,233,635
1910	1,235,170	308,078	1,543,248
1911	1,413,541	290,098	1,703,639
1912	1,456,012	363,759	1,819,771

PROPERTIES AND MINERALOGICAL RANGE OF ASBESTOS.

The fundamental property which characterizes asbestos and renders it especially useful is its fibrous structure. Generally the fiber possesses a good degree of flexibility and tensile strength, as well as in-

[1] Preliminary report on the mineral production of Canada during the calendar year 1912, Department of Mines, Canada.

combustibility and low conductivity, with reference to heat and elasticity.

Although nearly half a dozen different fibrous minerals are included under the term asbestos, only three are of considerable importance in this country. They are anthophyllite, amphibole, and serpentine, and they occur in three types—cross fiber, slip fiber, and mass fiber. The cross-fiber type is by far the most important. It is almost invariably fibrous serpentine (chrysotile) and occurs in veins in which the fibers run directly across the vein. Slip fiber occurs in veins on planes along which the rock has slipped in the process of mountain building. Much of the slip-fiber type, especially in serpentine, is chrysotile and may be of fair quality, but in other rocks it is generally amphibole, which is for the most part brittle. In the mass-fiber type the fibers occur in small groups or bundles of parallel fibers, and the bundles lie in all positions through the rock, of which they form the entire mass. The cross-fiber type is mined in Vermont; it occurs also in the Grand Canyon of Arizona and in Wyoming. The slip-fiber type is not mined successfully anywhere in the United States or Canada at the present time. The mass-fiber type is mined at Sall Mountain, Ga.

PROSPECTING FOR ASBESTOS.

In prospecting for asbestos the most promising rock is serpentine and the purer the serpentine the better the prospect, especially if the serpentine is much sheared and intruded, as in Canada, by dikes of granitic rocks. With a few complex veins about an inch in thickness and with enough smaller veins to make the total fiber as much as 3 per cent of the mass of the rock, the prospect may be considered worthy of careful examination with reference to its development.

In the Grand Canyon of the Colorado at a number of points between the mouth of the Little Colorado and Kanab Wash excellent asbestos of the cross-fiber type of chrysotile has been found with serpentine in limestone and has been partly prospected. Although the smallness of the quantity easily available at the locality and its inaccessibility in the depths of the canyon have militated against the development of this deposit of asbestos, it should be noted that the deposit has not been fully prospected, especially in the portion of the canyon west of Powell Plateau, where asbestos is reported to have been seen by members of the Powell party in the boat trip through the canyon.

A fine sample of asbestos like that of the Grand Canyon was recently sent to the Survey and was stated to be from some other but unmentioned locality in Arizona.

The mass-fiber type of asbestos occurs among thoroughly crystalline basic igneous rocks, such as pyroxenites bordering upon peridotites, and has been found at many places in the Appalachian Mountains in North Carolina and Georgia, but it has been successfully mined in Georgia alone. The grade of this asbestos being low, the possibility of its successful financial development is more limited than in the case of the higher grades, especially since this type of fiber has been successfully worked only where it has been softened by long exposure to surface weathering.

MILLING.

Asbestos is almost universally quarried from the ground in open pits and then milled to fiberize it in preparation for the various uses to which it is applied. The milling process for all grades involves a variety of machinery to accomplish two purposes, the pulverization of the rock material by the percussion of high-speed beaters and the assorting and gradation of the ground material by air currents generated by suction fans. The milling of the lower grade (anthophyllite), mined in Georgia and to some extent in years past in Virginia, begins with the transfer of the rock from the pit to the ore bins and thence through jaw crusher, conveyer, rolls, and elevator to pulverizer, from which by a suction fan it is carried into a double conical separator. The coarser particles are returned to a smaller pulverizer for regrinding, and the finer are carried into the settling tanks for bagging. This plant produces one grade and has a capacity of about 1 ton an hour.

The milling of chrysotile, after hand cobbing has removed the highest grades of fiber, Nos. 1 and 2 crude, is a more extensive and expensive process than that just described. It developed chiefly in Canada, where there is great variation in the form and arrangement of the machinery in the mills as described by Fritz Cirkel, from whose report[1] figure 1 is copied as illustrating one of the working combinations. For details as to machinery and milling, as well as to cost of production, reference must be made to the report itself.

USES.

Asbestos is the most important fireproofing material known. Its fibrous structure adapts it to a wide range of applications from woven fabrics, such as theater curtains and articles of clothing, to various forms of asbestos shingles, stucco, plaster, lumber and other building material that render structures thoroughly fireproof. Its lightness, strength, durability, and insulating property against heat and electricity give it special advantages for structural use in cars and electric motor subways. For insulation in electrical appliances the asbestos should be free from magnetite. Processes for the removal of magnetite are referred to later in this report.

The most common use of asbestos is for asbestos paper, millboard, pipe covering, and lagging to inclose heat pipes, furnaces, and locomotives in order to prevent loss of heat by radiation. As a nonconductor of heat it may be used not only in the preparation of fireproof safes and vaults, but also for cold-storage and cooling structures. Houses made of asbestos materials or coated with asbestos throughout are not only warmer in winter but cooler in summer.

In recent years asbestos has been used successfully as a filler in high-grade paints. Its fibrous structure is advantageous when not used in too large proportion.

In Germany[2] it has been successfully employed in the process of neutralizing furnace fumes, but the process has not been introduced into this country.

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[1] Chrysotile-asbestos, its occurrence, exploitation, milling, and uses, pp. 140–141. Published by the Canada Department of Mines, 1910.

[2] Trans. Am. Inst. Min. Eng., vol. 41, p. 640. 1910.

The two kinds of asbestos differ in their resistance to acids. Chrysotile is decomposed by hydrochloric and sulphuric acids; on

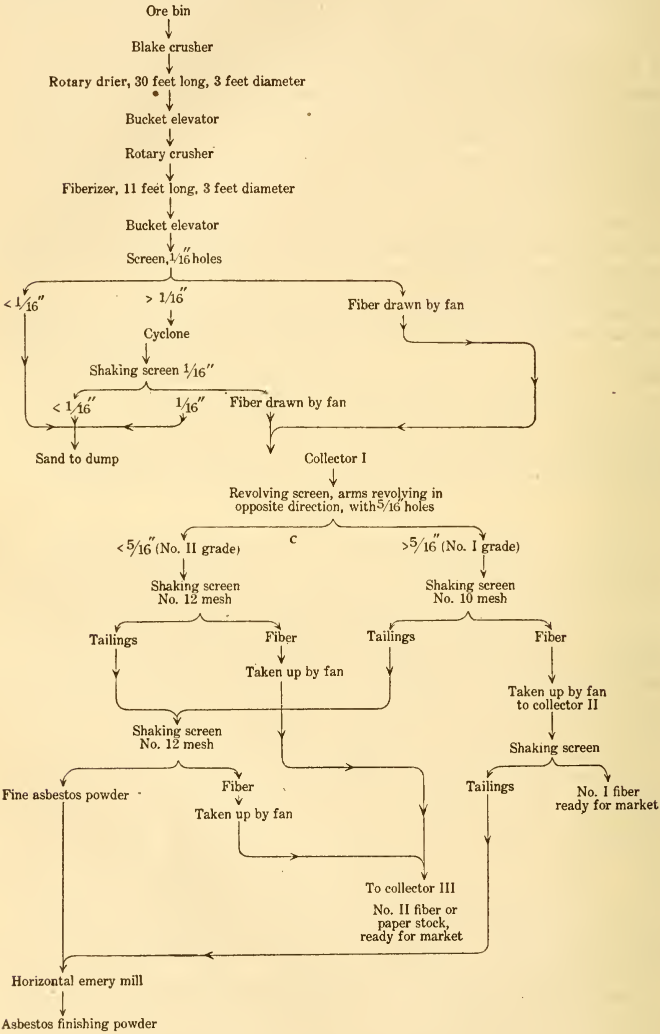

FIGURE 7.—Progress of asbestos through mill.

the other hand, amphibole asbestos is not attacked by acids. It is evident, therefore, that amphibole asbestos only can be employed for filters and for other uses involving the presence of acids.

ASBESTOS DEPOSITS OF THE UNITED STATES.

DOMESTIC DEPOSITS.

The distribution and character of the asbestos deposits of the United States are shown on the accompanying map and in the list of quarries and prospects.

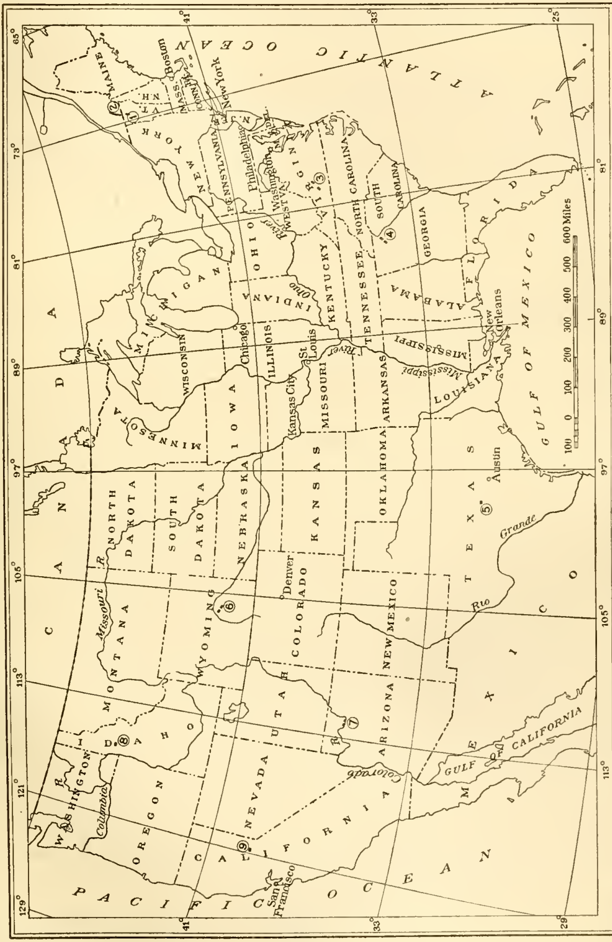

FIGURE 8.—Map of United States showing distribution of asbestos deposits.

The following list gives the locality, variety, and status of occurrence of asbestos in the United States and Canada:

List of asbestos quarries and prospects noted on the map by number.

District.	Variety and type of asbestos.	Status of occurrence.
1. Vermont:		
Chrysotile, southwest of Lowell.	Chrysotile, mainly cross fiber	Quarry and mill production large.
2. Quebec, Canada:		
Thetford, Black Lake, Danville.	do	About a dozen quarries and mills in operation yielding the larger portion of the world's production.
3. Virginia:		
12 miles south of Bedford City.	Amphibole, mainly slip fiber	Prospect. Mill at Bedford City idle.
Rocky Mount	do	Prospect.
4. Georgia:		
Sall Mountain	Ampbibole (anthophyllite), mass fiber.	Quarries at Sall Mountain and Cleveland. Mill at Sall Mountain.
3 miles northeast of Clarkesville.	Amphibole, mass and slip fiber	Prospect.
5. Texas:		
Llano	Amphibole, slip fiber	Do.
6. Wyoming:		
Casper Mountain	Chrysotile, cross fiber and slip fiber.	Quarry and mill.
Smith Creek	do	Do.
7. Arizona:		
In Grand Canyon of Colorado under Grand View.	Chrysotile, cross fiber	Prospect.
On Asbestos Creek	do	Do.
8. Idaho:		
Kamiah	Amphibole (anthophyllite), mass fiber.	Do.
9. California:		
Towle	Amphibole, slip fiber chiefly	Do.

ARIZONA.

According to tests made both in Germany and in this country the excellence of the quality of the asbestos fiber in Arizona continues to hold attention upon the Grand Canyon locality, although on account of its difficult accessibility prospecting in the national forest has not yet extended into the canyon west of Powell Plateau.

There are three known localities of asbestos in 60 miles of the great chasm below the mouth of the Little Colorado. A small amount of development work has been done opposite Grand View, and 20 miles farther west, beneath Bass's Camp, prospects were opened and a small quantity was removed several years ago for sale. The linear extent of the deposits is great, about a mile or more at each locality, although the thickness is only a few feet. On the other hand, the proportion of the high-grade crude to mill stock is much larger than in any other asbestos deposit with which the writer is acquainted.

The following is an analysis of the asbestos from the Grand View locality:

Analysis of chrysotile asbestos from Grand View, Grand Canyon, Arizona.

[R. C. Wells, analyst.]

MgO	40.64	K_2O	0.11
SiO_2	43.68	Na_2O	.14
Al_2O_3	.34	H_2O-	1.18
Fe_2O_3	.51	H_2O+	13.12
MnO	.17		
CaO	.09		99.98

This chrysotile is remarkable on account of its low content of iron, which makes it especially good for electric insulation.

If the water power of Shinumo Creek can be made available it would apparently enable the operator to overcome all the difficulties of transportation from the bottom of the canyon.

Five samples of asbestos have been sent to the Survey from what is said to be a new locality in Arizona. The quality is equal to that of the Grand Canyon asbestos.

GEORGIA.

On account of the low grade of fiber the asbestos industry in Georgia has not been very encouraging, but within the last few years increase of production and more convenient railroad facilities have caused the outlook to brighten. The Sall Mountain Co. has for years derived some of its supply from Cleveland, a locality 3 miles distant, but now that the railroad has reached Cleveland a mill may be built at that point.

VERMONT.

Vermont continues to be by far the most important producer of chrysotile asbestos in the United States; in fact it was the only producer in 1912 aside from the small quantity reported from Wyoming. The plant of the Lowell Lumber & Asbestos Co., which has been in almost continuous operation since 1909, was enlarged in 1911 and that company was succeeded by the Chrysotile Asbestos Corporation. Owing to labor problems, it is said, the plant was shut down for more than three months in the spring of 1912, and foreign trade was so disturbed by wars abroad as materially to affect the mine record of sales which amounted in 1912 to about one-half the quantity, but to three-fourths the value of the production of 1911.

This deposit of chrysotile in Vermont, which has recently been briefly described[1], is closely related genetically to that of the great asbestos mines of Danville, Black Lake, and Thetford in the province of Quebec, Canada, more than 100 miles to the northeast.

Asbestos generally contains numerous grains of iron ore, for the most part magnetite, and in some of the mills the magnetite is removed in the process of milling by means of large magnets. But the removal of the iron ore is not complete, and what remains greatly impairs the electric insulating quality of the asbestos. More or less successful attempts have been made to remove the magnetite by chemical means in solution without injuring the fiber. The Chrysotile Asbestos Corporation states that it has purchased the control of such a process to be added to its mill.

The importance of this matter is indicated by the fact that the General Electric Co. has recently secured the method patented[2] by William C. Arsem for removing the oxides of iron from asbestos fiber by means of phosphoric or orthophosphoric acid.

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[1] Seventh Rept. Vermont Geol. Survey, 1909–10, pp. 315–330; Diller, J. S., Bull. U. S. Geol. Survey No. 470, 1911, pp. 507–510.
[2] Patent No. 1049972, issued Jan. 7, 1913.

WYOMING.

In the Casper region of Wyoming, while the officers of several companies were being prosecuted for their methods of promotion, other companies have extended their prospects and have produced a small quantity of asbestos that has been taken to Chicago for manufacture into flooring. These companies report a small production and manufacture in Denver and Chicago, but the developments are very meager. Other prospects have been reported from the Wind River Mountains, northwest of Lander, that show good fiber as much as three-fourths of an inch in length.

OTHER STATES.

In California prospecting continues, especially in the northern Sierra. Samples of slip fiber have been received from the border of the large serpentine dike on Goodyear Creek, Sierra County, but no cross-fiber chrysotile has been reported.

Mass fiber similar to that of Sall Mountain, Ga., has been found near Cane River, Yancey County, N. C., and Bedford City, Bedford County, Va., and large deposits of the same sort of asbestos occur in Idaho near Kamiah; but no production was reported from any of these localities in 1912.

FOREIGN PRODUCTION.

CANADA.

From the table on a preceding page giving the world's production of asbestos it is seen that Canada is much the largest producer. The greater portion of its production comes to the United States for manufacture. The United States is, therefore, much more interested in the asbestos of Canada than in that of any other country. In the table referred to all the grades of true asbestos produced in Canada are grouped together, the product of lowest grade known in commerce as asbestic being shown separately.

In the following table is given the total Canadian production of all grades and values for 1912:

The output and sales of Canadian asbestos in the calendar year 1912, together with the stock on hand at the end of the year, in short tons.

Grade.	Output.	Sales.			Stock on hand Dec. 31, 1912.		
	Quantity.	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
Crude No. 1	1,448	1,929	$507,904	$263.31	865	$220,789	$255.31
Crude No. 2	3,224	3,669	372,357	101.49	2,719	293,263	107.86
Mill stock No. 1	19,672	18,758	843,559	44.97	7,490	338,069	45.13
Mill stock No. 2	35,389	43,359	855,902	19.74	6,278	132,349	21.08
Mill stock No. 3	38,083	38,805	379,955	9.79	4,334	36,596	8.44
Total asbestos	97,816	106,520	2,959,677	27.79	21,686	1,021,066	47.08
Asbestic		24,740	19,707	.80			

In the absence of a uniform classification of asbestos of different grades the subdivisions in the table have been adopted purely on a valuation basis. Crude No. 1 comprises material valued at $200 a ton or more; crude No. 2, material under $200; mill stock No. 1, stock valued at $30 to $100; No. 2, at $15 to $30; No. 3, under $15.

The quantity and value of the asbestos produced and sold in Canada since 1895 is shown in the following table:

Sales of asbestos and asbestic in Canada for the calendar years 1895–1912, in short tons.[a]

Year.	Asbestos.		Asbestic.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1895	8,756	$368,175			8,756	$368,175
1896	10,892	423,066	1,358	$6,790	12,250	429,856
1897	13,202	399,528	17,240	45,840	30,442	445,368
1898	16,124	475,131	7,661	16,066	23,785	491,197
1899	17,700	468,635	7,746	17,214	25,446	485,849
1900	21,621	729,886	7,520	18,545	29,141	748,431
1901	32,892	1,248,645	7,325	11,114	40,217	1,259,759
1902	30,219	1,126,688	10,197	21,631	40,416	1,148,819
1903	31,129	915,888	10,548	16,869	41,677	932,757
1904	35,611	1,213,502	12,854	12,850	48,465	1,226,352
1905	50,669	1,486,359	17,594	16,900	68,263	1,503,259
1906	60,761	2,036,428	21,424	23,715	82,185	2,060,143
1907	62,130	2,484,768	28,296	20,275	90,426	2,505,043
1908	66,548	2,555,361	24,225	17,974	90,773	2,573,335
1909	63,349	2,284,587	23,951	17,188	87,300	2,301,775
1910	77,508	2,555,974	24,707	17,629	102,215	2,573,603
1911	101,393	2,922,062	26,021	21,046	127,414	2,943,108
1912	106,520	2,959,677	24,740	19,707	131,260	2,979,384

[a] Obtained from the report of the director of mines on the mines and metallurgical industries of Canada or 1907-8, pp. 448, 936. The data for 1909, 1910, 1911, and 1912 were obtained from the general summary of he mineral production of Canada.

The asbestos manufacturing industry in the United States is dependent upon the mines of Canada, and the outlook is reported to be encouraging.

T. C. Denis,[1] superintendent of mines, Ottawa, Canada, states that—

After having passed through a rather critical period of two years owing to overproduction and glutting of the market, the asbestos industry is gradually resuming a normal state. At present there appears to be a greater demand for the long-fiber qualities, and prices for grades of $60 and over are satisfactory. The prices for lower grades, however, are still below normal and are not remunerative.

In consequence, only the mines which can produce a certain proportion of good fiber were operated during the year. In Thetford and Black Lake great activity ruled during all summer and fall, and some difficulty was experienced in getting the necessary labor. All of the East Broughton mines were closed down, as the rock in that field is essentially a milling rock and the fiber is short.

In 1911 the shipments of asbestos amounted in value to over $3,000,000. The shipments of asbestos over the Quebec Central Railway for the first nine months of 1912 showed an increase in tonnage of some 12½ per cent as compared with the corresponding period of 1911. From this it may be augured that in spite of the closing down of the East Broughton mines the value of the asbestos production for 1912 will be higher than in 1911.

Definite figures from the Canadian Bureau of Mines confirm this prediction. Although the production of asbestos and asbestic reported for 1912 is subject to correction, as given in the preliminary report for 1912, it is valued at $2,979,384, an increase of $36,276 compared with the value of the production of 1911.

[1] Canadian Min. Jour., Jan. 1, 1913, p. 5.

ASPHALT.

By David T. Day.

INTRODUCTION.

In considering the subject of asphalt it is always a question what substances shall be included under that name and within the scope of a treatise upon that subject. Formerly the word "bitumen" was considered to cover little more than semisolid or solid tarry matter found in nature or produced by destructive distillation. The meaning given to bitumen has now broadened to include many other substances. In 1912 a committee of the American Society for Testing Materials suggested, and the society adopted, the following satisfactory definition for the term "bitumen":

> Bitumens are mixtures of native or pyrogenous hydrocarbons and their nonmetallic derivatives, which may be gases, liquids, viscous liquids, or solids, and which are soluble in carbon disulphide.

A committee of that society has recommended the following definition for asphalt:

> Asphalts are solid or semisolid native bitumens, solid or semisolid bitumens obtained by refining petroleums, or solid or semisolid compounds which are combinations of the bitumens mentioned with petroleums or derivations thereof, which melt upon the application of heat and which consist of a mixture of hydrocarbons and their derivatives, of complex structure, largely cyclic and bridge compounds.

The effect of this definition is to include as asphalt the material obtained by evaporating asphaltic oils to a solid or semisolid consistency. It makes it impossible to consider as asphalt merely the solid products existing naturally; asphalt as herein considered is therefore partly a series of natural products and partly material manufactured from oil. This definition necessitates no change in the subjects grouped under asphalt in this report, as it has been necessary for several years to include all these products in order to follow the development of the asphalt trade. In fact, during the last few years the asphalt-paving industry has used a constantly increasing proportion of asphalt obtained from oil, until in 1912 over 61 per cent of the total asphalt used in paving was derived from petroleum and only 38.3 per cent from natural asphalt.

Asphaltic oils differ very widely in the proportion of asphalt contained, ranging from no asphalt to very viscous oils which are suitable for road material with practically no refining. Such natural liquid asphalt is known in many localities, especially near Lander, Wyo. It has not yet come into popular use, as asphaltic residues of exactly the required consistency may be obtained more cheaply by boiling down the thinner asphaltic oils characteristic of many regions in Texas, California, and Mexico.

PRODUCTION.

Including all the varieties of asphalt and also sandstone and limestone impregnated with asphalt, the total quantity of asphaltic material produced in 1912 amounted to 449,510 short tons, valued at $4,620,731. This represents a very satisfactory growth from 1911, when 364,266 short tons, valued at $3,991,109, were produced. In fact, the growth in the use of asphalt has been very rapid for several years, as is shown in the table below:

Production of asphalt and bituminous rock, 1882–1912, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1882	3,000	$10,500	1898	76,337	$675,649
1883	3,000	10,500	1899	75,085	553,904
1884	3,000	10,500	1900	54,389	415,958
1885	3,000	10,500	1901	63,134	555,335
1886	3,500	14,000	1902	105,458	765,048
1887	4,000	16,000	1903	101,255	1,005,446
1888	50,450	187,500	1904	108,572	879,836
1889	51,735	171,537	1905	115,267	758,153
1890	40,841	190,416	1906	138,059	1,290,340
1891	45,054	242,264	1907	223,861	2,826,489
1892	87,680	445,375	1908	198,382	2,057,881
1893	47,779	372,232	1909	228,655	2,138,273
1894	60,570	353,400	1910	260,080	3,080,067
1895	68,163	348,281	1911	364,266	3,991,109
1896	80,503	577,563	1912	449,510	4,620,731
1897	75,945	664,632			

The changes in production in the different classes of asphalt are detailed for several years in the table which follows:

Production of asphalt, 1909–1912, by varieties, in short tons.

Variety.	1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous rock	55,376	$205,756	64,554	$400,557	41,338	$144,244	53,041	$152,675
Refined bitumen [a]	10,953	112,184	5,018	85,931	29,305	317,722	22,852	241,772
Maltha	652	8,047	1,252	12,742	8,574	125,966	474	3,518
Wurtzilite (elaterite)	220	1,400	....	....	610	30,500	[b] 8,452	115,620
Gilsonite	28,669	218,186	29,832	372,900	30,236	486,114	31,478	573,069
Grahamite	3,894	32,737	....	....	5,000	15,000	([c])	([c])
Ozokerite and tabbyite	30	1,500	....	....	....	....	....	....
Oil asphalt	128,861	1,558,463	159,424	2,207,937	249,203	2,871,563	333,213	3,534,077
Total	228,655	2,138,273	260,080	3,080,067	364,266	3,991,109	449,510	4,620,731

a Includes a small quantity of mastic. b Includes some grahamite. c Included in wurtzilite.

The following table shows the production of asphalt, by States and kinds, in 1911 and 1912:

Production of asphalt in 1911 and 1912, by varieties and by States, in short tons.

1911.

Variety.	California.		Utah.		Oklahoma.[a]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous rock	27,507	$89,264			13,831	$54,980
Refined bitumen [b]	15,589	179,646			916	10,076
Maltha	8,574	125,966				
Uintaite (gilsonite)			30,236	$486,114		
Wurtzilite (elaterite) and tabbyite			610	30,500		
Grahamite					5,000	15,000
Oil asphalt	153,527	1,896,878			52,650	315,900
Total	205,197	2,291,754	30,846	516,614	72,397	395,956

Variety.	Texas.		Total.	
	Quantity.	Value.	Quantity.	Value.
Bituminous rock			41,338	$144,244
Refined bitumen [b]	12,800	$128,000	29,305	317,722
Maltha			8,574	125,966
Uintaite (gilsonite)			30,236	486,114
Wurtzilite (elaterite) and tabbyite			610	30,500
Grahamite			5,000	15,000
Oil asphalt	43,026	658,785	249,203	2,871,563
Total	55,826	786,785	364,266	3,991,109

1912.

Variety.	California.		Utah.		Oklahoma.[a]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous rock	35,637	$88,621			10,969	$44,428
Refined bitumen [c]	9,649	84,651			1,203	13,121
Maltha	474	3,518				
Uintaite (gilsonite)			31,478	$573,069		
Wurtzilite (elaterite) and tabbyite			[d] 8,452	[d] 115,620		
Grahamite					([e])	([e])
Oil asphalt	203,571	2,009,613			53,545	283,824
Total	249,331	2,186,403	39,930	688,689	65,717	341,373

Variety.	Texas.		Total.	
	Quantity.	Value.	Quantity.	Value.
Bituminous rock	6,435	$19,626	53,041	$152,675
Refined bitumen [c]	12,000	144,000	22,852	241,772
Maltha			474	3,518
Uintaite (gilsonite)			31,478	573,069
Wurtzilite (elaterite) and tabbyite			[d] 8,452	[d] 115,620
Grahamite			([e])	([e])
Oil asphalt	76,097	1,240,640	333,213	3,534,077
Total	94,532	1,404,266	449,510	4,620,731

[a] Includes Illinois and Kentucky.
[b] Includes a small quantity of mastic in California and Oklahoma.
[c] Includes a small quantity of mastic in California and Kentucky.
[d] Includes grahamite from Oklahoma.
[e] Included in wurtzilite in Utah.

It will be noted that the chief increase in 1912 was in oil asphalt in Texas and California.

PRODUCTION IN PRINCIPAL COUNTRIES.

The following table shows the production of asphalt in the principal producing countries from 1902 to 1912, inclusive:

Production of asphalt and bituminous rock in the principal producing countries, 1902–1912, in short tons.

Year.	United States.		Trinidad.[a]		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902	105,458	$765,048	178,230	$828,347	97,415	$146,470
1903	101,255	1,005,446	204,880	943,302	96,401	198,940
1904	108,572	879,836	152,392	727,552	101,121	212,058
1905	115,267	758,153	114,845	626,293	113,513	235,620
1906	138,059	1,290,340	150,373	832,964	129,388	268,631
1907	223,861	2,826,489	171,271	832,274	139,567	264,494
1908	198,382	2,057,881	143,552	403,023	98,088	188,334
1909	228,655	2,138,273	159,416	459,446	85,446	176,897
1910	260,080	3,080,067	157,120	421,419	89,491	152,565
1911	360,004	3,828,751	[b] 179,718	[c] 494,000	90,256	154,938
1912	435,103	4,487,813	[b] 189,496	[c] 521,000	....	....

Year.	France.		Italy.[d]		Spain.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902	284,719	$390,254	70,619	$151,829	6,946	$12,356
1903	267,859	353,535	98,865	240,497	6,918	12,240
1904	250,222	289,415	123,347	307,985	4,146	7,259
1905	211,043	325,340	117,929	298,097	7,135	14,794
1906	216,405	345,599	144,802	349,926	8,587	17,130
1907	195,136	330,065	178,127	442,014	9,057	16,001
1908	188,616	264,188	148,433	368,306	13,635	24,084
1909	186,298	269,161	123,361	305,159	5,822	10,282
1910	187,085	277,210	179,261	452,911	([e])	([e])
1911	....	....	207,926	591,550	....	....
1912	....	....	....	....	....	....

Year.	Austria-Hungary.		Russia.		Venezuela.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902	4,047	$67,623	13,624	$116,935	11,872	([e])
1903	2,715	62,492	28,281	217,085	[b] 16,057	$286,113
1904	4,029	59,386	[f] 95	230,541	[b] 14,910	262,809
1905	8,257	854,197	23,659	201,965	[b] 33,803	258,526
1906	10,633	778,781	12,517	110,294	[b] 22,128	98,250
1907	11,335	727,892	14,116	101,705	[b] 37,637	167,938
1908	12,239	768,162	24,961	([e])	[b] 31,539	141,912
1909	11,179	663,246	([e])	([e])	[b] 37,292	180,061
1910	9,070	702,022	([e])	([e])	[b] 31,890	[c] 151,000
1911	....	....	....	....	[b] 50,163	[c] 238,000
1912	....	....	....	....	[b] 65,875	[c] 312,000

[a] Includes small quantity of manjak, produced in Barbados.
[b] Exports.
[c] Estimated.
[d] Only about 7 per cent of the amount given represents asphalt, the remainder being bituminous sandstone and limestone.
[e] Not available.
[f] Ozokerite only; quantity of asphalt not available.

OZOKERITE.

After several years of nonproductivity the well-known deposit near Colton, Utah, was developed by the American Ozokerite Co. to the stage of yielding an actual commercial product, though not on the scale proposed for 1913. This product is included under the statistics of asphalt to prevent revealing individual statistics. The material is sold as refined ozokerite.

The ozokerite imported amounted to 4,472,708 pounds, valued at $388,461, in 1911. This increased to 6,352,003 pounds in 1912, valued at $488,894. The import price declined from 8.7 cents a pound in 1911 to 7.7 cents a pound in 1912.

IMPORTS.

The following table shows the imports of asphalt, by calendar years, from 1908 to 1912, inclusive:

Asphalt imported for consumption into the United States, 1908–1912, in short tons.

Year.	Crude.		Dried or advanced.		Bituminous limestone.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	137,808	$532,297	7,6 2	$67,364	6,224	$20,758	151,674	[a] $624,979
1909	128,109	511,631	10,087	94,146	6,409	18,440	144,605	[a] 633,205
1910	162,435	588,206	20,180	178,704	3,696	9,301	186,311	[a] 785,963
1911	167,681	572,198	20,461	184,954	8,180	23,468	196,322	789,236
1912	193,645	726,345	20,707	177,992	3,976	15,808	218,328	921,145

[a] Imports for 1908 include $4,560 of manufactures; 1909, $8,988; 1910, $9,752.

The following table shows the imports, by countries, of asphalt into the United States for the fiscal years 1903 to 1912:

Asphalt imported into the United States during the fiscal years ending June 30, 1903 to 1912, by countries, in long tons.[a]

Imported from—	1903		1904		1905		1906		1907	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Europe:										
Austria-Hungary	....	....	2	$46	10	$99	10	$108	....	....
Belgium	....	....	....	....	....	....	....	....	....	....
France	298	$1,462	....	....	302	1,983	167	1,411	111	$1,091
Germany	1,422	9,974	1,528	11,755	372	3,442	2,385	16,212	2,667	25,378
Italy	13,789	61,284	3,211	11,581	7,863	28,244	....	....	7,204	24,109
Netherlands	....	....	....	....	....	36	....	....	99	1,134
Switzerland	442	3,735	414	3,815	1,327	12,986	655	5,595	890	8,688
Turkey	638	8,917	....	....	....	....	....	....	....	....
United Kingdom	136	2,885	63	932	66	1,173	420	6,032	668	8,462
North America:										
Canada	....	....	130	1,032	....	....	34	379	4	18
Mexico	621	2,374	382	2,223	355	4,032	422	2,529	2,733	34,636
West Indies—										
British	129,133	366,998	110,031	368,623	87,690	397,277	52,627	232,930	70,992	281,244
Cuba	9,898	48,218	9,494	22,230	12,296	44,529	5,348	26,206	5,016	20,362
Danish	....	....	....	....	....	....	....	....	....	....
South America:										
Colombia	3	106	23	1,456	23	672	....	....	89	2,996
Venezuela	16,445	74,874	50,194	217,017	29,876	149,573	20,000	100,000	33,921	169,278
Asia:										
East Indies—British India	....	....	49	312	....	....	....	....	....	....
Turkey	67	5,038	119	2,763	399	6,158	17	391	36	2,496
Oceania	....	....	....	....	....	....	....	....	....	....
Total	172,892	585,865	175,640	643,785	140,579	650,204	82,085	391,793	124,430	579,892

[a] Until 1909 figures were given separately for dried or advanced asphalt, bituminous limestone, and crude asphalt, but a · the first two classes were comparatively small, they have been combined with crude asphalt

Asphalt imported into the United States during the fiscal years ending June 30, 1903 to 1912, by countries, in long tons—Continued.

Imported from—	1908		1909		1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Europe:										
Austria-Hungary	....	....	....	....	....	....	....	....	....	....
Belgium	....	....	....	....	12	$369	364	$5,498	420	$2,914
France	....	....	84	$1,120	1,648	7,917	119	1,598	248	2,390
Germany	2,371	$20,972	1,210	1,054	2,294	18,587	2,091	17,576	2,586	22,111
Italy	3,549	14,135	4,222	15,441	3,050	8,092	6,099	17,636	5,515	22,873
Netherlands	196	2,268	59	666	....	....	....	41	....	....
Switzerland	705	6,307	817	6,937	1,280	9,184	750	5,783	1,453	9,863
Turkey	....	....	....	....	....	....	....	....	....	....
United Kingdom	372	6,337	304	4,002	274	6,808	297	6;876	434	5,278
North America:										
Canada	4	88	2	90	....	....	36	600	94	2,351
Mexico	....	....	76	1,390	145	2,652	32	457	581	11,089
West Indies—										
British	104,727	389,734	83,529	312,944	89,994	407,325	94,594	405,735	115,884	475,299
Cuba	3,976	17,983	7,174	36,618	13,873	73,455	14,027	73,233	12,405	68,879
Danish	....	....	....	....	200	800	....	....	....	....
South America:										
Colombia	91	4,399	34	1,356	1	9	45	1,639	11	1,216
Venezuela	37,822	202,031	30,528	214,049	33,503	173,363	34,104	170,683	53,922	260,074
Asia:										
East Indies—British India	....	....	....	....	....	....	....	....	....	....
Turkey	24	1,659	....	....	8	554	....	....	....	....
Oceania	10	427	11	429	89	3,436	10	391	25	967
Total	153,847	666,340	128,050	606,096	146,371	712,551	152,568	707,746	193,578	885,304

EXPORTS.

Exports of domestic asphalt in fiscal years 1907 to 1912 are shown in the following table:

Value of asphalt exported from the United States during the fiscal years 1907–1912, in short tons.

Year.	Unmanufactured.	Manufactures of.	Total.
1907	(a)	(a)	$374,476
1908	(a)	(a)	451,968
1909	(a)	(a)	425,429
1910	$488,703	$213,817	702,520
1911	565,581	302,971	868,552
1912	707,997	462,885	1,170,882

a Figures given as "Asphaltum and manufactures of," until 1910.

EXPORTS FROM TRINIDAD.

The exports of asphalt from Trinidad from 1907 to 1912, inclusive, have been fairly steady with a gradual increase as is shown in the following table:

Total exports of asphalt from Trinidad, 1907–1912, in short tons.

Year.[a]	To United States.			To Europe.			To other countries.			Grand total.
	Lake.	Land.	Total.	Lake.	Land.	Total.	Lake.	Land.	Total.	
1907	97,243	4,642	101,885	59,987	224	60,211	....	230	230	162,096
1908	92,212	5,886	98,098	51,183	1,276	52,459	....	....	....	150,557
1909	97,629	13,787	111,416	49,345	224	49,569	....	....	....	160,985
1910	109,198	9,274	118,472	65,778	150	65,928	....	....	....	184,400
1911	103,590	8,040	111,630	67,105	....	67,105	983	....	983	179,718
1912	95,111	8,600	103,711	85,299	....	85,299	486	....	486	189,496

a Ending Jan. 31 of year succeeding.

SOURCES OF SUPPLY.

The characteristics of the foreign and domestic sources of supply of asphalt and ozokerite were given in detail in the report for the year 1911. Few changes in these have developed in 1912, with the exception of the considerable increase in oil asphalts in California and Texas.

It is evident from the figures of production of asphalt in California that the industry is expanding rapidly. This expansion is easy, because of the practically unlimited amount of asphalt which can be separated from the crude oils, especially from the heavier grades. During the last part of 1912 the Standard Oil Co. of California ceased making contracts for crude petroleum below 18° B. This forced the producers to "top" their product, obtaining large amounts of asphaltic residues. These they sold partly for fuel and partly for asphalt. The heavy oils of the Kern River field required comparatively slight topping to leave an asphaltic residue which was well suited for road and roofing asphalt, because the less heat to which an asphalt is subjected the better the resulting asphalt. It is less brittle.

Under the conditions it has proved possible to push the sale of California asphalt to great distances. In fact early in 1913 the American ship *Manga Reva* sailed for New York with a cargo of 3,500 tons of California oil asphalt in open-headed barrels. This was her second voyage with such a cargo. The trade thus begun is expected to increase greatly with the opening of the Panama Canal.

At the beginning of 1912 the Uvalde Rock Asphalt Co. began operations, producing bituminous limestone 6 miles from Cline station, Tex., on the Southern Pacific Railroad. A branch railroad is under construction. During 1912 the product, which is used for paving and road building, was hauled to the railroad by motor trucks.

The higher values shown for Texas asphalt is partly due to the larger percentage of the material which is prepared for sale as roofing. The increase in production was facilitated by the importation of highly asphaltic oils from Mexico.

PROPORTION OF ASPHALT IN OILS.

The proportion of asphalt contained in the asphaltic oils of California, Texas, and Oklahoma varies within wide limits. This is due chiefly to great variations in the asphaltic oils themselves, but there are also deplorable differences in the methods of determining asphalt in crude petroleum.

The asphalt in an oil may be determined in either of three ways:

(1) By Holde's method, which consists of distilling off the light oils which may exist in the crude oil and then shaking the residue with 40 times its volume of gasoline boiling between 65° C. and 95° C. and as free as possible from unsaturated hydrocarbons; it then is allowed to stand for 24 hours and is filtered. By this means the solid asphalt contained in the oil is obtained upon the filter, together with the clay and other mineral impurities contained in the oil. The asphalt is dissolved by washing with benzol. The benzol is evaporated in a weighed porcelain dish and the weight of the asphalt obtained.

(2) There is usually considerable liquid asphalt present in the oil which is not separated by this means; therefore another method is

often employed which gives the total asphalt, hard and soft. This is called the ether-alcohol method. It is well described by Dr. Albert Sommer as follows:

Ether-alcohol precipitates not only asphaltenes but also the softer components of asphalt, and is therefore used especially to determine the total amount of asphaltic matter in crude oils, etc. The method can also be well adopted for the determination in fluxes and harder bitumen. The procedure is as follows:

Two grams of the asphalt are weighed into a 100 cubic centimeter graduated cylinder with a well-fitting glass stopper, and 40 cubic centimeters of a mixture of alcohol-ether, consisting of four parts alcohol and three parts ether, poured into the same cylinder. The same should then be attached to a shaking device and shaken well for about 20 minutes. After this time it should be left to stand overnight, and should be filtered in the same manner as described with petroleum ether, only the same mixture of alcohol-ether should be used until all the soluble parts are removed from the precipitate. Benzol is then used in the same manner as above described, and the weighing and calculation made in the same manner as with the asphaltenes. (In the case of oils which are very rich in paraffin this method sometimes precipitates part of the latter also. Therefore the precipitate of such oils should be repeatedly extracted with hot alcohol.)

(3) The third method of determination of asphalt is by evaporation, also described by Dr. Sommer, as follows:

A certain quantity of asphalt is evaporated in a dish of certain dimensions, at a certain temperature. The loss is taken, and consistency of the residuum determined by the usual methods, such as penetration, i. e., the number of tenths of millimeters which a needle, weighted with 100 grams, penetrates into the asphalt at 25° C. Ten millimeters of "100 penetration" is usually the chosen standard, and the percentage of remainder of that consistency is usually called "asphaltic contents."

The oils of the Coalinga district in California have been analyzed by I. C. Allen, now petroleum chemist of the Bureau of Mines.[1] Samples were studied from 83 wells. The asphalt was determined in 56 of these samples. The method of determining the asphalt was somewhat different from that used by either Holde or Sommer. The crude oil was distilled to 250° C. at atmospheric pressure and the distillation was then continued under a vacuum of about 40 inches of mercury "to a temperature of 330° to 350° C.—that is, until practically all liquid is over and only a hard brittle mass of asphaltum remains when cooled."

By this method the Coalinga oils were found to vary in asphalt contents from a minimum of 1.89 per cent to 57.42 per cent. The average for the series was 26.5 per cent.

The highest percentage of sulphur found was 0.77. The oils highest in sulphur were abnormally high in asphalt.

In the other oil fields of California the percentage of asphalt varies within great limits. For example, the analyses compiled from various sources and published in the petroleum report in Mineral Resources of the United States for 1907 show a variation between 16.2 per cent and 38.7 per cent of asphalt in the oils from the Kern River field. In the Sunset-Midway-McKittrick region the variation ranges between 11 per cent and 51 per cent, in the Los Angeles field from 13.3 to 42.2 per cent, and in the Santa Maria field from 12 to 42 per cent.

These great variations may undoubtedly be attributed to some extent to differences in the methods of analysis employed, but this is not a probable reason for the extent of the variations found. They seem to represent fundamental differences in the original oils with further changes brought about during the slight migration of the oils into their places of accumulation.

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[1] Bull. U. S. Geol. Survey No. 398, 1910, pp. 264-272.

In Texas and Louisiana the asphaltic oils, limited practically to the region of the Gulf coast, show similar variations from no asphalt to a maximum of 20 per cent. These oils are further complicated by the presence of paraffin wax, which is absent in most of the California oils.

These variations in the asphalt contents of various oils are of great technologic significance at the present time, since the value of the asphalt for road construction and for roofing seems to depend greatly upon its ductility, and this is unfavorably influenced by the prolonged heating necessary when the oil must be distilled down to small percentages.

It is evident from the analyses given in Mineral Resources for 1907 that oils high in asphalt can be found in practically all the California fields, and the need is also evident for comparable analyses of all these oils which will set forth the percentages of asphalt obtainable as residues under present methods of distillation.

UNITED STATES GEOLOGICAL SURVEY PUBLICATIONS ON ASPHALT.

The following list comprises the more important papers relative to asphalt published by the United States Geological Survey or by members of its staff. The Government publications, except those to which a price is affixed, can be obtained free by applying to the Director, United States Geological Survey, Washington, D. C. The folios may be purchased from the Geological Survey; the other priced publications from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Anderson, Robert, An occurrence of asphaltite in northeastern Nevada: Bull. 380, 1909, pp. 283–285.

Boutwell, J. M., Oil and asphalt prospects in Salt Lake basin, Utah: Bull. 260, 1905, pp. 468–479. 40c.

Branner, J. C.; Newsome, J. F., and Arnold, Ralph, Santa Cruz folio (No. 163), Geol. Atlas U. S., 1909. 5c.

Clarke, F. W., The data of geochemistry, 2d ed.: Bull. 491, 1911, pp. 686–689. 70c.

Day, D. T., Asphalt, related bitumens, and bituminous rock: Mineral Resources U. S. for 1909, pt. 2, 1910, pp. 731–733 (75c.); idem for 1910, pt. 2, 1911, pp. 833–839; idem for 1911, pt. 2, 1912, pp. 1003–1021.

Day, W. C., The coal and pitch coal of the Newport mine, Oregon: Nineteenth Ann. Rept., pt. 3, 1899, pp. 370–376. $2.25.

Eldridge, G. H., The uintaite (gilsonite) deposits of Utah: Seventeenth Ann. Rept., pt. 1, 1896, pp. 909–949. $2.

——— The asphalt and bituminous rock deposits of the United States: Twenty-second Ann. Rept., pt. 1, 1901, pp. 209–452. $1.60.

——— Origin and distribution of asphalt and bituminous rock deposits in the United States: Bull. 213, 1903, pp. 296–305. 25c.

Fairbanks, H. W., San Luis folio (No. 101), Geol. Atlas U. S., 1904. 5c.

Fuller, M. L., Asphalt, oil, and gas in southwestern Indiana: Bull. 213, 1903, pp. 333–335. 25c.

Hayes, C. W., Asphalt deposits of Pike County, Ark.: Bull. 213, 1903, pp. 353–355. 25c.

Hilgard, E. W., The asphaltum deposits of California: Mineral Resources U. S. for 1883–84, 1885, pp. 938–948. 60c.

Hovey, E. O., Asphaltum and bituminous rock: Mineral resources U. S. for 1903, 1904, pp. 745–754 (70c.); idem for 1904, 1905, pp. 789–799 (70c.).

Richardson, C., Asphaltum: Mineral Resources U. S. for 1893, 1894, pp. 626–669. 50c.

Smith, C. D. (See Taff, J. A., and Smith, C. D.)

Taff, J. A., Albertite-like asphalt in the Choctaw Nation, Indian Territory: Am. Jour. Sci., 4th ser., vol. 8, 1899, pp. 219–224.

——— Description of the unleased segregated asphalt lands in the Chickasaw Nation, Indian Territory: Circ. No. 6, U. S. Dept. Interior, 1904, 14 pp.

Taff, J. A., Grahamite deposits of southeastern Oklahoma: Bull. 380, 1909, pp. 286–297.

——— Asphalt and bituminous rock: Mineral Resources U. S. for 1906, 1907, pp. 1131–1137 (50c.); idem for 1907, pt. 2, 1908, pp. 723–730 ($1).

Taff, J. A., and Smith, C. D., Ozokerite deposits in Utah: Bull. 285, 1906, pp. 369, 372. 60c.

Vaughan, T. W., The asphalt deposits of western Texas: Eighteenth Ann. Rept., pt. 5 (cont.), 1897, pp. 930–935. $1.

——— Uvalde folio (No. 64), Geol. Atlas U. S., 1899. 5c.

FELDSPAR AND QUARTZ.

By Frank J. Katz

FELDSPAR.

INTRODUCTION

The production of feldspar in the United States in 1912, as indicated by the figures which follow, fell off somewhat as compared with 1911, but was considerably larger than in any other previous year except 1907. The production in 1912 was less by 6,128 tons in quantity and $58,446 in value than that of 1911. The use of feldspar of the lower grades for poultry grit, roof surfacing, and surfacing concrete work seems to be on the increase, and in 1912 small quantities were sold for experimental work on the extraction of potash.

COMPOSITION, OCCURRENCE, AND USES.

Bulletin 420 of the Survey, "Economic geology of the feldspar deposits of the United States," by Edson S. Bastin, published in 1910, is so complete a treatise on the subject that it is not deemed necessary in this place to go into detail regarding the composition and occurrence of feldspar in the United States. All who are interested in the subject are referred to that bulletin, which may be had on application to the Director, United States Geological Survey, Washington, D. C.

Feldspar is a compound of silica, alumina, and one or more of the bases potash, soda, and lime. There are two principal commercial varieties—the potash spar and the soda spar. Both of these may be present in the same deposit or in the same crystal. The principal members of the potash group are orthoclase and microcline. These varieties are alike in chemical composition ($KAlSi_3O_8$, or $K_2O.Al_2O_3.6SiO_2$) and so nearly alike in physical properties as to be considered commercially identical. The theoretical composition of pure orthoclase or microcline is silica 64.7 per cent, alumina 18.4 per cent, and potash 16.9 per cent. The potash may be partly or completely replaced by soda. When the soda content is greater than the potash content the feldspar is called anorthoclase.

Potash feldspars range in color from white to reddish; some are gray. The soda feldspars vary from white to pale green in color. When first taken from the quarry feldspar is so hard that it is with difficulty scratched with a knife.

The most of the feldspar mined in the eastern part of the United States is of the potash or soda variety or a mixture of the two. These varieties are used in the pottery industry because after being melted and cooled they form a glass, whereas lime-soda feldspar under these conditions becomes crystalline.

In 1912 deposits in California, Connecticut, Maine, Maryland, Minnesota, New York, North Carolina, Pennsylvania, Vermont, and Virginia were worked. Vermont appeared for the first time as a producer.

The principal use of feldspar is in the manufacture of pottery, enamel ware, enamel brick and tile, and electrical ware. Of these applications the most important is its use in the body and glaze of the various grades of pottery and vitrified sanitary ware, in which it constitutes from 10 to 35 per cent. Its value in pottery is that it melts at a lower point than the other ingredients and serves as a flux, binding the clay and quartz particles together. In glazes the percentage of feldspar used is higher than in the body and runs from 30 to 50 per cent. Other uses of feldspar, which do not require the high grade demanded by the pottery trade, are in the manufacture of emery and corundum wheels, where it serves as a binder; in the manufacture of opalescent glass; as a poultry grit; as a constituent of roofing material; and for surfacing concrete work. Small quantities of the purest grades of potash feldspar are used in the manufacture of artificial teeth. For this purpose it brings the highest prices—from $6 to $8 a barrel of 350 pounds. It is also used in the manufacture of scouring soaps and window wash. As a fertilizer ground feldspar has been used, but with results of doubtful value. Attempts are being made to extract from feldspar its content of potash. Experiments along this line have not yet developed a commercial process, but it may well be that some of the efforts will be successful.

PRODUCTION.

The production of feldspar in 1912 was 86,572 short tons, valued at $520,562. This was a decrease from 1911 of 6,128 tons, or 6.61 per cent, in quantity and of $58,446, or 10.10 per cent, in value. The production of crude spar was 26,462 short tons, valued at $89,001, a decrease of 1,669 tons, or 5.93 per cent, in quantity and an increase of $607, or 0.69 per cent, in value, as compared with 1911. The production of ground spar was 60,110 short tons, valued at $431,561, a decrease of 4,459 tons, or 6.91 per cent, in quantity and of $59,053, or 12.04 per cent, in value, as compared with 1911. The average price per ton in 1912 for crude spar was $3.36, compared with $3.14 in 1911, and for ground spar it was $7.18, compared with $7.60 in 1911. Of the output for 1912, 1,750 short tons, valued at $17,102, was used for abrasives, and approximately 12,500 short tons, valued at $37,500, was used for roofing, concrete surfacing, and poultry grit. Of the total quantity, 30.57 per cent was sold by the producer crude, and 69.43 per cent was sold ground. Of the total value the crude represents 17.10 per cent and the ground 82.90 per cent.

The following tables show the production of feldspar in 1911 and 1912 by States, with the increase or decrease in quantity and value in the several States for 1912 as compared with 1911, and the totals for the United States classified as crude and ground from 1907 to 1912.

These figures include feldspar for all purposes, and show the marketed product rather than the quantity actually quarried.

Production of feldspar in 1911 and 1912, by States, in short tons.

1911.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Connecticut	9,118	$27,450	7,379	$46,107	16,497	$73,557
Maine	112	300	25,864	246,005	25,976	246,305
Maryland	10,132	31,925	2,562	24,340	12,694	56,265
New York	587	2,456	18,213	77,470	18,800	79,926
Pennsylvania	2,967	9,078	10,317	92,012	13,284	101,090
California, Minnesota, North Carolina, and Virginia	5,215	17,185	234	4,680	5,449	21,865
Total	28,131	88,394	64,569	490,614	92,700	579,008

1912.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Connecticut	9,556	$34,943	9,519	$59,154	19,075	$94,097
Maine	67	180	19,024	172,896	19,091	173,076
Maryland	4,689	15,984	4,542	40,014	9,231	55,998
New York	3,192	14,250	19,000	87,275	22,192	101,525
Pennsylvania	1,947	4,985	7,504	66,302	9,451	71,287
California, Minnesota, North Carolina, Vermont, and Virginia	7,011	18,659	521	5,920	7,532	24,579
Total	26,462	89,001	60,110	431,561	86,572	520,562

Production and value of feldspar, 1911–12, by States, with increase and decrease and percentage of increase and decrease.

State.	1911		1912		Increase (+) or decrease (−) in quantity, 1912	Percentage of increase (+) or decrease (−) in quantity, 1912	Increase (+) or decrease (−) in value, 1912	Percentage of increase (+) or decrease (−) in value, 1912
	Short tons.	Value.	Short tons.	Value.				
Connecticut	16,497	$73,557	19,075	$94,097	+2,578	+15.63	+$20,540	+27.92
Maine	25,976	246,305	19,091	173,076	−6,885	−26.51	− 73,229	−29.73
Maryland	12,694	56,265	9,231	55,998	−3,463	−27.28	− 267	− 0.47
New York	18,800	79,926	22,192	101,525	+3,392	+18.04	+ 21,599	+27.02
Pennsylvania	13,284	101,090	9,451	71,287	−3,833	−28.85	− 29,803	−29.48
Other States having less than 3 producers	5,449	21,865	7,532	24,579	+2,083	+38.23	+ 2,714	+12.41
Total	92,700	579,008	86,572	520,562	−6,128	− 6.61	− 58,446	−10.10

Production of feldspar, 1907–1912, in short tons.

Years.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1907	31,080	$101,816	60,719	$457,128	91,799	$558,944
1908	18,840	65,780	51,634	362,773	70,474	428,553
1909	25,506	70,210	51,033	354,392	76,539	424,602
1910	24,655	81,965	56,447	420,487	81,102	502,452
1911	28,131	88,394	64,569	490,614	92,700	579,008
1912	26,462	89,001	60,110	431,561	86,572	520,562

FELDSPAR INDUSTRY BY STATES.

California.—The only quarry in California reporting shipments of feldspar was that of John C. Jens, near Chualar, Monterey County. This material was used for making pottery.

Connecticut.—Connecticut was the third largest producer of feldspar in 1912, being exceeded only by New York and Maine. Its production, 19,075 tons, valued at $94,097, was greater by 2,578 short tons in quantity and by $20,540 in value than that of 1911. The price in Connecticut for crude ranged from $3.09 to $5 a ton, with an average of $3.66; for ground, the range was from $5.25 to $9, with an average of $6.21; the average for all feldspar was $4.93 a ton. There were four producers. One company made no sales. Connecticut's feldspar is used for pottery, enamel ware, glass, abrasives, soaps, and tiles.

Maine.—Maine fell to second place in feldspar production in 1912, having yielded to New York. Six quarries were in operation. The production reported was 19,091 short tons, valued at $173,076. This was less by 6,885 tons, or 26.5 per cent, in quantity, and by $73,229, or 29.73 per cent, in value, than in 1911. The prices for crude feldspar were $2.75 and $3 a ton; for ground they ranged from $7.50 to $9.75, and averaged $9.09 a ton. The feldspar produced in Maine was used in pottery. A new mill erected at Topsham by the Maine Feldspar Co. was prepared to begin operations at the close of 1912.

Maryland.—Maryland was fifth in the list of feldspar producers for 1912. There were 10 producers. One new company, the Earth Products Co., near Laurel, continued development begun in 1911 and prepared to erect a mill. Three of the small operations have been discontinued. The production of the State for 1912 was 9,231 tons, valued at $55,998, a falling off from 1911 of 3,463 tons, or 27.28 per cent, in quantity and of $2.67, or 0.47 per cent, in value. The average price per ton of crude feldspar was $3.41 and of ground $8.81. In 1911 these prices were $3.15 and $9.50, respectively. Maryland feldspar is used chiefly for pottery.

Massachusetts.—There was no production of feldspar in Massachusetts in 1912, the quarry near Blandford, Hampden County, making no shipments.

Minnesota.—The one quarry in Minnesota, the product from which was used exclusively for abrasive paper, was not in operation in 1912. Small shipments were made in 1912 from material mined in 1910.

New York.—New York took first rank in production of feldspar in 1912. The larger part of this State's ground product is used for roofing, concrete facing, and poultry grit, the remainder for pottery, enamel ware, glass, and abrasive soap. There were four producing quarries in New York in 1912. Of these, the Bedford Feldspar Co., with quarries and mill at Bedford, Westchester County, is new. The total production for the State was 22,192 short tons, valued at $101,525, an increase over 1911 of 3,392 tons, or 18.04 per cent, in quantity and of $21,599, or 27.02 per cent, in value. The average price in New York for 1912 of crude feldspar was $4.46 a ton. Ground feldspar sold at prices ranging up to $7.50 a ton. The average price was $4.59.

North Carolina.—North Carolina, first producing in 1911, took sixth place in 1912. The Carolina Mineral Co., in Mitchell County, is still the only operator. There are prospects at other localities in Jackson, Yancey, and Madison counties.

Pennsylvania.—Pennsylvania was fourth among the feldspar-producing States in 1912. The production was 9,451 tons, valued at $71,287, a decrease as compared with 1911 of 3,833 tons, or 28.85 per cent, in quantity and of $29,803, or 29.48 per cent, in value. There were nine active and four idle quarries in the State. The Edgemont Feldspar Co.'s property was acquired by the Chester Products Co., which reports sale of feldspar for fertilizer. The average price per ton in Pennsylvania for 1912 was $2.56 for crude and $8.84 for ground. In 1911 these figures were $3.06 and $8.92, respectively. The feldspar produced in Pennsylvania is used for pottery, tile, enamel ware, glass, paint, poultry grit, roofing, and fertilizer.

Vermont.—The grinding plant completed by the A. L. Stone Manufacturing Co., of Chester, about the end of 1911 began production in 1912. This was the only feldspar operation in Vermont. The product was used for poultry grit, soap and cleansers, and pottery.

Virginia.—Only one quarry produced feldspar in Virginia in 1912, from which a small quantity was shipped for experimental potash extraction.

PRODUCTION IN OTHER COUNTRIES.

The following table gives such figures as are available on the production of feldspar in recent years in the United States and other countries:

Production of feldspar in the principal producing countries, 1908–1910, in short tons.

Country.	1908 [a]		1909 [a]	
	Quantity.	Value.	Quantity.	Value.
United States	70,474	$428,553	76,539	$424,602
Belgium	....	....	....	1,655
Canada	7,877	21,096	12,783	40,382
Germany (Bavaria)	6,458	15,456	3,473	11,976
Italy [b]	28,550	31,295	34,976	43,832
Madagascar	....	891	....	....
Norway [c]	37,960	124,202	40,167	127,556
Sweden	19,284	46,709	17,385	44,475

Country.	1910 [a]		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	81,102	$502,452	92,700	$579,008	86,572	$520,562
Belgium	....	1,655	(d)	(d)	(d)	(d)
Canada	15,809	47,667	[e] 17,723	[e] 51,939	[e] 12,233	[e] 25,416
Germany (Bavaria)	2,888	10,697	(d)	(d)	(d)	(d)
Italy [b]	29,872	40,057	(d)	(d)	(d)	(d)
Madagascar	....	15	(d)	(d)	(d)	(d)
Norway [c]	43,549	150,336	(d)	(d)	(d)	(d)
Sweden	23,800	57,566	(d)	(d)	(d)	(d)

[a] Statistics taken from Mines and Quarries: General report and statistics, pt. 4, London, except Italy, the latter being credited to Rivista del Servizio Minerario, Rome.
[b] Includes quartz.
[c] Export figures.
[d] Statistics not available.
[e] Preliminary report on mineral production of Canada, 1912: Canada Dept. of Mines, 1913.

QUARTZ.

INTRODUCTION.

Quartz (SiO_2), the oxide of silicon, is the most abundant of minerals. It occurs in a great many different forms, such as sand, tripoli, sandstone, and quartzite. In some forms, such as rose and smoky quartz and amethystine quartz, it has a gem value. This chapter deals only with massive crystalline quartz, with flint, and with quartzite that is used for other than building or paving purposes. Sand and other varieties of quartz are discussed in other chapters of the volume "Mineral Resources of the United States, 1912."

Massive crystalline quartz is usually white, but sometimes rose colored or smoky. It occurs in veins or dikelike masses unmixed with other minerals, or as a constituent of pegmatite. In the latter case it is usually produced as an accessory product in the mining of feldspar. The States producing massive crystalline quartz in 1912 were, in the order of the value of their output, Maryland, Wisconsin, Tennessee, California, Pennsylvania, Michigan, North Carolina, New York, Connecticut, Massachusetts, and Arizona. In quantity of material produced they ranked as follows: Tennessee, Maryland, Pennsylvania, Wisconsin, New York, North Carolina, California, Connecticut, Arizona, Michigan, and Massachusetts.

USES.

Quartz as treated in this chapter is used for many purposes. The principal uses are in the manufacture of pottery, paints, scouring soap, and as a wood filler. In pottery the use of quartz diminishes the shrinkage in the body of the ware; it is also used in many glazes. Quartz for use in pottery should contain less than 0.5 per cent of iron-bearing minerals. Considerable quantities of ground quartz are used in the manufacture of paint, as much as one-third of the total pigment used in some paints being this material. Crystalline quartz is superior to silica sand for this purpose because of the angularity of the grains, which makes them adhere more firmly to the painted surface and after wear affords a good surface for repainting. The same property renders ground crystalline quartz superior to silica sand in the manufacture of wood fillers. For soaps and polishing powders quartz is preferred to silica sand on account of its whiteness and angularity. Quartz crushed and graded to various sizes is used in the manufacture of sandpaper and sand belts, as a scouring agent, and for "frosting" glass with sand-blast apparatus, etc. Blocks of massive quartz and quartzite are used in the chemical industry as a filler for acid towers and as a flux in copper smelting. Ground quartz is also used in filters and in tooth powders and by dentists as a detergent.

Crystalline quartz and also sand have been used in the manufacture of silicon and of alloys of silicon with iron, copper, and other metals in the electric furnace. Quartz may be fused in the electric furnace to make chemical apparatus, such as tubes, crucibles, dishes, etc. The principal objection to the use of these wares is that the rough character of their surfaces makes it difficult to wash thoroughly all material from the apparatus.

PRODUCTION.

The production of quartz in 1912 was 97,874 short tons, valued at $191,685, against 87,943 short tons, valued at $155,122, in 1911. This was an increase in quantity over 1911 of 9,931 tons, or 11.29 per cent, and in value of $36,563, or 23.57 per cent. The increase in the quantity of the crude was 4,446 tons, or 5.72 per cent, with a decrease in value of $3,174, or 4.51 per cent. The increase of the ground was 5,485 tons, or 53.9 per cent, in quantity and $39,737, or 46.9 per cent, in value. The average price per ton for crude in 1910 was $1.62, in 1911 it was 91 cents, and in 1912 it was 82 cents. The average price per ton for ground quartz was $8.24 in 1910, $8.32 in 1911, and $7.94 in 1912. In 1912, of the total output 84.1 per cent was sold crude and 15.9 per cent ground, and of the value 35.08 per cent was for crude and 64.92 per cent was for ground.

The following tables show the production and value of quartz in 1911 and 1912 by kinds and States, and from 1908 to 1912 by kinds:

Production of quartz in the United States, 1911–1912, by States and kinds, in short tons.

1911.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Connecticut, Massachusetts, and New York	8,200	$20,371	1,110	$13,257	9,310	$33,628
Maryland	4,738	8,244	3,239	26,042	7,977	34,286
Pennsylvania and Tennessee	49,381	32,015	1,500	9,750	50,881	41,765
Other States [a]	15,440	9,800	4,335	35,643	19,775	45,443
Total	77,759	70,430	10,184	84,692	87,943	155,122

1912.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Connecticut, Massachusetts, and New York	5,802	$10,701	61	$1,758	5,863	$12,459
Maryland	10,130	15,369	5,995	46,782	16,125	62,151
North Carolina, Pennsylvania, and Tennessee	66,049	40,486	1,200	7,800	67,249	48,286
Other States [b]	224	700	8,413	68,089	8,637	68,789
Total	82,205	67,256	15,669	124,429	97,874	191,685

[a] Includes Arizona, Michigan, and Wisconsin.
[b] Includes Arizona, California, Michigan, and Wisconsin.

Production of quartz in the United States, 1908–1912, in short tons.

Years.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1908	26,478	$37,319	20,838	$152,838	47,316	$190,157
1909	121,459	131,334	14,010	118,132	135,469	249,466
1910	49,886	80,984	13,691	112,773	63,577	193,757
1911	77,759	70,430	10,184	84,692	87,943	155,122
1912	82,205	67,256	15,669	124,429	97,874	191,685

QUARTZ INDUSTRY BY STATES.

Arizona.—In Arizona in 1912 only one firm was operating—the Calumet & Arizona Mining Co., operating a quarry near Douglas, Cochise County. Miller Bros.' quarry in Yavapai County was not in operation. The quartz produced was ground and used for reverberatory bottoms. The Arizona output was approximately 94 per cent less in 1912 than in 1911. This State ranked ninth in the quantity produced in 1912 and eleventh or last in the value of its product.

California.—California became a producer of quartz in 1912, and took fourth place in value and seventh in quantity of product. One firm only, the Quartz Glass & Manufacturing Co., Los Angeles, reported production from a quarry in Perris Valley, Riverside County. The product was milled in Los Angeles and sold for paint, abrasives, plasters, cements, artificial stone and filters, and to foundries and chemical works.

Connecticut.—There was but one producer of quartz in Connecticut in 1912, A. P. Freeman, of Canaan. The output of the State was approximately one-third the quantity of 1911 and was all used for abrasive paper. Connecticut ranked eighth in quantity and ninth in value among the quartz-producing States.

Maryland.—Maryland was second in output and first in value of quartz, reporting 10,130 tons of crude quartz, valued at $15,369, or $1.52 a ton, and 5,995 tons of ground quartz, valued at $46,782, or $7.80 a ton. This was an increase in the quantity of crude quartz of 5,392 tons, or 114 per cent, and in value of $7,125, or 86.43 per cent. There was an increase in quantity of ground quartz reported of 2,756 tons, or 85.1 per cent, and in value of $20,740, or 79.6 per cent. Maryland reported 16.5 per cent of the total quantity and 32.4 per cent of the total value of the output in 1912. There were six producers in Maryland in 1912: Indian Rock (formerly Harford County) Flint Co., Conowingo; Husband Flint Milling Co., Baltimore; Thomas & Son, Westminster; Maryland Flint Co., Williamsport, Pa.; Guilford & Waltersville Granite Co., Baltimore; and H. Clay Whiteford & Co., Flintville. One quarry was preparing to open a new deposit. Maryland's quartz was used in the manufacture of pottery and for wood filler, soap, paint, sandpaper, filters, and in chemical manufacturing plants.

Massachusetts.—The only producer of quartz in Massachusetts in 1912 was the Enos Adams Co., with quarry and mill near Cheshire, Berkshire County. The product was used for facing cement brick, blocks, etc., and for soap and powder.

Michigan.—In Michigan the only producer, as in previous years, was the Michigan Quartz Silica Co., with mine at Ishpeming and mills at Ishpeming, Mich., and Milwaukee, Wis. Its product was used for wood filler and paint.

New York.—P. H. Kinkel's Sons, at Bedford, Westchester County, were the only producers in New York in 1912. The production was less than in 1911.

North Carolina.—The only producer of crude quartz in North Carolina in 1912 was Fred Oliver, of Charlotte, who operated a quarry at Mount Holly. The output was used for packing acid towers.

Pennsylvania.—There were two producing operators in 1912 in Pennsylvania—the Columbia Flint Co., with quarry near Bendersville, and Harry T. A. Rhodewalt, with quarry at Cornog station.

Pennsylvania was third in quantity and fifth in value of quartz production for 1912. The output for that year increased 5.35 per cent in quantity and decreased 11.73 per cent in value, as compared with the output in 1911.

Tennessee.—Tennessee was the largest producer of quartz in 1912, but ranked third in value of product. The Tennessee Copper Co. was the only producer and reported a larger production than in 1911. The product is of low grade and is used as a flux in copper smelting. This large production in Tennessee is responsible for the increase in the output of crude quartz and for the low average value for this variety.

Wisconsin.—The Wausau Quartz Co. was the only producer in Wisconsin in 1912. An analysis of the material of this company by Professor Daniels shows it to contain 99.07 per cent silica, 0.17 per cent iron oxide, and 0.52 per cent of alumina. It is used as a filtering sand, for roofing, as an abrasive, for chicken grit, and in concrete work.

IMPORTS OF FLINT PEBBLES.

The imports for consumption of flint pebbles into the United States in 1912 were valued at $292,052, as compared with $236,158 in 1911, $307,286 in 1910, $301,547 in 1909, and $219,754 in 1908.

The following table shows the imports of flint pebbles in 1912 by country of origin:

Imports of flint pebbles, unground, into the United States, 1912, by countries.

Belgium	$99,472
Canada	14,141
Denmark	78,123
England	870
France	99,140
Germany	$67
Norway	239
Total	292,052

The production of quartz in the United States and other countries for the years 1908 to 1912, inclusive, is given in the following table:

Production of quartz in the principal producing countries, 1908–1912, in short tons.

Country.	1908[a]		1909[a]	
	Quantity.	Value.	Quantity.	Value.
United States	47,316	$190,157	135,469	$249,466
Canada	44,741	52,826	56,924	71,284
Germany (Saxony)	[b] 2	[b] 268	....	[b] 10
Italy	([c])	([c])	([c])	([c])
Sweden	12,501	15,583	11,317	14,449

Country.	1910[a]		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	63,577	$193,757	87,943	$155,122	97,874	$191,685
Canada	88,205	91,951	[d] 60,526	[d] 83,865	[d] 100,242	[d] 195,216
Germany (Saxony)	....	....	([e])	([e])	([e])	([e])
Italy	([c])	([c])	([e])	([e])	([e])	([e])
Sweden	13,801	15,607	([e])	([e])	([e])	([e])

[a] Statistics taken from Mines and Quarries: General Report and Statistics, pt. 4, London, except Italy, the latter being credited to Rivista del Servizio Minerario, Rome.
[b] Includes mica and molybdenite.
[c] Included with feldspar.
[d] Preliminary report on mineral production of Canada, 1912: Canada, Dept. of Mines, 1913.
[e] Statistics not available.

FULLER'S EARTH.

By Jefferson Middleton.

INTRODUCTION.

The fuller's earth industry declined somewhat in 1912. The previous year had been one of considerable progress, and 1912 gave promise of being a record breaker, but these promises were not realized, the production decreasing from 40,697 short tons in 1911 to 32,715 tons in 1912, and the value from $383,124 to $305,522.

Chemically fuller's earth is a clay, often high in combined water; in color it ranges from gray to dark green; when dry it often adheres to the tongue, though this quality is found in some other clays. A chemical analysis is of little value in determining the value of clay as fuller's earth; actual use is the only criterion.

OCCURRENCE.

Fuller's earth occurs in Alabama, Arkansas, California, Colorado, Florida, Georgia, Massachusetts, Minnesota, Mississippi, Nebraska, New York, South Carolina, South Dakota, Texas, Utah, and Virginia; but it was produced in 1912 in only seven States, namely, Arkansas, California, Colorado, Florida, Georgia, Massachusetts, and Texas, the same number as for 1911, but South Carolina dropped out in 1912 and Colorado entered the list of producers.

MINING AND PREPARATION.

In this country fuller's earth in mined with pick and shovel. When mined it contains more or less water, and is dried either in the sun or by artificial means. After being dried it is ground to 60 mesh or finer and is then ready for shipment. In England the earth is washed in long, narrow troughs very much like hydraulic sluice boxes, a large percentage of the material being allowed to settle out as sand, while the lighter material goes off into settling tanks, where it is dried; it is then sold in the resulting lump form.

USES.

The principal use of fuller's earth in this country is in the bleaching, clarifying, or filtering of fats, greases, and oils. The common practice with mineral oils is to dry the earth carefully after it has been ground to 30–60 mesh and run it into long cylinders, through which the crude, black mineral oils are allowed to percolate slowly. As a result the oil that first comes out is perfectly water white and much thinner than that which follows. The oil is allowed to continue percolating through the earth until the color reaches a certain maximum shade.

With the vegetable oils the process is radically different. The oil is heated beyond the boiling point of water in large tanks, from 5 to 10 per cent of its weight of fuller's earth is then added, and the mixture is vigorously stirred and then filtered off through bag filters. The coloring matter remains with the earth, the filtered oil being of a pale straw color, provided the operation has been conducted with sufficient care.

HISTORY.

For a great many years fuller's earth, as its name indicates, was used for fulling cloth, and until 1893 it was imported for this purpose from England, the then only known source of supply. With the growth of the domestic vegetable-oil industry a demand arose for a clarifying agent, and fuller's earth was used extensively, whereas for filtering mineral oils bone black was used. Upon the discovery of fuller's earth in this country it superseded bone black as a detergent for mineral oils.

At first it was thought that American earths were better adapted for use on mineral oils and that English earths were better for fats and vegetable oils. In recent years, however, the American earths have been quite freely used in clarifying cottonseed oil and animal fats.

For many years it was thought that fuller's earth was first discovered in this country in 1893 at Quincy, Fla. In 1912, however, J. C. Branner[1] stated that in 1891, while he was State geologist of Arkansas, John Olsen, who is at present a producer of fuller's earth, discovered fuller's earth near Alexander, Ark. The analysis of the material was so similar to that of the imported earth that a practical test was made by the Southern Cotton Oil Co., at Little Rock. Branner states that the material was used for some time by this company, but he does not know how long before its use was finally abandoned.

The fuller's earth discovered in Florida in 1893 therefore seems to have been the first commercially successful deposit found, and from this discovery the industry was developed.

From the inception of the industry Florida has been the leading producing State. During the early history of the industry the production was from only two or three States. In 1897–1899 it was reported from Florida, Colorado, and New York, with a very small production from Utah; in 1901 Arkansas was added to the list. From 1904 to 1907 Arkansas was the second largest producer. Fuller's earth was found in Georgia soon after its discovery in Florida, but Georgia did not appear as a producer until 1907, when it was the third largest producing State; it has ranked second since 1909, inclusive. In 1904 Alabama and Massachusetts and in 1907 South Carolina and Texas first reported production, and in 1909 California entered the list.

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[1] Trans. Am. Inst. Min. Eng., vol. 43, 1913, pp. 520–522.

PRODUCTION.

The following table shows the production of fuller's earth in the United States from the beginning of the industry:

Production of fuller's earth in the United States, 1895–1912, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1895	6,900	$41,400	$6.00	1904	29,480	$168,500	$5.72
1896	9,872	59,360	6.01	1905	25,178	214,497	8.52
1897	17,113	112,272	6.56	1906	32,040	265,400	8.28
1898	14,860	106,500	7.17	1907	32,851	291,773	8.88
1899	12,381	79,644	6.43	1908	29,714	278,367	9.37
1900	9,698	67,535	6.96	1909	33,486	301,604	9.01
1901	14,112	96,835	6.86	1910	32,822	293,709	8.95
1902	11,492	98,144	8.54	1911	40,697	383,124	9.41
1903	20,693	190,277	9.20	1912	32,715	305,522	9.34

In 1912 the production decreased 7,982 tons, or 19.61 per cent, from 1911, and the value decreased $77,602, or 20.26 per cent. The production in 1912, 32,715 tons, was the smallest since 1908. The average price per ton also decreased slightly in 1912.

The following table shows the production of fuller's earth in 1911 and 1912, by sections:

Production of fuller's earth in the United States, 1911–1912, in short tons.

	1911				1912			
	Number of operators.	Quantity.	Value.	Average price per ton.	Number of operators.	Quantity.	Value.	Average price per ton.
Eastern States [a]	9	39,528	$371,384	$9.40	8	31,496	$291,099	$9.24
Western States [b]	4	1,169	11,740	10.04	5	1,219	14,423	11.83
Total	13	40,697	383,124	9.41	13	32,715	305,522	9.34

[a] Includes, 1911, Florida, Georgia, South Carolina, Massachusetts, Texas; 1912, Florida, Georgia, Massachusetts, Texas.
[b] Includes, 1911, Arkansas and California; 1912, Arkansas, California, Colorado.

Owing to the small number of producers in each State it is impossible to give State totals, so the table has been made to show simply the production of the Eastern and the Western States. The eastern section of the country continues to produce by far the larger portion of the fuller's earth marketed, its eight operators reporting 96.27 per cent of the quantity and 95.28 per cent of the value of the entire output. In value of production Florida was the leading State in 1912, Georgia was second, Arkansas was third, and Texas was fourth.

The decrease in production and value was in the Eastern States, the Western States showing a small increase in quantity and a considerable increase in value of production. The average price per ton increased in the West from $10.04 in 1911 to $11.83 in 1912, and was $2.59 higher than in the East in 1912.

NOTES ON THE FULLER'S EARTH INDUSTRY, BY STATES.

Alabama.—No fuller's earth was reported from Alabama in 1912, the operations near Mobile having been abandoned.

Arkansas.—Only two of the five operators of this State reported production for 1912, namely, John Olsen, at Klondyke, and Adams & Bemis, at Murfreesboro. The Arkansas Fuller's Earth Co., with mine at Fairplay, was succeeded during the year by the Fuller's Earth Union (Ltd.), of London, England. The earth from this State is reported as having been used in refining cottonseed oil and lard.

California.—California had only two producers of fuller's earth in 1912—the Eight Oil Co., at Bakersfield, and the Western Fuller's Earth Co., at Vacaville. The fuller's earth in California is reported as having been used in refining animal fats and vegetable oils.

Colorado.—Colorado in 1912 again entered the list of producers of fuller's earth. The American Clay Co., of Akron, was the only producer, its earth being used in bleaching cottonseed oil.

Florida.—Florida is the leading producer of fuller's earth. There were three operators in 1912—the Atlantic Refining Co., at Ellenton, the Floridin Co., at Jamieson and Quincy, and the Fuller's Earth Co., at Midway. The Florida earth is used for refining petroleum and vegetable oils and greases and as a filler for rubber.

Georgia.—Two companies reported sales of fuller's earth in Georgia for 1912—the Lester Clay Co., at Attapulgus, and the General Reduction Co., at Dry Branch. Demand was reported in excess of the supply in this State.

Massachusetts.—Only one firm has produced fuller's earth in Massachusetts for several years—Messrs. J. E. & R. M. Farnsworth, of Lancaster. The earth is used for fulling woolen goods.

Minnesota.—The only known deposit of fuller's earth, near Austin, was not worked in 1912. It is owned by the P. D. McMillan Land Co., of Minneapolis.

Mississippi.—A large deposit of fuller's earth, said to be suitable for clarifying vegetable oils, is reported to occur at Bay Springs, Miss. It has not been developed. The deposit is owned by Hon. A. H. Longino, of Jackson.

New York.—The only developed deposit of fuller's earth in New York is that of the New York Fuller's Earth Co., in Oneida County. It was not worked in 1912.

South Carolina.—The two fuller's earth companies in South Carolina—the Sugar Loaf Mining Co., with mine in Chesterfield County, and the National Earth Co., with mine in Williamsburg County—were idle in 1912.

South Dakota.—The plants of the Argyle Fuller's Earth Co. at Argyle, and of William Bodenner, near Fairburn, were idle in 1912.

Texas.—Of the eight operators in Texas in 1912 only two—the Fuller's Earth Co., of Houston, with mine at Somerville, Burleson County, and the Commercial Pulverizing Co., of Houston, with mines in Fayette and Burleson counties—reported production. The fuller's earth was used for bleaching vegetable oils and animal fats.

Utah.—The only deposit of fuller's earth in Utah known to the Survey was not worked in 1912. It is located in San Pete County, and is owned by George F. Young, whose address is North Powder, Oreg.

IMPORTS.

The following table shows the imports of fuller's earth from 1897 to 1911, inclusive:

Fuller's earth imported for consumption into the United States, 1897 to 1912, in short tons.

Year.	Unwrought or unmanufactured.			Wrought or manufactured.			Total.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
1897 [a]	2,585	$14,283	$5.53	2,395	$20,037	$8.37	4,980	$34,320	$6.89
1898	2,283	15,921	6.97	7,073	55,123	7.79	9,356	71,044	7.59
1899	4,192	23,194	5.53	7,366	46,446	6.31	11,558	69,640	6.03
1900	2,723	14,750	5.42	6,431	50,047	7.78	9,154	64,797	7.08
1901	3,266	17,230	5.28	8,792	63,467	7.22	12,058	80,697	6.69
1902	4,239	26,635	6.28	10,895	75,945	6.97	15,134	102,580	6.78
1903	4,260	28,339	6.65	12,840	92,332	7.19	17,100	120,671	7.06
1904	1,975	9,546	4.83	8,247	64,460	7.82	10,222	74,006	7.24
1905	1,705	12,798	7.51	12,858	93,199	7.25	14,563	105,997	7.28
1906	2,905	20,129	6.93	11,920	88,566	7.43	14,825	108,695	7.33
1907	2,490	16,833	6.76	13,916	105,388	7.57	16,406	122,221	7.45
1908	2,363	16,242	6.87	9,803	77,171	7.87	12,166	93,413	7.68
1909	1,802	12,492	6.93	10,950	88,659	8.10	12,752	101,151	7.93
1910	2,160	14,399	6.67	14,427	118,146	8.19	16,857	132,545	7.86
1911	1,881	10,877	5.78	16,343	132,717	8.12	18,224	143,594	7.88
1912	1,970	11,619	5.90	17,139	133,718	7.80	19,109	145,337	7.61

[a] July to December.

The increase in the imports in 1912 was only 885 tons, or 4.86 per cent, in quantity and $1,743, or 1.21 per cent, in value. The imports are nearly all of the wrought or manufactured earth, 89.69 per cent of the quantity and 92.01 per cent of the value being of that variety.

In the following table is shown the quantity and value of the fuller's earth imported from 1867 to 1883 by fiscal years. The wrought and unwrought earths were not classified separately during this period. From July 1, 1883, to June 30, 1897, fuller's earth was not reported separately in the customhouse returns to the Treasury Department, but was included in minerals "not elsewhere specified."

Imports of fuller's earth into the United States, 1867–1883, in short tons.

Year ended June 30—	Quantity.	Value.	Year ended June 30—	Quantity.	Value.
1867	314	$3,113	1876	277	$3,097
1868	236	2,522	1877	448	4,460
1869	363	3,587	1878	375	4,095
1870	268	2,619	1879	404	4,269
1871	325	3,383	1880	647	6,925
1872	307	3,358	1881	300	3,207
1873	281	2,978	1882	1,017	11,444
1874	310	3,440	1883	1,390	14,309
1875	336	3,694			

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GEMS AND PRECIOUS STONES.

By Douglas B. Sterrett.

INTRODUCTION.

The principal gem mineral mined in the United States during 1912 was Montana sapphire, of which there was a large output for use both as gems and in mechanical applications. The greater part of the gem sapphires came from the mines in Fergus County, where they occur in a rock matrix. The majority of these stones have the true sapphire-blue color. The bulk of the sapphire for mechanical use came from the placer deposits in Granite and Deer Lodge counties and consists of varicolored stones.

The development of the opal deposits of Humboldt County, Nev., was attended with much success, and a quantity of magnificent gem material was obtained. The opal is of an unusual type, consisting of dark translucent mineral with a variety of rich colors. The deposits promise to supply a gem equal if not superior in beauty to the opal from Australia.

Prospecting and mining at the emerald mine in North Carolina were attended with only partial success. Two pockets or deposits of emerald were removed during the year; other developments consisted mainly of exploratory work, which has continued into 1913.

The tourmaline output of southern California was small, but some magnificent specimen crystals were obtained. Especially fine gem crystals of kunzite were found and brought good prices. The production of turquoise was very small, compared with some previous years. Beautiful amethyst was found in Warren County, N. C., and some fine gems have been cut from sample crystals. A few fine specimens of golden beryl were obtained from prospects in Alexander County, N. C. Beautiful gems were cut from some of these. The production of agate and associated varieties of chalcedony was again large in several Western States.

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AMETHYST.

DISTRIBUTION.

Amethyst is widely distributed over the Piedmont and mountain regions of the Southeastern States. Some of the deposits have been prospected or mined, and at others no work has been done. Several localities in North Carolina and Georgia were described in this report for 1910 and 1911. Many other localities in North Carolina and Virginia were visited during 1912 and will be described. A few of these seemed promising. At many of the localities the prospects were not seen under favorable circumstances, for little recent work had been done and the best specimens had at most places been already picked up. Pale-purple crystals are all that have been left around many of the prospects. The crystals found on the immediate surface are generally paler colored than those which have not been exposed to the sun and weather, so that surface specimens should not be used as a definite criterion of the color to be expected in those under ground.

NORTH CAROLINA.

The deposits in North Carolina described below are all in the Piedmont Plateau and are associated with the crystalline rocks of that region. Very little work has been done at any of the localities, and prospecting at some of them might result in the discovery of good gems. Fine gem amethyst has already been obtained from some of the localities.

Warren County.—Amethyst occurs at a number of places in Warren County, at some of which fine gem material has been found. An especially promising prospect is located on the Cherry Hill plantation of George W. Alston, at Inez, about 11 miles southeast of Warrenton. There is another promising prospect on the old John Buxton Williams plantation, about 2 miles south of Inez. This place now belongs to Fuller & Person, of Louisburg, N. C. A few specimens have been found on Mrs. Jennie Connell's plantation, about 2 miles southeast of Inez. Good specimens and gems are reported to have been found on the surface and in a pit at Folly Springs, about one-third of a mile southwest of Warrenton.

Warren County lies chiefly within the Piedmont Plateau region of North Carolina along the border of the Coastal Plain. Its elevation ranges from less than 200 feet above sea level along the rivers to about 500 feet in the less dissected parts of the plateau, in the western portion of the county. In general the country is nearly flat or gently rolling, with steep hills only along the larger drainage lines. Warrenton is situated on a slightly dissected remnant of the plateau. Inez is located in the fork of one of the elevated ridges, and the country immediately around it has small relief. The Williams and Connell places are on two forks of the same ridge, but are nearer Shocco Creek and accordingly in more broken country.

Amethyst has been found at two places on the Alston plantation, about 200 yards south and about 150 yards southeast of the house. Both prospects are located in a slight hollow, the former in the edge of a small patch of woods and the latter in a cultivated field. At the time of examination the prospect in the woods had been opened by a small pit and a trench about 3 feet deep and 10 feet long on the vein. These openings were about 12 feet apart in a N. 30° W.-S. 30° E. direction from each other. No rock outcrops were seen near the amethyst prospect, but the surface is covered with a light sandy soil containing scattered blocks of granite and pegmatite. The country rock around Inez is chiefly granite, with hornblende schist and mica schist both to the north and to the south for a distance of a few miles. The amethyst occurs in a vein from 1 foot to more than 2 feet thick, striking about with the workings, N. 30° W. This vein consists of irregular seams, streaks, and pockets with or without amethyst crystals, in decomposed fine granite and pegmatitic granite. Black manganese oxide is associated with the crystals and fills most of the seams and veinlets; in places it occurs as small botryoidal and stalactitic masses. Many of the crystals are partly or entirely coated with this manganese oxide, and it is only by breaking them or scraping off the coating that the quality of the stone can be determined.

The crystals are rather stout and range from a fraction of an inch to 3 inches in diameter. The majority have transparent clear portions, suitable for gems when the color is good. The crystals range from practically colorless amethystine to rich dark purple. They have a distinctive reddish-violet tint and yield brilliant gems. Under artificial light these gems lose nothing of their beauty but become an even more beautiful lively reddish purple. In many crystals the color is not evenly distributed but is arranged in layers or streaks parallel to certain crystal faces. One transparent fractured crystal from this locality exhibits a remarkable color variation when viewed in transmitted light. The light transmitted directly through the the crystal is a beautiful reddish purple. That transmitted with an interior reflection is a magnificent bluish purple.

About half a bushel of rough crystals were obtained from the two openings. Of these possibly a quart were suitable for cutting into gems of especially fine quality, 2 quarts could be cut into gems of ordinary quality, and the remainder would probably be suitable only for specimens or might be cut into cheap gems.

The possible extension of this amethyst vein is concealed by its location in the woods. Three small amethysts were found in the light sandy soil of a field about 50 yards S. 40° E. of the pits. Further prospecting might show the continuation of the vein to this point.

No work had been done at the prospect 150 yards southeast of the house, but a quantity of amethystine quartz crystals have been found in the light sandy soil at that place. The crystals are scattered over a belt about 30 feet wide and nearly 100 feet long in a west of north direction. Some of them are quite clear, but only pale purple. Common vein quartz and quartz inclosing plates of titanic iron also occur with the amethyst. An east-west crosscut trench would probably locate the vein.

Only a few specimens of amethysts were seen on the old John Buxton Williams place, but the quality of these and reports concerning the quantities of fine specimens that had been carried away show that the prospect is a very promising one. No digging has been done, but the crystals have been picked up as specimens by different people during many years, apparently with little thought of their possible value. The amethysts are found on a knoll about a quarter of a mile northwest of the house, outside of the southeast corner of the Williams cemetery. The knoll has been cultivated and is covered with light sandy soil containing angular fragments of fine granite gneiss, quartz, feldspar, and pegmatite composed of smoky quartz, potash feldspar, and mica. Porphyritic hornblende crystals were observed along the bedding planes of some of the fine granite gneiss.

The amethysts are scarce on the surface now, but information furnished by persons who have been visitors at the Williams place shows that they were plentiful some years ago. The specimens found at the time of examination consisted of stout crystals, the largest one measuring 2 inches thick and 2 inches long. The color of the best specimens was very similar to that of the amethyst from the Alston place—that is, characterized by a fine reddish-violet tint. These crystals are clear and brilliant. The color is segregated in patches or layers, and is in evident relation to the crystal structure. The large crystal mentioned is rather pale purple and incloses a few scattered reddish rutile needles. One specimen is partly incrusted with black manganese oxide, like those at the Alston prospect. The occurrence of amethysts on the surface with the depth of color and transparency of a few of those found is considered an especially good indication of a deposit containing good gem material.

As far as could be learned no real gem amethyst has been found on Mrs. Jennie Connell's plantation. A few specimens of amethystine quartz have been found in cultivated land north of the house. In the specimens seen the purple occurred in patches through smoky and gray quartz. Rough fragments of smoky and gray quartz are abundant over the ground in the vicinity. Bluish-green fractured beryl has been found in pegmatite a few hundred yards west of the Connell house in a little stream. The possible occurrence of a better grade of beryl suitable for gems had not been determined.

Lincoln County.—There are many occurrences of amethyst in Lincoln County. Besides the few places described below other localities have been reported. Two prospects were visited on the land of the Misses Rendleman, 2 miles northeast of Iron Station. One of these is about 200 yards south of the old Rendleman home along the east side and on the spur of a small ridge. A few small pits have been dug, but the best specimens observed were loose in the sandy soil of a cultivated field. The crystals were found through a distance of about 100 yards in a north-south direction. The biotite granite gneiss country rock has mostly decomposed to a friable sandy gray saprolite, but around the amethyst prospects it has been hardened by silicification. This process has developed numerous seams and veinlets of quartz crystals, with comb structure through the rock. Some of the larger veinlets carry amethystine quartz and amethyst. Of the crystals found at the time of examination some were pale purple and others a smoky purple. The latter consisted in part of smoky quartz and in part of amethyst, with the different colors generally arranged in layers or zones parallel to the crystal faces. Such specimens furnish good examples of "ghost" or "phantom" crystals. Clear and smoky quartz crystals are also found loose in the soil about 100 feet west of the amethyst lead.

The other and more promising prospect on the Rendleman place is about a quarter of a mile southeast of the house, on a low rocky knoll in a cultivated field. No digging has been done and only surface specimens were seen. The crystals are scattered over an area about 150 feet across, in which no direction of a lead could be determined. The country rock is decomposed granite, but the knoll on which the amethysts are found is covered with rough blocks of silicified granite. Evidently the occurrence of amethyst is connected with this silicification, as at the other prospect, for in some specimens groupings of amethyst crystals are associated with the seams of smaller quartz crystals in the silicified granite. Amethystine quartz crystals measuring 3 inches across were found and specimens more than 1 inch thick were common. A few amethysts of medium dark purple color were seen, but the majority were pale. Some of the crystals are fairly clear and would be suitable for gems if darker colored.

A small prospect was opened for amethysts several years ago on the land of J. P. Lynch, 1¾ miles northeast of Iron Station. The pit is now filled up, but a few pale amethysts were found in the sandy soil at that place and other specimens were seen in the possession of Mr. Lynch. The amethysts were associated with silicified granite, as at the Rendleman prospects. A slab of this rock covered with pale amethysts and quartz crystals, some of them half an inch thick, in the possession of Mr. Lynch, showed that the mineral occurs here lining the walls of a fissure or other cavity. Groups of much larger crystals were found, also. Some of the amethystine quartz crystals are clear and brilliant.

A quantity of smoky quartz crystals and clusters of crystals measuring 2 inches or less in diameter are found on the place of George W. Goodson, about 5 miles north of east of Iron station. So far as known no amethysts have been found here.

A few amethystine and colorless quartz crystals were seen on the place of Miss Mary Forney, about 1¼ miles southwest of Denver. The crystals were found loose in the soil of a cultivated field about 250 yards north of the old Forney home. No work has been done, and probably most of the surface crystals have been picked up.

Better-colored stones than those seen at the time of examination are reported to have been found. The country rock is granite gneiss, decomposed near the surface, inclosing streaks of mica schist. Hornblende gneiss saprolite outcrops near the house and to the west. No vein has been located, and it is probable that the surface specimens came from more than one deposit.

Amethyst has been found at many localities in Iredell County, N. C. Probably the greatest amount of work has been done and the best specimens obtained from the A. C. Cook place, 9 miles southeast of Statesville. No digging has been done at many of the prospects and the only crystals found were loose in the soil. Such prospects were seen on Mrs. M. G. Martin's place, about half a mile west of the Cook mine; on the Burette Brawley place, about 1½ miles south of Cook's; on the J. S. Fisher place, 4½ miles N. 75° W. of Mooresville and 12½ miles south of Statesville; and on the Joe Cornelius place, 6 miles N. 80° W. of Mooresville. Other occurrences have been reported in Iredell County and in Rowan County adjoining, on the land of J. T. Eudy, at Mount Ulla.

The amethysts on the A. C. Cook place were worked about 12 years ago by H. S. Williams, of New York. The prospect had been located by a large quantity of crystals loose in the light, sandy soil of a field. At the time of examination, in 1903, there was a shaft about 12 feet deep with other workings from it badly caved in. The crystals occurred in veinlets and streaks, cutting decomposed pegmatitic granite. A quantity of crystals were left around the workings and a few of gem quality were found washed out of the dirt by rains. It is reported that only a small quantity of amethysts of fairly good color were found, though many crystals were suitable for cutting into less valuable gems. A large quantity of amethystine quartz crystals suitable for specimens and even for cutting into cheap gems was obtained. Some of the darker-purple crystals contained small rutile needles, penetrating them at various angles. The crystals seen reached a maximum of an inch and a half in thickness.

The occurrences on Mrs. M. G. Martin's plantation and on the Burette Brawley plantation are similar. At both places the crystals have been found in coarse, light, sandy, soil formed by the decomposition of granite probably inclosing pegmatite. At both places amethystine quartz crystals measuring nearly 2 inches thick and fairly clear were observed. Better specimens were reported to have been found.

The amethyst on the J. S. Fisher plantation has been found scattered over the surface on about an acre of ground some 200 yards northeast of the house. The crystals are loose in the light sandy soil of a cultivated field, and no location or direction of vein has been determined. It is probable that there is more than one vein in the granite saprolite underlying the field. Only pale-purple and colorless quartz crystals were seen at the time of examination.

On the J. Cornelius place amethyst crystals have been found on the surface in a cultivated field. The field is on a north slope and has gray sandy soil with blocks of partly weathered biotite granite gneiss scattered through it. A ledge of granite gneiss outcrops above the amethyst prospect with a strike of N. 65° E. and a dip of 30° SE. The position and probable direction of the vein have not been determined. The best colored crystals are reported to be found associated with shells or veinlets of limonite that have weathered out on the surface. Only pale purple and colorless crystals were found at the time of examination, but some of these were quite transparent.

Davidson County.—Amethysts have been found at two places on the plantation of N. H. Swicegood, about 5 miles northwest of Linwood and 1 mile south of Taro, in Davidson County. These prospects are about one-fifth of a mile west and northeast of the house, respectively. At the former place a trench 15 feet long and 8 feet deep was dug along a vein striking about S. 25° W. and exposed in the bank of a stream. This work was done in 1909, and several pounds of good crystals are said to have been found. At the prospect northeast of the house a trench about 15 feet long had been made on a vein striking northwest. This work was done some 25 or 30 years ago, and about 300 pounds of amethysts are reported to have been taken out in one day. Only a few pale-purple or amethystine quartz crystals were found around the prospects at the time of examination.

The rock in the region around Taro is granite with coarse porphyritic phases. Most of it has weathered at the surface to light sandy soil and saprolite. Decomposed porphyritic phases were encountered in the amethyst prospects. This granite area extends within about 1½ miles of Linwood and from that point to Linwood the country rock is chiefly diorite.

Franklin County.—An investigation was made of the reported occurrence of amethyst near Louisburg, Franklin County, N. C. Amethystine quartz has been found there in two places—on the corner of Nash and Cedar Streets in Louisburg and along the public road about 1 mile northeast of the town in front of the cemetery. At Nash and Cedar Streets a few small, pale, clear amethystine quartz crystals were found in the light sandy granitic soil. A specimen from the other locality seen in a private collection in Louisburg consisted of a slab 7 inches in diameter and 2 inches thick studded with clear quartz and amethystine quartz crystals as much as two-thirds of an inch in thickness. No specimens were found at the time of visit to the locality, but this may have been in part due to improvements on the road covering the original prospect. The rock at this point is evidently granitic, as shown by the light soil and saprolite formed by its decomposition.

A large ledge of pegmatitic quartz extends across Thomas B. Wilder's place on Nash Street in a N. 25°–30° E. direction. This ledge contains many cavities lined with small quartz crystals. It is reported that a few amethysts have been found in some of the cavities.

VIRGINIA.

Nelson County.—Amethysts were mined about 5 years ago by the American Gem & Pearl Co., of New York, on the John Saunders place, 2½ miles northeast of Lowesville and 8½ miles N. 60° W. of Arrington, in Nelson County. A dozen or more pits were dug along the summit of a low flat ridge in a N. 70° W.-S. 70° E. direction. The pits cover an area about 300 feet long, its greatest width being about 125 feet. They range from 2 to 7 feet deep. Little could be learned of the nature of the occurrence of the amethysts from the pits. The gems were found in pockets, one of which is reported to have yielded about 40 pounds. M. D. Rothschild, president of the American Gem & Pearl Co., states that some of the amethysts obtained were very fine.

Rock outcrops are scarce near the mine and the nature of the country rock could not be definitely ascertained. A reddish, somewhat sandy, saprolite containing scattered fragments of bluish-opalescent quartz and a few small bodies of kaolin were encountered in the pits. The saprolite is suggestive of a granitic rock inclosing pegmatite. On the surface of the ground along the ridge there is a little débris of a pegmatitic rock composed of blue quartz, feldspar, and hornblende, with a little apatite in some specimens. These observations agree with the conditions outlined in the report of Watson and Taber [1] on the rutile deposits in the adjoining region, in which the country rock is described as a complex metamorphosed gneiss of igneous origin corresponding to quartz monzonite. This gneiss is intruded by various later igneous rocks, among which is pegmatite consisting essentially of feldspar and blue quartz with hornblende, apatite, and rutile present in many places. This rock forms the rutile ore in some of the mines operated for that mineral.

Amherst County.—A rather promising occurrence of amethyst is known on the W. P. Sutton place at Fancy Hill, one-third of a mile north of Sandidges post office and 7 miles N. 33° W. of Amherst, in Amherst County. The crystals have been found along a ridge at two places, one about 250 yards and another about 100 yards northeast of C. H. Floyd's house. At the first place amethystine quartz crystals have been picked up in some quantity from an old woods road leading off of the ridge to the northwest. At the second place only a few crystals have been found in the same road along the summit of the ridge. No digging has been done at either place, but it is possible that little work would be required to locate the veins. The country rock of the region surrounding the amethyst deposits is a gneiss of granitic composition, intruded by pegmatite and pegmatitic granite with a porphyritic texture. The pegmatitic rocks contain abundant blue opalescent quartz similar to those of the rutile region in Nelson County already mentioned in the description of the American Gem & Pearl Co.'s amethyst mine.

The amethyst crystals found range from very pale purple to fairly dark purple. In some specimens the purple inclines to a light reddish violet of very pleasing tint. Segregations or patches of color are common in the crystals, their positions generally being influenced by the crystal structure. The majority of the crystals seen were short stout prisms with one or both ends terminated by the rhombohedral faces. Most of the crystals were less than an inch thick. Colorless quartz crystals occur at other points on the Sutton place.

Charlotte County.—Amethyst is found on the A. W. Donald plantation, about 2¼ miles north of west of Charlotte Court House, in Charlotte County. The occurrence of these crystals has been known to members of the Donald family for more than 35 years. Many specimens have been picked up as curiosities, but no use has been made of them as gems. The amethysts have been found rather

[1] Watson, T. L., and Taber, Stephen, The Virginia rutile deposits: Bull. U. S. Geol. Survey No. 430, 1910, pp. 200–213.

plentifully scattered over the fields through a distance of about 200 yards in an east of north and west of south direction. The road from the house to town crosses this lead. A few small test pits have been made, one northeast and others southwest of the road.

The country rock exposed near the amethyst prospects is hornblende gneiss and schistose diorite inclosing granite and pegmatite. The strike of the diorite is N. 10°–45° E. and the dip 40°–60° SE. The lead of amethyst cuts this at a small angle having a more northerly trend. The pit northeast of the road was made some years ago and is now filled up. Many pale amethystine quartz crystals are scattered over the surface here, and Mr. Donald states that amethysts were found equal in color to those from the later pits. In a trench about 4 feet deep and in other small pits on the southwest side of the road several seams and pockets of amethystine quartz and amethyst crystals were found in dark-red clay, probably decomposed hornblendic rock. The seams were irregular in size and direction. In places they opened into pockets of crystals.

A large number of amethysts were plowed up in the field a few yards south of this place, at which point an irregular vein striking N. 15° W. with a vertical dip was exposed by a pit 2½ feet deep. This vein was inclosed in hornblende gneiss saprolite and ranged from 2 inches thick at the surface to 12 inches thick in the bottom of the pit. The thicker part was composed of more than one streak of crystals embedded in red clay. A lump of clay about 12 inches thick removed from the vein apparently contained 4 streaks of amethyst crystals, 1 to 3 inches thick, with red-clay filling between. These four streaks were in reality only two veins lined with a layer of crystals on each wall. The crystals grew with their points turned toward the opposite wall of the vein, but failed to fill the fissure in which they formed. In this way veins with typical comb structure were produced with cavities or vugs in the middle. By weathering the inclosing hornblende gneiss was changed into a red clay saprolite and some of this clay was washed into the cavities in the veins.

A quantity of amethysts were plowed up in the field about 20 yards south of this pit. The groupings of the crystals found here indicate a deposit similar to that exposed in the pit just described.

No fine gem amethysts were seen at the Donald prospect, but the examination was not made under most favorable conditions. The majority of the crystals are rudely developed owing to mutual interference during growth. Most of them have the rhombohedral terminations at one end with only part or none of the prism faces. The rest of such crystals show striated indentations formed by contact with other crystals. Most of the amethysts from the 2½-foot pit described above are coated with a shell of lighter colored or gray quartz less than a millimeter thick. The stones range from practically colorless, to amethystine quartz, to crystals with a fine deep-purple color. As is common in amethysts the color is not evenly distributed through the crystals, but is stronger in one part than another. The patches of color are influenced by crystal structure as shown by their shape and position. The majority of the crystals are not highly transparent, but a few were seen which would cut into small clear gems of rich violet color.

Amethyst has also been reported on the Wingo place, about 4 miles south of Charlotte Court House.

Campbell County.—Amethyst occurs in several places in Campbell County. Crystals have been picked up in a field and a few dug from the roadside on the land of Lacey Rush, about one-third of a mile northeast of Brookneal. Two large crystals have been found here, one measuring nearly 10 inches long and 4 inches thick. The purple color in this crystal is rather pale and occurs chiefly in two layers parallel to two rhombohedral faces at one end. The rest of the crystal is colorless or gray. Colorless quartz crystals are more plentiful than the amethystine-colored ones.

Amethysts and amethystine quartz crystals have been found on the L. H. Clay place, about 10 miles northeast of Brookneal and nearly 3 miles south of west of Red House. They are rather sparingly scattered over the fields 200 to 400 yards northwest of the house. One crystal 2½ inches long and seven-eighths of an inch thick was seen, one end of which was medium dark reddish violet. Amethysts are also reported in the fields of the Shelton Jennings place, three-fourths of a mile southwest of the Clay house.

Practically no work has been done at any of these places. All of the prospects are in areas of light sandy soil formed by the disintegration of granitic rock. The three localities mentioned apparently lie on the same belt of schistose granite extending northeast through Brookneal. In the outcrops this is seen to be schistose biotite-muscovite granite with porphyritic phases.

BERYL.

NORTH CAROLINA.

Alexander County, N. C., is famous for its gem and specimen minerals. Beryl occupies a prominent place among these, and has been found at a number of localities. Emerald and aquamarine varieties have been mined near Hiddenite, associated with green spodumene (hiddenite) and many other minerals of gem or specimen value. Occasional specimens of gem beryl have been reported from the region west and northwest of Taylorsville, and recent finds of valuable yellow and golden beryl have been made by a small amount of prospecting. Most of the gem localities of Alexander County have been idle for a number of years.

The emerald-hiddenite mine has not been operated since 1907, when the last work was done by the late Cary Wright for the American Gem Mining Syndicate. A description of these operations was given in this report for 1907. The workings are filled with water, and the whole mine site has grown up in a thicket of brush and trees. The writer was fortunate in having Mr. J. E. Turner, foreman of the mine when in operation, point out places of interest. The open cut is about 150 feet long, 20 to 50 feet wide, and 15 to 20 feet deep. The cut has a roughly east-west direction, and was made in red clay saprolite formed by the decomposition of a biotite gneiss country rock. Other pits and shafts were made near the open cut. Several veins were followed down into hard rock by two shafts 40 to 50 feet deep.

The gems occur in more or less parallel veins which are not continuous through many feet. Most of these veins have north of east strike and a high northerly dip. In places the veins run out into seams and in other places they open into pockets lined with crystals of several minerals, such as quartz, calcite, dolomite, muscovite, rutile, black tourmaline, beryl, hiddenite, pyrite, and monazite. A pocket opened in one of the shafts was so large that W. E. Hidden is said to have crawled inside of it. The array of glittering crystals lining this pocket is described as a wonderful sight.

A quantity of fine beryl and hiddenite crystals was obtained from the saprolite removed from the open work. Promising specimens of gem beryl with some hiddenite and many quartz crystals were found in the openings north and west of the mine. Mining operations in the saprolite are easy, but in the fresh biotite gneiss they are difficult. Mr. Turner suggests, and an examination of the locality seems to support his suggestion, that more of the saprolite along the sides of the open cut and at the west end might profitably be removed and washed. If the gently rolling country around the mine were kept under cultivation a good chance would be offered to locate other veins or to determine the trend and possible continuation of the gem formation by a careful search of the fields after rains.

Gem beryl crystals have been found at several places in the region around Hiddenite, and one good hiddenite crystal is reported to have been found about 1 mile east of the mine. These finds, taken into consideration with the widespread occurrence of beautiful crystals of quartz, rutile, and other minerals, such as were found in the veins of the emerald-hiddenite mine, indicate the possible occurrence of other valuable gem deposits in the region.

W. E. Hidden [1] mentions an occurrence of emeralds and hiddenite discovered by W. H. Lackey on the Osborne-Lackey place, one-fifth of a mile northwest of the emerald-hiddenite mine. About 50 emerald crystals, 2 to 7 centimeters long and 2 to 8 millimeters thick, were found. They were transparent but pale colored. One crystal was large and pure enough to cut for gems. The hiddenite crystals were pale colored and of very inferior quality.

Some promising beryl crystals have been found in a prospect on W. H. Warren's place about 1½ miles southeast of Hiddenite. A pit 25 feet long and 15 feet deep was opened in a field where a few surface specimens had been found. A pegmatite vein nearly 8 feet thick with an approximate east and west strike and vertical dip was encountered in a decomposed gneiss formation. The latter is probably biotite gneiss inclosing granite and lies nearly flat. The pegmatite is composed of orthoclase or microcline, gray quartz, and green muscovite, with some biotite, black tourmaline, dark red opaque garnet, and beryl. The beryl occurs in pale greenish or aquamarine, yellow, and nearly golden-colored crystals. The largest crystal seen measured 1 by 1½ inches. Most of the specimens remaining in Mr. Warren's possession are somewhat checked and flawed, but some have small clear portions which are very brilliant.

Beryl crystals are reported to have been found at two places in the fields on the land of Alexander Miller adjoining the Warren place. Transparent, slightly smoky quartz crystals were seen at one of these prospects.

Beryl crystals have been found in two places on the estate of the Miller heirs, 1½ miles east of Hiddenite on the ridge between Davis Creek and Little Yadkin River. Good specimens are reported from

[1] Hidden, W. E., Am. Jour. Sci., 3d ser., vol. 29, 1885, pp. 250–251.

this property, and G. F. Kunz,[1] quoting J. A. Stephenson, describes two of them as emeralds "of good color and quite transparent, but very rough on the surface." Since these crystals were found, several prospects have been opened and beryl found in two veins. Quantities of quartz and some fine rutile crystals were obtained from the other openings. In one prospect on a steep hillside above Davis Creek good deep aquamarine-colored beryl crystals are reported to have been found in pegmatite. This pegmatite is composed of orthoclase feldspar, greenish muscovite, smoky quartz, and black tourmaline. The other beryl prospect is about 200 yards northwest of the one mentioned and consists of two sets of openings about 100 feet apart. The beryl occurs in pegmatite cutting a decomposed gneiss, probably biotite gneiss, with an easterly strike. Little could be learned of the results of the prospecting.

Some of the beryl prospects northwest of Taylorsville and to the north of All Healing Springs were examined in November, 1912. All Healing Springs are 5 miles N. 83° W. of Taylorsville, or about 6½ miles by road. No work was in progress at the time of examination, and the prospects seen had been made from one to several years before. The following month a little further work was done on some of the prospects and very fine gem material was obtained. Good specimen and gem beryls are reported to have been found in the earlier work, but through misplaced confidence in a tramp miner, nothing was realized on them by the owners, who therefore became discouraged and stopped prospecting. The prospectors are now receiving good prices for their gem beryl, and it is hoped interest in mining for them will be revived.

Especially fine beryl has been obtained from a prospect on Eli Barnes's place, 1¼ miles N. 20° W. of All Healing Springs. This prospect is in a field on the west slope of a small hill about 200 yards northwest of the house. At the time of visit the work consisted of a trench about 20 feet long and 2 to 5 feet deep on a pegmatite vein striking about N. 15° W. The vein is about 4 feet thick and was exposed at both ends and in the bottom of the trench. The country rock is a gneiss, granitic in character, and has decomposed to a granular reddish earth covered by light sandy soil. The pegmatite is composed chiefly of orthoclase or microcline feldspar and quartz, with a little mica, black tourmaline, beryl, and garnet. The best beryl is reported to have been found along a quartz streak or vein from a few inches to 1 foot thick in the pegmatite. This quartz vein pinched out in the bottom of the trench but was exposed in the north end. The feldspar occurs in masses and rough crystals several inches thick, inclosing rough gray crystals and masses of quartz and other minerals. Some of the quartz is slightly cloudy or translucent dark gray. The black tourmaline occurs in the common rounded triangular crystals measuring up to an inch in thickness. Fragments of dark-red semigem garnet crystals more than an inch thick were observed. The beryl crystals occur in both the feldspar and the quartz, and some are closely associated with black tourmaline. Only inferior specimens of colorless, white, yellow, and greenish-yellow beryl crystals were found around the prospect, but a few better specimens were held by

[1] History of gems found in North Carolina: Bull. North Carolina Geol. and Econ. Survey No. 12, 1907, p. 38.

the owners. One of these was a beautiful light, clear straw-yellow crystal which has since been cut into two perfect gems weighing 1.5 and 0.4 metric carats. These stones are very brilliant but slightly pale for the best gems. Some of the light-colored and colorless beryls would yield very brilliant gems.

Since this prospect was examined in November, 1912, a beautiful clear yellow beryl crystal weighing 70.5 grams or 352.5 metric carats, has been found. This crystal has been fractured at the ends and measures in its present form 25 by 30.5 millimeters thick and 33 to 48 millimeters long. There are three larger cracks across the crystal and other smaller flaws. The prism faces have rhombic etchings. Much of the beryl is limpid and clear and of fine gem quality. It has a light golden or rich honey-yellow color.

Good beryl is reported to have been found in the prospect of Thomas Barnes, 2 miles N. 30° W. of All Healing Springs, on a spur extending east from a mountain ridge. The prospect has been opened by four pits and open cuts in a distance of about 125 feet in a N. 15° W. direction across the ridge. The deepest pit was about 10 feet. The country rock is mica schist and gneiss containing cyanite and garnet. These rocks strike about east and west with a vertical dip. The beryl occurs in pegmatite, cutting the country rock with a strike of N. 15° W. and a dip of about 70° W. The pegmatite is about 3 feet thick and incloses a quartz streak or vein 1 foot thick parallel with its walls through the whole distance opened. A quantity of mica was found along this quartz vein in the work, and for this mineral the prospect was in part opened. Mica crystals 6 inches in diameter were found, but the quality and quantity could scarcely be considered of commercial value. Golden, yellow, greenish, and colorless beryl crystals were found. The beryl occurs along the contact of the quartz streak with the feldspathic part of the pegmatite chiefly in granular to coarsely crushed glassy phases of the quartz. Black tourmaline occurs in the pegmatite, and some is associated with the beryl in the quartz. The largest beryl crystal found is reported to have been about 3 inches thick and 18 inches long. A section of this about 3 inches long was seen at Nathan Barnes's house. It was light-colored, mostly opaque, and not of gem quality. Small yellow to golden beryl crystals with fine clear portions were seen, indicating the occurrence of good gem material in the vein.

The presence of another pegmatite 15 feet west of the deep pit was shown in a small prospect pit.

At the prospect on James Chapman's place, formerly owned by Mike Swim, 1¾ miles N. 15° E. of All Healing Springs, a pit, now nearly filled up, 10 or 12 feet deep, was made on a pegmatite deposit. A vein striking about N. 25° W. was found inclosed in a gneiss of granitic nature. The presence of hard fine-grained biotite gneiss débris around the dump causes uncertainty as to whether the country rock may not be biotite gneiss injected by granite and not granite gneiss. A couple of hundred yards west of the prospect the country rock is cyanite schist. The pegmatite incloses a quartz streak about 1 foot thick. This quartz is mostly glassy and crystallized and some is smoky brown. The feldspar occurs in rather large masses, and a rough crystal with a cleavage face 8 inches across was seen on the dump. Some graphic intergrowths of quartz and feldspar occur. In some of the blocks seen on the dump pegmatite appears to grade into coarse granite. Black tourmaline and muscovite and biotite mica were also present. Good golden and yellow beryl are reported to have been found in this prospect.

Golden and yellow beryl are also reported to have been found in a prospect on John Webster's place, about 1¼ miles N. 50° E. of All Healing Springs. This prospect has been opened by three small pits in a N. 15° W. direction, on a hillside. The deposit could be worked by a drift on the vein from the north, probably more than 30 feet lower than the present pits. The country rock is mica schist injected with granite. The beryls were found in pegmatite associated with a streak of glassy smoky quartz. The feldspar of the pegmatite occurs in masses which yield cleavage faces several inches across. Muscovite, biotite, black tourmaline, and beryl are accessory minerals of the pegmatite.

A distorted crystal of beryl measuring about 20 by 35 by 42 millimeters was found by Felix Webster in a field on George Teague's land a few hundred yards north of John Webster's prospect. This crystal has a pale-yellow color and is rather badly fractured. It contains clear portions sufficiently large to cut a few gems of less than one-half carat weight.

Specimens of beryl crystals from Cleveland County, N. C., with notes on their occurrence, were shown to the writer by Mr. George L. English, of Shelby, N. C. The prospect is on the Whisnant place, on the west side of Broad River, near Hollybush. It was opened by Messrs. Whisnant and Morrison, of Hollybush, by a shaft about 30 feet deep. The vein is pegmatite with considerable black tourmaline scattered through it. Many pounds of rough beryl crystals were found, and among them were a few crystals of gem quality. The latter were light-yellow and greenish with portions sufficiently free from flaws to cut. A gem of nearly two carats weight cut from a pale-yellow crystal was very brilliant and pretty.

CHRYSOPRASE.

ARIZONA.

The chrysoprase deposits of Riggs & Walker, about 20 miles west of Mineral Park, Mohave County, Ariz., briefly described in these reports for 1908 and 1911, have been taken over by John L. Riggs, of Chloride, Ariz. The peculiarity of the occurrence of this chrysoprase in rhyolite porphyry and not in serpentine, as is usual, has been mentioned. Mr. Riggs has kindly furnished additional specimens for examination. A feature of some of these specimens is a banding of fairly dark and light-green chrysoprase with layers of gray and pale-purplish cherty chalcedony. This stone would make unique cameos in which a variety of effects could be obtained. A large number of other patterns and contrasts of color can be secured by cutting brecciated jasper and flint matrix with a chalcedony and chrysoprase filling.

DIAMOND.

ARKANSAS.

According to John T. Fuller,[1] no great advances were made in diamond mining in Arkansas during 1912. The Ozark Diamond Mines Corporation erected a steam washing, crushing, and recovery plant, capable of treating 100 loads of 16 cubic feet per day, which ought to be in operation during 1913. A small washing plant was erected on the property of the Arkansas Diamond Co. and operated intermittently, recovering 35 diamonds. Additional test pits and one diamond drill hole were sunk.

Mr. Howard A. Millar [2] has kindly furnished notes on the work of the Kimberlite Diamond Mining & Washing Co. This company owns one of the later-discovered areas of peridotite and has a long term lease on the Mauney tract covering a part of the original peridotite area. A diamond washing plant is under construction on Prairie Creek, near the edge of the town of Kimberly. A tram 4,300 feet long is being built between the washing plant and the Mauney lease, and it is proposed to construct another tram to the other peridotite outcrop owned by the company. Actual washing is expected to begin in May, 1913. Five diamonds were found in 1912 during the course of cleaning around the mines preparatory to systematic mining. These stones were clear white and of good quality. A yellow or amber-colored diamond was found early in 1913. Mr. Millar mentions the finding of a fine white diamond weighing over 7½ carats by a Mr. Blanchard during 1912 on one of the later-discovered peridotite areas.

It has been practically impossible to determine the quantity and value of the diamonds found in the Arkansas field since the first discovery in August, 1906. Most of the stones are still held by the mining companies and few have been sold. It is estimated from the figures furnished the Survey and from reports in the press and those furnished by private persons that about 1,400 diamonds weighing nearly 550 carats have been found from August, 1906, through December, 1912. The total estimated value placed on this output in these reports amounts to $12,108.

The latest information concerning the geology of the Arkansas diamond region and the new peridotite areas is contained in a report by H. D. Miser,[3] from the manuscript copy of which the majority of the following notes have been abstracted:

At the time of Mr. Miser's visit, late in 1912, four areas of peridotite were known. The first of these was described by J. C. Branner and R. N. Brackett [4] and later by G. F. Kunz and H. S. Washington [5] after the discovery in 1906 of diamonds associated with it. This outcrop is 2 to 2½ miles S. 25° E. of Murfreesboro, in section 21, and covers an area of more than 50 acres. Three companies hold this area, the Arkansas Diamond Co., the Ozark Diamond Mines Corporation, and the Kimberlite Mining & Washing Co.

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[1] Eng. and Min. Jour., Jan. 11, 1913, p. 75.
[2] Personal correspondence, dated St. Louis, Mo., June 13, 1912, and Feb. 8, 1913.
[3] New areas of diamond-bearing peridodite in Arkansas: Bull. U. S. Geol. Survey No. 540-U (in press).
[4] The peridotite of Pike County, Arkansas: Am. Jour. Sci., 3d ser., vol. 38, 1889, pp. 50–59.
[5] Diamonds in Arkansas: Trans. Am. Inst. Min. Eng., vol. 39, 1908, pp. 169–176.

The second area was described by A. H. Purdue,[1] but prospecting has developed further points of interest. It is 3 miles S. 75° E. of Murfreesboro, in sec. 14, and is held by the American Diamond Mining Co. The exposures of the peridotite and its weathered products are on a steep north hill slope. Prospecting has been carried on by shallow pits, trenches, cuts, a shaft, a tunnel, and drill holes. The peridotite exposures occur within an area of 2½ acres, but the drill holes show that this rock is much larger under and near the surface. Dikes extend outward from the mass of peridotite, or large bodies of the country rock are included in it, or probably both conditions exist.

On the property of the Kimberlite Diamond Mining & Washing Co., about one-fourth mile northwest of the American Diamond Mining Co.'s tract, in sec. 14, peridotite has been exposed in pits, trenches, and drill holes. The apparent form of intrusion, judging from present exposures, is that of a crescent-shaped dike with a northeast-southwest strike. This dike is at least 700 feet long and possibly 100 feet wide at the surface, but may be found wider after further prospecting.

There are two exposures of peridotite on the Grayson-McCloud Lumber Co.'s tract, about half a mile southwest of the American Diamond Mining Co.'s property. One of these is at the "Black Lick" near the northwest corner of sec. 23 and the other is about 900 feet to the east. Two test pits were made at these places by Mr. Miser, in which the greenish earth was found to retain the original texture of the peridotite. These two exposures may be on the same mass of peridotite. Hand specimens from these pits closely resemble the decomposed peridotite on the American Diamond Mining Co.'s property, in section 14.

The nature of the peridotite and its products from weathering are similar at the four areas discovered. The fresh peridotite is dark-greenish to brownish-black and in places presents a porphyritic texture. Altered phases become rather more greenish with an earthy appearance and grade into greenish and yellowish soil. A dark to black "gumbo" soil results from the presence of vegetable matter. Numerous inclusions occur in the peridotite, among which black shale, baked by the heat of intrusion, are common.

The rocks of this part of Arkansas are chiefly sedimentary and are of Ordovician, Carboniferous, Cretaceous, and Quaternary age. The Ordovician and Carboniferous rocks, consisting of shales, sandstones, novaculites, and cherts, outcrop a few miles north of the area in which the peridotite has been found. The peneplaned surface of the Carboniferous rocks is overlain by the Trinity formation, of the Lower Cretaceous, consisting of intercalated beds of marly clay, sand, gravel, and limestone. The Trinity formation is unconformably overlain by the Bingen sand, of the Upper Cretaceous, consisting of intercalated beds of gravel, sand, and clay.

The peridotite cuts the Trinity formation, the clays of which were baked to a hard semivitrified rock by the heat of the intrusion, but is overlain by the Bingen sand. At one place, near known peridotite areas, the gravel at the base of the Bingen sand contains altered grains of serpentine and fragments of peridotite. The age of intru-

[1] A new discovery of peridotite in Arkansas: Econ. Geology, vol. 3, 1908, pp. 525–528.

sion of the peridotite is shown by the facts stated to be between Lower and Upper Cretaceous. It seem reasonable to assume that the intrusion accompanied diastrophic movements of this period, during which there was a land elevation recorded by the unconformity noted.

INDIANA.

The finding of another diamond in August, 1912, in Morgan County, Ind., again attracts attention to that region. This stone was found by F. Doyle while panning for gold near the junction of Gold Creek and Sycamore Creek. Through the kindness of Messrs. Perry Bradford and R. L. Royse, of Centerton, Ind., the writer was afforded an opportunity to examine this diamond and another smaller crystal found in a previous year. The larger stone weighs 2.28 metric carats. It is a distorted flattened hexoctohedron with strongly curved faces. It is practically colorless with a small dark chrome-green spot near the surface, which gives the whole a slightly greenish cast in certain positions. If it were desired to cut this diamond it would yield a fine gem with probably very small waste. The other diamond weighs 0.135 metric carat. It is an elongated clear light-brownish crystal with curved faces, possibly also a hexoctohedron.

Probably as many as 20 diamonds in all have been found in Morgan and Brown counties during the last 35 years in panning and washing for gold. W. S. Blatchley [1] mentions eight diamonds examined by himself and states that he had "credible information concerning several others." The following notes are abstracted from Blatchley's report: The presence of gold in the gravels of Morgan County has been known over 60 years and was subsequently determined in numerous counties. Records show mining was in progress in 1850, and since that time the gravels at a number of localities have been washed intermittently. The earliest record of the discovery of diamond in Indiana is a note by E. T. Cox [2] mentioning a stone weighing 3 carats from Little Indian Creek, in Morgan County, and the discovery of several diamonds in Brown County, one of which weighed 4 carats. Of the eight diamonds seen by Blatchley, the largest was the Stanley diamond, found in 1900 in a branch of Gold Creek, Morgan County. This stone was an octohedron and weighed $4\frac{7}{8}$ carats. It had a peculiar greenish-yellow tinge with a black spot, not quite central. It was cut into two stones weighing $1\frac{1}{8}$ and $1\frac{1}{16}$ carats, respectively. The other stones ranged from less than one-eighth of a carat to $1\frac{21}{32}$ carats in weight and consisted of dodecahedral and hexoctohedral crystals of white, yellow, brownish-yellow, bluish, and pink colors.

A large variety of minerals and rocks are found associated with the gold and are accordingly associates of the diamonds. The concentrates obtained by the present writer from a deposit on Highland Creek, in Morgan County, contain large quantities of black sands and pebbles, composed of magnetite, hematite, titanic iron, pyrite or marcasite, and small quantities of corundum, garnet, zircon, cyanite, etc. Bowlders in the stream gravels consist of numerous basic rocks, as gabbro, diorite, diabase, and amphibolite, and also of granite,

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[1] Gold and diamonds in Indiana: Twenty-seventh Ann. Rept. Indiana Dept. Geology and Nat. Resources, 1902, pp. 11-47.

[2] Eighth, Ninth, and Tenth Ann. Repts. Indiana Geol. Survey, 1878, p. 116.

garnetiferous granite, gneiss, and pegmatite. Some of the corundum approaches the gem variety, sapphire, in quality. A few clear blue stones have been found and numerous bronze-colored fragments, some of which show a strong chatoyancy when cut "en cabochon." The bedrock of this region is loose shale and sandy shale which has been lightly folded. Some of it contains quantities of sulphide concretions, pyrite or marcasite. This shale probably belongs to the Mississippian series which constitutes the lower part of the Carboniferous.

The gravel deposits of the creeks and streams in the areas mentioned are composed of material entirely foreign to the bedrock of this part of Indiana. They have resulted from the erosion of the glacial drift deposits of the region, the materials of which are derived from far to the north. Two areas of glacial drift have been mapped by Frank Leverett [1] in this part of Indiana, the older or pre-Wisconsin drift and the later or Wisconsin drift. Mr. Leverett has kindly furnished the following information: "The portions of Morgan and Brown counties in which gold and diamonds are found are covered by pre-Wisconsin drift, the Wisconsin drift lying north of these areas. In Morgan County Sycamore Creek heads in Wisconsin drift and runs through an area of the earlier drift. Highland and Cold creeks head in and flow through the pre-Wisconsin drift only."

Diamonds are reported to have been found associated with glacial drifts and at several localities in Wisconsin, near Milford, Ohio, and near Dowagiac, Mich. These finds have been summarized by W. H. Hobbs [2] in a discussion of the possibility of tracing back the route of the glacial drift matrix to the original source of the diamonds. A comparison of the weight, color, crystal form, and markings shows a wide variation in the nature of the stones found. By plotting the diamond localities and the glacial striæ recorded by the study of different geologists Hobbs concludes that the source of the diamonds is far northward beyond the Great Lakes in Canada.

CALIFORNIA.

Information concerning the finding of diamonds in Butte County, Cal., during 1912, has been furnished by Messrs. Harry Jacoby and M. J. Cooney, of Oroville, and D. L. Vinton, of Cherokee—all residents of that county. Three diamonds were found during washing for gold in the placers of Cherokee Flats. One stone found by John Hufford has been cut and is now in the possession of R. S. Powers, of Oroville. This diamond weighed $1\frac{1}{16}$ carats before cutting and yielded a fine white flawless gem weighing $\frac{17}{32}$ carat.

TEXAS.

Mr. L. M. Richard, of Stamford, Tex., has kindly furnished information concerning a reported discovery of a diamond in Texas. The find was made in June, 1911, by Elcy Black in loose sand and gravel in Foard County, section 64, block 44. The specimen was reported by the Klein Bros. Lapidary Co., of Chicago, Ill., to be a rough diamond, rather brown, but fairly clear, that would yield a cut gem

[1] Mon. U. S. Geol. Survey, vol. 38, 1899.
[2] Diamond field of the Great Lakes: Jour. Geology, vol. 7, 1899, pp. 375-388.

weighing about one-fourth of a carat. Mr. Richard states that this discovery has been proved authentic.

C. H. Gordon's map [1] of this part of Texas shows a large part of Foard County to be covered by the Seymour formation of Pleistocene age, consisting of sands and gravels overlain by fine silts. The valleys contain outcrops of Clear Fork and Double Mountain formations of Carboniferous (Permian) age. Recent alluvium is shown in some of the valleys. In places the later conglomerates, called "upland gravels," probably in part belonging to the Seymour formation, are cemented by lime into hard masses which have in some cases been mistaken for the Permian gravels.[2] M. J. Munn, of the United States Geological Survey, suggests that possibly some of the unconsolidated gravels in the region east and northeast of Foard County, in Texas and Oklahoma, are of more recent age than the Seymour. The presence of more than one gravel formation in the region, some of which resemble one another, makes difficult the placing of the reported diamond in its proper stratigraphic position. Mr. Richard refers it to the Clear Fork formation, but there is a possibility of its having come from gravels of the Seymour formation or from later gravels.

The nearest outcrops of eruptive rocks lie some 60 miles northeast of Foard County in the Wichita Mountains, Okla. They have been described by J. A. Taff [3] in four general classes as gabbro and related anorthosite, granite and associated aplite, granite porphyry and associated aporhyolite, and diabase. These rocks are considered older than Middle Cambrian and probably of pre-Cambrian age.

AFRICA.

UNION OF SOUTH AFRICA.

Cape Colony.—The production of diamonds during the fiscal year 1912 by the De Beers Consolidated Mines [4] amounted to 2,087,392 carats, as compared with 2,180,856 carats in 1911. Actual sales during the year amounted to 2,058,397 carats at £5,524,475 ($26,884,858). The total production of blue ground in 1912 amounted to 7,950,442 loads, as compared with 8,105,138 loads in 1911. The total quantity of blue ground and tailings washed during 1912 was 7,995,953 loads, as compared with 9,219,192 loads in 1911. The yield in carats of diamonds per load of blue ground wash increased from 0.28 to 0.31 at the De Beers and Kimberly mines, from 0.27 to 0.29 at the Wesselton mine, from 0.38 to 0.41 at the Bultfontein mine, and from 0.21 to 0.23 at the Dutoitspan mine. The De Beers mine has not been reopened since it was closed in 1908, but a small amount of prospecting was carried on. The main shaft at the Kimberly mine is 3,601 feet deep, and hoisting is now done from the 3,520-foot level. The value per carat of the diamonds obtained from the different mines was as follows: De Beers and Kimberly 53s. 11.47d., Wesselton 45s. 3.12d., Bultfontein 40s. 8.24d., and Dutoitspan 83s. 0.13d.

[1] Geology and underground waters of the Wichita region, north-central Texas: Water-Supply Paper U. S. Geol. Survey No. 317, 1913, Pl. 1.
[2] Udden, J. A., and Phillips, D. McM.: A reconnaissance report on the geology of the oil and gas fields of Wichita and Clay counties, Texas: Bull. Univ. Texas, No. 246, 1912, p. 107.
[3] Geology of the Arbuckle and Wichita mountains in Indian Territory and Oklahoma: Prof. Paper U. S. Geol. Survey No. 31, 1904.
[4] Twenty-fourth Ann. Rept. De Beers Consolidated Mines, for year ending June 30, 1912.

A feature of South African diamond mining during 1912 was the absorption of the Voorspoed [1] diamond mine, in Orange River Colony, by the De Beers Consolidated Mines.

GERMAN SOUTHWEST AFRICA.

The production of diamonds in German Southwest Africa [2] for the year ended March 31, 1912, amounted to 766,465 carats, which were sold for $4,712,831, as compared with 792,642 carats, sold for $4,888,279, in 1911. The production from April 1 to September 30, 1912, was large and amounted to 439,261 carats, sold for $2,837,539. A shortage of labor in the German Southwest Africa mines has been in part filled by importation of "Cape bays."

EMERALD.

NORTH CAROLINA.

The emerald mine near Shelby, N. C., described in these reports for 1909, 1910, and 1911, has been acquired by the Emerald Co. of America, with office in New York City. The property was formerly known as the Turner emerald mine, but is now called the "Old Plantation mine." This name and that of "Cotton boll pit" for the principal opening allude to the location and discovery of the mine in a cotton field on the Turner plantation.

The discovery of this emerald deposit was made in 1909, but the presence of emeralds in the region has been known for some years. George L. English, of Shelby, N. C., endeavored unsuccessfully to locate the source of two emeralds reported to have been found on the Border farm, about 1 mile east of Turner's, some 18 years ago. George F. Kunz [3] mentions the finding of an emerald about the year 1897 near Earle, N. C. Kunz describes this emerald as a broken fragment of good color, better than anything observed from North Carolina and closely resembling the material from the Muzo mine of Colombia. The stone was somewhat flawed but was cut into a trapeziform or subtriangular gem, weighing $4\frac{15}{16}$ carats. Earle is $3\frac{3}{4}$ miles southeast of the "Old Plantation mine," and it is possible that the stone referred to came from that deposit. Nevertheless, it is well to keep in mind the possibilities of the occurrence of other emerald deposits in this region, since rock associations similar to those at this mine occur at other places.

Mining and prospecting were continued at the Old Plantation mine through 1912 and are still in progress (April, 1913). Deposits of emeralds were opened in July and August, 1912, and 269 carats of irregularly shaped pieces and fragments of crystals were obtained. These lots of emeralds consisted of both clear and partly cloudy gem material, the color of some of which was a fine deep green.

Some emeralds of very fine quality have been obtained along with those of ordinary grade. The best stones have the deep grass or emerald green color characteristic of that gem, with only the average amount of flaws or defects usual in the fine-grade material. In other

[1] Min. and Eng. World, Dec. 21, 1912, quoting "Financial News."
[2] Jewelers' Circular Weekly, Jan. 29, 1913.
[3] History of the gems found in North Carolina: Bulletin North Carolina Geol. and Econ. Survey, No. 12, 1907, p. 42.

stones the color may be fine and deep, but defects, such as cracks, cloudiness, or silky inclusions, are prominent. Still other gems of paler color but containing only very slight flaws, if any, are found. The total yield of selected rough emeralds in 1912 is placed at 2,969 carats, with an estimated value of $12,875. This material should yield about 800 carats of cut gems with a greatly increased value, probably $25 a carat or more. Retail values for some of the better emeralds range up to $200 a carat, and one fine stone weighing a fraction over 2 carats was sold for $200 at wholesale value.

Prospecting and development of the deposit and separation of emeralds from the matrix have been carried on under the direction of Lovat Fraser, of New York. The deposit lies in a hill with moderate slope northwest and north, and has been opened by numerous pits, crosscut trenches, and open cuts within a distance of about 100 yards in an east and west direction. The principal development is the cotton-boll pit at the place of original discovery. In November, 1912, this consisted of an open cut of irregular shape about 75 feet long in an east and west direction and 10 to 25 feet deep with a shaft or pit several feet deeper in the bottom. A tunnel 15 feet long was run in from the east end of the cut and a crosscut trench 160 feet long extended north from the bottom of the pit for prospecting, drainage, and to facilitate mining. Other pits and trenches, both east and west, have been made close to the cotton-boll pit. A track about 250 feet long with a mine car is used in the big crosscut trench to carry vein material and waste rock to their respective dumps near a branch north of the mine. Later developments have been reported by Mr. Fraser, which consist of a deep pit about 90 feet south of east and a deep crosscut trench about 200 feet east of the cotton-boll pit.

The general geology of the region and of the emerald deposit was discussed in this report for 1911, but a brief summary is here given in order that the notes on later developments may be more easily understood. The region is composed of mica, garnet, kyanite, graphite, and hornblende gneisses and schists cut by granite, pegmatite, diorite, gabbro, hypersthenite, and other ferromagnesian rocks. The strike of the rock formations is variable between east-west and north-south where the strata are tilted, but over large areas they are essentially flat, with many small rather gentle folds.

The emeralds occur in pegmatite cutting hornblende hypersthenite. Olivine gabbro is closely associated with the hypersthenite either as a magmatic segregation from it or as a separate mass east of the cotton-boll pit. Ferromagnesian rocks closely allied to the hornblende hypersthenite occur at other localities in the region. The common constituents of these rocks are pale-green hornblende, light-brownish hypersthene, olivine, augite, biotite, pleonaste, magnetite, and a little pyrite and pyrrhotite. By weathering, a rock resembling chloritic soapstone is produced. Diorite, broken up by a later intrusion of biotite granite, surrounds the hornblende hypersthenite at the emerald mine. The granite also cuts the hypersthenite, and has become more basic near the contact with it and with the diorite by a partial absorption of those rocks. Pegmatite bodies cut the hornblende hypersthenite in various directions, but the majority have an easterly strike. Some of these have been found grading into pegmatitic granite or coarse granite, and it is probable that the pegmatites are closely associated with the granite masses near the emerald deposit. The pegmatites form sheetlike or lenticular masses, and the emerald vein proved to be one of the latter. It had a warped east-west strike, and ran close to, if it did not join, a bulge or boss of pegmatitic granite encountered in the tunnel in the east end of the cut. The vein ranged from a seam up to 6 feet in thickness, with a length of about 40 feet and a depth of about 20 feet. It is possible that further work might expose other pegmatite lenses deeper and farther west opening out in the continuation of the seam left where the original vein pinched out. Other veins almost identical in appearance with the original emerald vein were found near by, and some of these are being prospected for emeralds.

The pegmatite of the emerald vein was medium to coarse grained, and was composed of quartz and feldspar, part of which was albite, with some black tourmaline and a little beryl. A few small irregular microlitic cavities were found, and in these the minerals assumed partly developed crystal form. In some of the pegmatites bluish-green apatite occurs, especially in the mass of pegmatitic granite. A few stout crystals of albite and of smoky and colorless quartz have been found in the pegmatite veins. Some of the quartz contains numerous light-colored needle-like inclusions of actinolite. The pegmatite is partly decomposed, so that some of it is ready for washing on sieves, but some is mined in large blocks, which have to be broken separately and examined for emeralds. So far true emeralds have been found in only one vein, but the similarity in the association of minerals and of inclosing rocks in the other pegmatites is considered promising.

In the opening 90 feet south of east of the cotton-boll pit a pegmatite vein was encountered carrying small, clear, nearly colorless beryl crystals and cylindrical rutile crystals, some of which show brilliant red streaks. The beryl crystals yield very brilliant stones when cut. The part of the vein opened appears to lie south of the hornblende hypersthenite area, and the vein will be prospected along its northerly strike to that rock. In the trench 200 feet east of the cotton-boll pit beryl crystals were found in pegmatite at a depth of 12 feet. These crystals were rough in form and of poor quality, with a greenish color. One piece contains some patches of true aquamarine. These beryl crystals ranged from small size up to 2 inches in diameter.

The emerald crystals are being cut preparatory to the market. Several fine specimens are still intact. A fire at the emerald mine in April, 1913, destroyed a quantity of the rough matrix specimens and associated minerals, so that now only a few of such specimens are available.

AUSTRALIA.

A discovery of green beryl and emerald has been reported near Poonah, on the Murchison gold field [1] in western Australia. The occurrence was brought to light through the efforts of H. P. Woodward, assistant government geologist, who assisted in tracing back specimens to their source. The crystals have been found scattered over the surface in dusty soil formed by the decomposition of schist country rock. No work had been done at the time of Mr. Woodward's visit. The formation has been traced nearly 2 miles in a

[1] Min. Jour., London, March 29, 1913.

north and south direction along the contact of granite with greenstones. Some specimens are associated with blue quartz which has doubtless come from pegmatite. The crystals found are described as green, some with rich color, translucent, weathered, and badly flawed.

FELDSPAR GEMS.

AMAZON STONE.

VIRGINIA.

Fine specimen and gem minerals have been obtained from some of the mica mines of the Amelia Courthouse region, Virginia. It is probable that the majority of them came from the A. H. Rutherfoord mine, 1¼ miles north of town, though the exact locality is not given in many of the descriptions of the fine minerals or on their accompanying labels in collections. Descriptions of this locality and its minerals have been given by W. F. Fontaine,[1] T. L. Watson,[2] and E. S. Bastin,[3] and their work is drawn on freely to supplement notes made by the writer in August, 1912. Additional information was kindly furnished by A. H. Rutherfoord.

This part of Amelia County is typical of the Piedmont Plateau region. The larger ridges are rather flat or gently rolling and rise to approximately one general level, 350 to 400 feet above sea level. Except near the larger water courses the slopes and hillsides in the valleys are rather light. Rock weathering has been deep and outcrops are not plentiful. The rock formations are biotite schist and gneiss, in some places garnetiferous, and in others highly feldspathic, resembling granite gneiss. Some of these phases may be metamorphosed granitic rocks. The strikes measured are generally northerly, with easterly and westerly variations. Pegmatites are common and some cut across the gneisses. The granitic rocks weather to light sandy soil and the schists and gneisses to reddish clay soils.

Fontaine mentions evidences of work by Indians or other persons at the Rutherfoord and other mica mines of this region. The mica vein is reported to have been removed to a depth of 10 feet on the outcrop and the rubbish to have been thrown back or washed into the workings. Mining by white men commenced in the Amelia mica mines in 1873 and has been more or less intermittent since that time.

At the Rutherfoord mine operations were conducted at two points about 90 yards apart in a northeast-southwest direction. The opening to the northeast is on a low hill and was called No. 1 by Fontaine; the other opening is in a bottom close to a branch and was designated No. 2 by the same writer. This distinction is very acceptable, in view of the fact that the first work was done at the upper place, which will be used in the following description. The outcrop at the lower place was discovered later in the stream bed, and the water was diverted to the north to facilitate working. At the time of Fontaine's examination in 1883, or earlier, there were shafts less than 80 feet deep at each place. In August, 1912, opening No. 1 consisted

[1] Notes on the occurrence of certain minerals in Amelia County, Va.: Am. Jour. Sci., 3d ser., vol. 25, 1883, pp. 330–339.
[2] Mineral resources of Virginia, Virginia Jamestown Exposition Commission, 1907, pp. 282 and 385–392.
[3] Quartz and feldspar: Mineral Resources U. S. for 1910, pt. 2, U. S. Geol. Survey, 1911, pp. 971–973.

of a pit, about 75 feet long in an east and west direction and 40 feet wide, and a shaft to the east of the pit. The pit was formed by the caving in of old shafts and tunnels. The shaft was made by the American Gem & Pearl Co., of New York, during the last decade and is reported to be 90 feet deep with a 40-foot drift at the 55-foot level. At opening No. 2 there is a pond about 50 feet wide and 150 feet long in an east and west direction, showing the surface area of the old work. It is reported that the deepest work here was a shaft 150 feet deep.

Present exposures of vein and country rock around the vein are very poor, and geologic observations are therefore limited. The country rock is biotite schist and gneiss characterized by the presence of considerable feldspar. An exposure of a slightly garnetiferous phase of this gneiss on the hillside between the two openings showed a strike of N. 55° W. and a dip of 20° NE. The extension of the workings indicates nearly parallel veins striking about east and west. Fontaine considers openings No. 1 and No. 2 on the same deposit, but calls attention to the difference of mineral associations in each. The impression gained by the present writer is that the two deposits are not connected, at least not near the surface.

The veins are pegmatite of somewhat unusual composition and texture for the southern Appalachian region. The normal minerals of pegmatite are present, but they occur in great variety associated with other minerals of interest as gems or specimens. Quartz occurs both in large and small irregular masses and in crystals ranging from small ones to those weighing 8 or 10 pounds. The ordinary quartz is glassy and opaque gray and the crystals are semitransparent to clear white, colorless, or smoky brown. The mica is muscovite of fine quality, with a clear light-brownish color in sheets a millimeter or more thick. Large quantities of fine stove mica were obtained during mining operations, and sheets measuring 22 by 24 inches are reported to have been cut from some of the crystals.

The variety of feldspars is unusual for a single pegmatite deposit. Potash feldspar occurs chiefly as microcline of gray-white, bluish-green, and green colors. In some of this material the colors are bright and the mineral is slightly translucent and yields fine grades of amazon stone for gem and ornamental use. Fontaine states that most of the amazon stone came from opening No. 2, but the later work of the American Gem & Pearl Co. for this mineral was at No. 1. Several thousand pounds of fine grade amazon stone, worth as many thousand dollars, is reported to have been obtained during this work, as well as considerable mica and other specimen minerals. Amazon stone of less attractive colors was found in masses of several pounds weight. In some of these masses considerable mica was intergrown. The mica plates range up to 2 inches in diameter. The other feldspars are albite and probably oligoclase. The albite occurs in clusters of white to colorless tabular crystals as much as half an inch in thickness and 3 inches in length. These crystals are grouped at various angles to one another and furnish beautiful cabinet specimens. Three large fine clusters of these albite crystals are held in the industrial office of the Southern Railway Co. in Washington, D. C. The largest of these measures probably 18 inches in length, 14 inches in width, and 12 inches in thickness. It is somewhat dome-shaped and is composed of beautiful clear and white interlocking tabular crystals grouped together with interspaces and cavities between them. The whole mass weighs probably over a hundred pounds.

The mineral called "oligoclase" is the sodic variety and chemically not far removed from albite in composition. It occurs in rough crystals, some of which have perfect cleavage and measure several inches across. It is mostly white, with small colorless patches, but exhibits a beautiful pearly blue chatoyancy on one of the cleavage planes. In some specimens this pearly luster is seen over areas several inches across when the specimen is viewed in a favorable position. This oligoclase makes beautiful cabinet specimens if properly exhibited and yields very pretty gems when cut cabochon about parallel with the pearly cleavage. Cut gems are white to mottled gray and show a fine blue chatoyancy in one position.

Fontaine describes a pocket 4 or 5 feet long and high and 1 to 2 feet wide opened in pit No. 2 lined with numerous crystals of smoky quartz and "pure white crystals of albite, some as transparent as glass."

Large beryl crystals were found in pit No. 2, but few, if any, of gem quality. Fontaine describes them as 3 or 4 feet long and as much as 18 inches in diameter, surpassed in size only by those of New Hampshire. They were bluish green and dingy yellow and were associated with the quartz and feldspar. The beryls were closely intergrown with the feldspar, but they separated easily from inclosing quartz.

A quantity of beautiful transparent spessartite garnet of reddish-brown or hyacinth-red color was found during mining operations. This material was cut for gems and also supplied many mineral collections. Some of the crystals measured 3 inches in diameter and were composed of solid garnet. The better stones came from opening No. 2. Watson states that hyacinth gems were cut weighing from 1 to 100 carats. Nine cut gems in the United States National Museum range from 5.65 to 39.13 carats in weight. These gems are rather lighter in color than most zircon or essonite garnet varieties of hyacinth. There is a marked shade of red or pink in the brown which is thereby enhanced in beauty. All the nine stones mentioned contain flaws; some of the nine are a little cloudy from the abundance of these flaws, but others are transparent and brilliant in spite of the few cracks. The gems exhibited in the Natural History Museum in New York show the same characteristics.

The chlorophane variety of fluorite also occurs in the Rutherfoord mine and according to Fontaine was found chiefly in pit No. 2. Some pale-purple fluorite has also been found. This fluorite is not of value for ornamental use but is of interest for the ease with which it phosphoresces. G. F. Kunz [1] calls attention to the fact that the mineral from this locality phosphoresces by attrition with hard substances. In a dark room at 80° F. it glows with a white luminous light. In boiling water it gives off a green light and on heated iron an emerald-green light. These observations were confirmed by tests made by the writer on a specimen supplied by Mr. Rutherfoord. This specimen was grass-green and badly flawed. The surface was strongly etched and corroded. The mineral glowed with a yellowish light after continued heating when the intensity of the green began to fade.

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[1] Chlorophane from Amelia County, Va.: Am. Jour. Sci., 3d ser., vol. 28, 1884, pp. 235-236.

Another mineral of interest because of its rarity and of the fine quality found here is microlite. A few exceptionally fine crystals have been cut for gems, as described by W. E. Hidden.[1] The particular crystal mentioned had a specific gravity of 6.13 and weighed 0.877 grams. It was perfectly transparent with a hyacinth-red color. When cut into "a gem it had all the brilliancy and beauty of a fine hyacinth or of an essonite garnet." Hidden also mentions red pyrope-colored microlites from the same locality in the Bement collection. These crystals measured nearly a centimeter across and were embedded in smoky quartz.

Other minerals of more or less interest found in the Rutherfoord mine were columbite, monazite, allanite, orlhite, helvite, apatite, galena, stibnite, zircon, and pyrochlore. Specimens of monazite 8 pounds in weight were found.

Amazon stone occurs at the Richeson, formerly Berry, mica mine, 1¼ miles N. 35° E. of Amelia Courthouse close to the track of the Richmond & Danville branch of the Southern Railway. The visible remains of the work here consist of a roughly circular pit about 35 feet in diameter and 15 feet deep to water with a cribbed shaft about 10 feet square in the bottom.

The country rock is rotted mica schist and gneiss, with gentle rolling folds approximating flat strata. The vein is a large pegmatite cutting the gneiss with an approximately east and west (possibly south of east) strike. Practically all the information available had to be obtained from a study of the dump. On the latter was a quantity of small blocks of pale semibleached amazon stone, white partly altered orthoclase or microcline, scrap mica of light color, and glassy translucent quartz. One bowlder of mottled yellow and reddish chalcedony or chalcedonic quartz was found at the side of the pit and one small crystal of columbite in the dump. The chalcedony would yield a rather attractive cheap gem if cut. Amazon stone of good color and quality might be found if the mine were reopened.

COLORADO.

There was renewed activity during 1912 in the mining of amazon stone and the beautiful associated minerals of the Crystal Peak region, 5 to 10 miles north of Florissant, Teller County, Colo. Claims have been worked by J. D. Endicott, of Canon City, Colo., around Crystal Peak for a number of years, and in 1912 the Crystal Peak Gem Co., of Cripple Creek, Colo., also operated several claims. A quantity of gem and specimen material was obtained, most of which is being prepared for the 1913 tourist trade, for which trade the native Colorado gems are always in much demand.

The minerals found are similar to those obtained in the Crystal Park region on the east side of Pikes Peak, described in this report for 1908. Crystals of amazon stone and smoky quartz are the most plentiful, but fine topaz and phenacite also occur associated with them. Other rarer minerals, as xenotime and fayalite, have also been found. The amazon stone, quartz, topaz, and phenacite are generally crystallized, and when not sufficiently good for gems they still afford fine specimens, either of single crystals or of groups of one or more crystals.

[1] A transparent crystal of microlite: Am. Jour. Sci., 3d ser., vol. 30, 1885, p. 82.

OPAL.

NEVADA.

A quantity of magnificent precious opal was mined during 1912 in Humboldt County, Nev. Two groups of claims have been located about 9 miles apart in Virgin Valley, a tributary of Thousand Creek. One group of claims has been developed by Ivan Dow, of Nevada City, Cal., and the gem material is handled by the International Gem Co., of New York City. The other deposit was located by J. F. Heeney and Deb Roop, of Reno, Nev., during 1912. Some beautiful gems were obtained during prospecting at this locality. A comparison of a few specimens from this deposit supplied by Messrs. Heeney and Roop, with a quantity in the office of the International Gem Co., shows that the type of gem and its occurrence are similar at the two localities.

The region has been described by J. C. Merriam [1] as composed of rocks of Tertiary age belonging to the Miocene. These rocks exposed in Virgin Valley consist in large part of volcanic ash and tuff, some of which have been deposited in shallow shifting lakes. The ash is somewhat indurated and has undergone considerable alteration, in the opal-bearing parts, through the agency of solutions, possibly those from which the opal was deposited. The locality has also proved of geologic interest for the mammalian fossils it contains. At certain horizons of the rock formations large logs of beautifully petrified wood are abundant and in one bed stems and leaves have accumulated in sufficient quantity to form a thin deposit of lignite. The opal occurs at the horizon carrying petrified wood, with which much of it is associated.

Of the many specimens of precious opal examined the majority were portions of petrified limbs or twigs of trees in which the opal appears to be a cast rather than a replacement of the body and texture of the wood. In some specimens there has been a partial replacement of the wood by gem opal, which therefore retains the texture and grain of the wood. Precious opal also occurs as a filling in cracks and cavities both in petrified wood and in the rock mass itself. The ordinary petrified wood examined consists of common opal and chalcedony. Limbs of trees up to 2 and 3 inches thick are reproduced in precious opal of gorgeous color or consist in part of common brown or black opal grading into gem opal. A piece of jet black common opal when heated in a closed tube gave off water and a strong tarlike odor showing the presence of inclusions of organic matter to which the color is doubtless due. A quantity of other variously colored common opal occurs with the gem variety, as translucent purplish, reddish-brown, gray, and white. A peculiar specimen consisted of volcanic ash through which was scattered a large number of small patches of opal. This opal has a magnificent play of green, yellow, blue, and red (or fire), but is exceedingly brittle, so that the small pieces can be crushed between the fingers into powder. The minute grains display their fine color and fire after the opal has been crushed. Specimens of charred wood also occur in the opal-bearing ash.

The best gem opal from this region is unexcelled in variety and brilliance of fire and color by that from other localities. The cut

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[1] Science, new ser., vol. 26, 1907, pp. 380–382.

gems exhibit wonderful flashes of green, blue, yellow, and red of various shades. In some the color is uniform over the whole stone or over large areas, changing as the gem is turned from green to red or from red to blue, and so on. Some of the gems show a rich ultramarine blue in one position with green or red in another. Many gems display various bright colors arranged in patches, and each patch changes color as the stone is turned. The brilliant flashes of peacock-feather colors obtained from the opal of dark color yields a gem which might be called black opal, but most of it is not like the Australian gem of that name, since it occurs in thick pieces and the colors are less localized. The majority of the dark-colored gems, no matter how beautiful in reflected light, become a rich reddish-brown color in transmitted light. Lighter-colored opal with good color and fire is also found and cuts into very beautiful gems.

CALIFORNIA.

The following information concerning the opal deposit of the American Opal Co., in San Bernardino County, Cal., was furnished to R. W. Pack, of the United States Geological Survey, by Mr. F. Saminfeld, superintendent of the mine, and kindly submitted for this report. The head office of the company is in Pasadena, Cal. The mine is 25 to 30 miles northwest of Barstow, in sec. 36, T. 31 S., R. 45 E., and extends into some adjoining quarter sections. The deposit has been worked for about three years, and during 1912 employed from 3 to 5 men. It is opened by a shaft 200 feet deep and by many feet of drifts and tunnels. The best opal, and that which is mined, occurs at ground-water level, about 200 feet deep, in a white volcanic tuff. This rock is not hard to mine and holds up well in the workings, requiring no timbering. According to Mr. Saminfeld about one-fourth of a ton of matrix and rough opal is shipped every ten days or two weeks.

Mr. F. M. Myrick, of Randsburg, Cal., kindly submitted specimens of precious opal which he obtained from a prospect 15 miles west of his bloodstone mine on Brown Mountain in the Death Valley region. This opal is light colored, and shows very pretty flashes of green, blue, and red. It is associated with chalcedony or agate.

AUSTRALIA.

The following notes are abstracted from a report by Consular Agent G. H. Prosser,[1] at Adelaide, South Australia. The production of opal in Australia has declined greatly and is now about 75 per cent less than during some previous years. The value of the output in 1911 has been estimated at about $300,000, of which $106,000 came from the White Cliff district and the remainder from the Wallangulla field, in the Walgett division. The total value of the opal produced since 1890 is estimated at $6,529,377. The Australian black opal has come from mines at the head of River Darling, in northern New South Wales, about 60 miles from the village of Walgett. The output of black opal has grown smaller each year, and during the first half of 1912 amounted to almost nothing. It is not thought that the deposits are exhausted, but fewer miners are at work and good finds are therefore less often made.

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[1] Daily Cons. and Trade Repts., Sept. 21, 1912.

PETRIFIED WOOD.

ARIZONA.

The possibilities of the agatized and jasperized wood of the petrified forests of Arizona as gem material have been shown by many specimens cut and placed on exhibition by the United States National Museum in Washington. These consist of 35 gems cut into various rounded and elongated cabochon shapes and varying in size from that suitable for a stick pin to gems 2 by 2½ inches across. The range of colors shown by these gems is large and includes red, pink, yellow, and gray of various shades, with black and white and some purplish and greenish tints. Both bright and dull shades of color occur and sometimes are present in the same specimen. There are a variety of patterns, according to whether the gems are cut with the grain or at various angles across it. Irregularities in petrification also furnish other patterns. Selected specimens of the Arizona petrified wood can be cut into objects suitable for ornamental purposes or for low-priced jewelry, and in these ways should supply demand in the tourist trade of the Southwestern States.

PREHNITE.

Frederick A. Canfield, of Dover, N. J., reports the discovery of transparent prehnite at Great Notch, N. J., in 1912. This material is suitable for cutting, but occurs rather sparingly. A small quantity of prehnite is obtained from the quarries and road cuts in the trap rocks of New Jersey each year. Some of it is used as gems, but this material is translucent only, and not transparent like the prehnite of the recent discovery.

QUARTZ.

NORTH CAROLINA.

Quartz crystals of varied types are widespread over Alexander County, N. C. Some are simple crystals of clear colorless or smoky quality; others are of value as specimens because of the development of a large number of unusual crystal faces. Other crystals contain inclusions of rutile needles and other minerals or of water with movable bubbles. The quartz crystals range from small size to those of 50 pounds weight. An abundance of crystals were obtained during the operation of the emerald-hiddenite mine, and some of those obtained from one pocket have been described by W. E. Hidden.[1] They were remarkable for the inclusions of large cavities partly filled with water and bubbles. Some of the Alexander County smoky and colorless quartz crystals have been cut for gem purposes, and those inclosing rutile needles have yielded especially good sagenite or rutilated quartz gems.

Two prospects for quartz crystals were visited during the course of an examination of beryl prospects in Alexander County in November, 1912. One of these was on the land of Thomas Barnes, 2 miles N. 32° W. of All Healing Springs and about 250 yards west of the prospect on the same property described under beryl. The quartz pros-

[1] On a phenomenal pocket of quartz crystals: Trans. New York Acad. Sci., March, 1882.

pect is near the summit of a knob on the same mountain ridge as the beryl prospect. Two small pits were dug on a vein of glassy quartz, 2 to 5 inches thick, cutting gneiss composed of mica, garnet, and cyanite schist. Beautiful smoky quartz crystals were found in pockets along this vein. The crystals range in size up to 2 inches in thickness and over 3 inches in length. They are transparent and have a fine smoky-brownish color. A few crystals were obtained in sufficiently perfect condition to have value as specimens, but many were chipped by rough handling.

The other prospect is on the place of Moses Barnes, 2 miles N. 20° W. of All Healing Springs. The prospect is in the side of a hollow or ravine and has been opened by a small irregular-shaped shaft 18 feet deep. The country rock is a mica schist inclosing granite. The crystals follow a glassy quartz vein 3 to 6 inches thick, striking north and south, with a vertical dip. The crystals range from small, nearly perfect ones to stones nearly 6 inches thick. Aggregates of muscovite mica crystals are inclosed in or partly penetrate some of the quartz crystals. The quartz varies from clear or slightly smoky to fairly dark smoky in color. Some of the crystals would yield good cabinet specimens if carefully removed from the vein.

SAPPHIRE.

MONTANA.

There was considerable activity in sapphire mining in Montana during 1912. The mines producing blue gem sapphire in Fergus County reported large productions. The operators were the Yogo-American Sapphire Co. and the New Mine Sapphire Syndicate. These companies are operating on the same sapphire-bearing vein or dike at a distance of about 2 miles from each other.

In Granite County the placer mines of the American Gem Mining Syndicate on West Fork of Rock Creek were extensively operated during the working season. Other deposits in Granite County were prospected and worked with good results on a smaller scale by Richard Stingle, of Philipsburg, Mont. These claims lie northeast of those of the American Gem Mining Syndicate across a mountain divide on tributaries of the main prong of Rock Creek. Mr. Stingle claims a large yield of varicolored gem sapphire in proportion to the total quantity mined. The stones range from colorless to greenish-blue, light-green, yellow, orange, pink, and nearly ruby-red. Rough stones weighing 7 to 8 carats are found.

SPODUMENE.

KUNZITE AND HIDDENITE.

The production of spodumene gems in 1912 was confined to the kunzite variety in southern California. None of the emerald-green variety, hiddenite, was found in North Carolina. Mr. Salmons, of the Pala Chief Gem Mining Co., mentions two specimens of kunzite weighing 47½ ounces and 45 ounces, respectively, found at the Pala Chief mine in San Diego County. These have been placed in the A. F. Holden collection in Cleveland, Ohio. Dr. L. P. Gratacap, of the Natural History Museum, New York, has furnished information concerning two other fine crystals placed in the Morgan collection. One of these is 9 inches high, 5 inches wide, and about three-fourths of an inch thick. It shows a fine deep suffused lilac coloration when viewed parallel to the vertical axis or length. The other crystal is 7 inches high, 5 inches wide, and three-fourths of an inch thick. Both are of gem quality and are free of all matrix and associations. They are strongly striated as usual, but have perfect terminations.

TOPAZ.

TEXAS.

The following notes on the occurrence of topaz in Mason County, Tex., have been abstracted in great part from a description by H. Conrad Meyer.[1] Topaz has been found at two places near Streeter and near Katemcy, respectively. Streeter is about 8 miles due west and Katemcy about 12 miles north of Mason, the county seat. This discovery of topaz was made in 1904 by the late R. L. Parker, of Streeter. Mr. Parker was attracted by the unusual weight of a supposed quartz crystal he had found in the bed of a stream on the land of Sam Awalt, near Streeter. He submitted it to a mineralogist, who pronounced it topaz. A careful search revealed the original matrix of the topaz, but the first work was confined chiefly to "dry washing" of the alluvial deposits. The topaz thus obtained consisted of waterworn crystals, with frosty-appearing surfaces. These were found to contain clear, limpid interiors when broken. Regular development of the topaz vein was not undertaken until 1908. Only a limited amount of work has been done on any of the deposits since 1910. In all a dozen or more prospect holes have been made at this locality.

Meyer refers to the report on the rare-earth minerals of Llano County, by F. L. Hess,[2] for a general description of the geology of the region. Hess speaks of the Llano region as an island of pre-Cambrian rocks intruded by plutonics and surrounded by an irregular zone of Cambrian and other Paleozoic rocks. The principal plutonic rocks are granites, which present several phases. An important variety, and one which Meyer mentions as the country rock at the topaz localities, is a rather coarse-grained red granite. The general geology of the Llano region, including a more complete description of this granite, has been given by Sidney Paige.[3]

The topaz occurs in pegmatite, but with different associations at the two localities. At the locality near Streeter the crystals are found in vugs partly filled with clay and associated with microcline feldspar, biotite, tourmaline, smoky quartz, and albite. The microcline is flesh-colored and occurs in large crystals. Smoky quartz, in many places intergrown with topaz, and biotite are quite abundant. The albite is found in fan-shaped laminated aggregates and is the clevelandite variety. Black tourmaline is sparingly present in small needle-like crystals. Some 200 pounds of good topaz crystals have been obtained. Besides the clear, colorless crystals, a small number of beautiful light-blue crystals, rivaling those of Siberia, have been

[1] Topaz and stream tin in Mason County, Tex.: Eng. and Min. Jour., Mar. 8, 1913, pp. 511–512.
[2] Bull. U. S. Geol. Survey No. 340, 1908, pp. 286–294.
[3] Llano-Burnet folio (No. 183), Geol. Atlas U. S., U. S. Geol. Survey, 1912.

found. Three specimens sent to the Survey by R. L. Parker, in 1907, were described in this report for that year, as (1) a cleavage fragment of a waterworn crystal, colorless and perfectly clear; (2) a perfectly clear crystal with a slight bluish tint; (3) a large crystal, weighing about 4½ ounces, clear in portions, with a delicate bluish-green tint. At that time Mr. Parker mentioned amber-colored topaz crystals as having been found. Meyer describes the largest crystal found here as about 3 inches in diameter, with a faint greenish-blue color.

An interesting discovery made by Meyer is that of the presence of stream tin or cassiterite in the concentrates from the dry placers. This mineral was found in broken crystals and angular grains of resin-yellow to brownish-black color and evidently was not far removed from its source.

The deposit near Katemcy was also found by R. L. and P. H. Parker and is on D. E. Amarine's property. Here the feldspar is greenish-blue microcline or amazon stone, which is reported to occur in large, cleavable masses with excellent color. Small specimens received at the Survey are light bluish-green and rather more transparent than usual with amazon stone. Transparent sea-green fluorite has also been found in the deposits near Katemcy. The topaz is intimately associated with quartz and feldspar, and the interstices are filled with a reddish felsitic rock. A specimen of the matrix furnished by Mr. P. H. Parker is composed of an agglomerated mass of brilliant, clear, glassy topaz crystals, gray and smoky quartz, tuffs or radiated groups of tabular albite or clevelandite crystals, gray microcline crystals, plates of muscovite mica, and red and gray fine felsitic rock inclosing minute black tourmaline needles and a few small plates of albite. The topaz crystals range up to an inch or more in thickness and are frozen in the rock. Meyer states that topaz composes about 80 per cent of the mass of this rock. A much smaller proportion of the topaz from this place is suitable for gem purposes than at the other locality described.

TOURMALINE.

The production of tourmaline in 1912 reported to the Survey amounted in value to $28,200, an increase over 1911, but far below the production of several preceding years, the maximum being that of 1909, which amounted to $133,192. The very large productions of those years were obtained chiefly from the numerous mines of southern California, where there was great activity in gem mining. These large outputs of tourmaline overstocked the market and caused the large decrease noted above. Maine has been an important contributor to the production of tourmaline during 1910, 1911, and 1912. This output came chiefly from a quarry near Poland, belonging to F. L. Havey, of Brunswick, Me. This property yields high-grade gem material in which green is the predominant color, but some crystals containing red and blue are found. Mr. Havey reports a production of 25,000 carats of fine green crystals, which, it is estimated, will cut into about 7,000 carats of gems. According to E. S. Bastin,[1] the prices received for native tourmaline in Maine are higher than those current in New York, because most of the stones are sold at retail to residents of the State or to summer tourists and have an enhanced value as souvenirs.

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[1] Pegmatites and associated rocks of Maine: Bull. U. S. Geol. Survey No. 445, 1911, p. 144.

Even with the decreased activity in gem mining in southern California in 1912, some rich finds were made in San Diego County. Dr. L. P. Gratacap mentions three magnificent specimens of rubellite of fine, deep gerardia color, found in a pocket at Pala, that have been added to the Morgan collection in the Natural History Museum, New York. One of these is attached to a large, well-developed quartz crystal. The specimens are composed of compound fascicled groups with fine gem nuclei. One, irregular in shape, is 8 inches high and 3½ inches in diameter at the top, tapers to a base, and has small, divergent crystals. The second is 4 inches high and 3½ inches thick, and the third is 8 inches high and 2 to 2½ inches thick and is associated with albite and lepidolite.

TURQUOISE.

Two interesting articles on turquoise appeared in 1912. These were "The origin of turquoise in the Burro Mountains, New Mexico," by Sidney Paige,[1] and "The aboriginal use of turquois in North America," by Joseph E. Pogue.[2] Data for Paige's article were obtained during the course of geologic mapping of the Silver City quadrangle and the conclusions reached are the result of study of the local occurrence of turquoise and its relations to the general geology of the region. Pogue's paper is an extract from a manuscript report dealing with the ethnology, mythology, mineralogy, geology, and technology of turquoise, prepared during work for the United States National Museum.

Several deposits of turquoise have been operated in the Burro Mountains of Grant County, N. Mex. The most extensive mining was conducted by the Azure Co., and a large quantity of very fine grade gem material was obtained. Other deposits were developed by the American Gem & Turquoise Co. and M. M. Porterfield with varying success.

The occurrence is somewhat similar at the different deposits, the turquoise being found in seams, veinlets, and nodules in fracture zones in rocks of granitic and quartz monzonitic composition which have undergone more or less decomposition and alteration. Paige's article deals chiefly with the occurrence at the Azure mine and the following notes have been abstracted from it.

The turquoise occurs in granitic and quartz monzonitic intrusive rocks. The granite belongs to a pre-Cambrian complex and was intruded in late Cretaceous or post-Cretaceous time by a mass of quartz monzonite porphyry followed by dikes of similar rock. The region has been strongly fractured, and the turquoise occurs in marked fracture zones. Fracturing was followed or accompanied by solutions probably of magmatic origin, which deposited cupriferous pyrite and quartz, formed sericite, and completely destroyed or altered hornblende and biotite.

The quartz monzonite intrusions were exposed by a prolonged period of erosion following the uplift of Cretaceous rocks. An important feature was the extensive subaerial erosion of Pleistocene time in which planated surfaces were formed. The turquoise occurs from the surface to shallow depths and is related to the surface of planation. During this period copper-bearing sulphides were altered to

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[1] Econ. Geology, June, 1912, pp. 382–392.
[2] Am. Anthropologist, new ser., vol. 14, No. 3, 1912, pp. 437–466.

carbonates and silicates; limonite formed in abundance; apatite was leached from the rock formations; and turquoise, jarosite, more sericite, and quartz were formed. The solutions from which the turquoise might have formed probably obtained the necessary phosphate and alumina from the decomposition of apatite and sericite. These minerals would have been readily attacked and leached by sulphate solutions formed by the oxidation of pyrite. The same solutions would have obtained sufficient copper to complete the formation of turquoise during the decomposition of cupriferous pyrite.

Pogue discusses the aboriginal use of turquoise in Central America, Mexico, and the United States as attested by historical evidence and by objects. The liberal use of footnotes refers the reader to various histories, works on anthropology, and museum collections where further information can be obtained. The esteem in which turquoise was held by the ancient inhabitants of the southwestern United States and Mexico is shown not to have abated among their present representatives, the Indian tribes of those regions. Thus the Pueblo, Zuni, Hopi, Navaho, Apache, and Ute tribes still bedeck themselves with ornaments of turquoise or use it for money.

VARISCITE.

The beautiful green mineral variscite has been used for gem and ornamental purposes under several names, such as "amatrice," "utahlite," and "chlorutahlite." The first variscite to be used as gems in the United States came from the mine of Don Maguire, of Ogden, Utah. This mine, located in Clay Canyon, 1½ miles west of Fairfield, Utah County, was discovered in October, 1894. G. F. Kunz [1] suggested the name utahlite for the mineral as a gem, and it was subsequently called chlorutahlite, under which name the material from this mine is now marketed. The next discovery was made in 1905 about 14 miles S. 65° W. of Tooele, in the foothills of the Stansbury Mountains. This material was described as "utahlite (variscite)" by Kunz,[2] but was later called "amatrice" by the Occidental Gem Corporation, of Salt Lake City,[3] and under this name it is now sold. Later discoveries were made at other localities in Utah and at many localities in Nevada, as set forth in these reports for 1909 and 1910. Practically all the minerals from these localities have been sold under the true name, variscite. There are two localities of interest in Utah—one in Washington County and one near Lucin, in Boxelder County. The former is worked by John A. Maynes, of Salt Lake City, and the latter is claimed by Edward Bird and Frank Edison, of Lucin. In Nevada variscite is widespread and has been prospected or mined at many places in Esmeralda County, especially near the deserted mining town of Columbus, near Candelaria, Coaldale, Blair Junction, and Sodaville.

The value of the production of variscite increased from several hundred dollars a year to several thousand dollars in 1907. During the next three years it was still greater, reaching a maximum of $35,938 in 1909. In 1911 and 1912 the output was less, but still sufficiently large to show that variscite has established a place for itself among American gem stones.

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[1] Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1894, p. 602.
[2] Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, p. 1351.
[3] Mineral Resources U. S. for 1907, pt. 2, pp. 832–833; idem for 1908, pt. 2, pp. 853–856, U. S. Geol. Survey. Also Zalinski, E. R., Amatrice, a new Utah gem stone: Eng. and Min. Jour., May 22, 1909.

The greater part of the output of variscite in 1912 came from Utah, where three mines were operated. Mr. Maguire reports extensive development at his mine, with the discovery of some fine material. Unfortunately the claims of Bird & Edison, near Lucin, have fallen under litigation with the Southern Pacific Co., so that none of the finely marked "turtle-back" and brecciated variscite from this locality could be placed on the market. Only one producer from near Coaldale reported from Nevada in 1912.

Variscite is a hydrous aluminum phosphate with bright green color. It has a hardness of only four, and is therefore not suited to rough wear. In some occurrences it is associated with allied phosphate minerals, among which is wardite. Other associated minerals and rocks, such as quartz, chalcedony, chert, jasper and black "jasperoid," limonite, hematite, slate, and rhyolite, often form strong contrasts in color and pattern with the variscite, yielding unique matrix gems. The variations from light to dark emerald-green in variscite itself, with its unusual markings due to texture, lend further contrast to these gems. Innumerable effects can thus be secured in cutting variscite and its matrix to meet the fancy of the various purchasers. The attractiveness of variscite gems, along with the reasonable price for which they can be sold, should guarantee their continued use in certain lines of jewelry, especially in the western tourist trade. Select gems have sufficient beauty to make them high priced. Variscite is especially adapted to what has been called barbaric jewelry and is beautifully "set off" in rich colored filigree gold mounting.

GREEN MICA SCHIST.

T. Nelson Dale [1] has described an occurrence of green mica schist in Shrewsbury, Vt., which promises to have considerable use as an ornamental stone. The following notes have been abstracted from his description of this rock: The occurrence is in a small saddle on the north side of Round Hill, on the west flank of the Green Mountain Range, 3¾ miles southeast of Rutland station. It was discovered and is being prospected by Edward H. Foley, of Rutland. The schist belt is about 100 feet thick and has a strike of N. 15°–30° W., with a high east dip. It consists largely of chrome mica (fuchsite), with some chlorite, quartz, tourmaline, and a little magnetite. The rough rock has a bright verdigris-green to faintly greenish-gray color. Its luster ranges from glistening to waxy and its texture is foliaceous and plicated. The polished stone has a brilliant dark emerald-green color varied with fine wavy streaks of lighter green. The stone saws and polishes well and will be suitable for internal decorations if obtained in masses of sufficient size and soundness. A block measuring probably 18 by 12 by 8 inches presented to the United States National Museum was firm and solid through the whole mass. A cube measuring possibly 3½ inches square and two rectangular slabs—one about 7 by 12 inches square and the other smaller—were cut from one end and side of the block. The polished face of the cube is rich dark-green of nearly even color. The slabs show both plicated banded light and dark-green layers and large areas of a nearly even green color.

[1] The commercial marbles of western Vermont: Bull. U. S. Geol. Survey No. 521, 1912, pp. 50–51.

METRIC OR INTERNATIONAL CARAT.

A strong movement was started in October, 1912, by members of the gem and jewelry trade to introduce the metric or international carat into the United States in place of the carat of variable weight now in use. At a meeting of jewelers and dealers in precious stones held in New York City in October,[1] 1912, resolutions were passed that the jewelry trade of the United States should adopt the metric or international carat of 200 milligrams on and after July 1, 1913. A committee with M. D. Rothschild, president of the American Gem & Pearl Co., as chairman, was appointed to secure the approval of various trade organizations interested. These resolutions were prepared after an expression of approval by a large majority of the jewelers to whom cards asking for their opinion had been mailed.

The international carat will be adopted on July 1, 1913, and the committee mentioned above has been very active furnishing information and arranging for a supply of the new weights. These will be divided into 100 parts, the smallest, therefore, weighing 2 milligrams. Director Stratton, of the Bureau of Standards, of the Department of Commerce, Washington, D. C., in a letter to the committee representing the gem and jewelry trade, has promised his cooperation in introducing the new weights.[2] The attitude of the Bureau of Standards was further made known in an address of Dr. Louis A. Fischer before the Retail Jewelers' Association of the District of Columbia,[3] in which the use of former carat weights was shown to be very illogical and the new international carat most advantageous to all parties concerned. The following countries have adopted the international carat: Spain, France, Italy, Bulgaria, Denmark, Norway, Japan, Portugal, Roumania, Switzerland, Sweden, Belgium, and Germany. Interest in the international carat is being aroused in Great Britain, where it is likely that it will be accepted more readily after its use is established in the United States.

The metric or international carat is about 2½ per cent lighter than the old carat, so that 1 carat in the old system weighs 1.025 carats in the international system. Conversion from either system of weights into the other may be made by simple multiplication or division.

BIRTH STONES.

The American National Retail Jewelers' Association adopted a standard list of birth-month stones at its meeting in Kansas City, in August, 1912. The changes made in the lists ordinarily used were slight and consisted chiefly of the addition of alternative stones. The following is the list[4] that was adopted:

Birth-month stones.

January	Garnet.
February	Amethyst.
March	Bloodstone or aquamarine.
April	Diamond.
May	Emerald.
June	Pearl or moonstone.
July	Ruby.
August	Sardonyx or peridot.
September	Sapphire.
October	Opal or tourmaline.
November	Topaz.
December	Turquoise or lapis lazuli.

[1] Jewelers' Circular Weekly, Oct. 30, 1912.
[2] Jewelers' Circular Weekly, Mar. 5, 1913.
[3] Jewelers' Circular Weekly, Apr 2, 1913.
[4] Jewelers' Circular Weekly, Aug. 14, 1912.

PRODUCTION.

The total production of gems and precious stones during 1912 reported to the Survey showed a decrease in value of $23,970 from 1911. The value of the production in 1912, estimated in part from the quantities of rough mineral reported, was $319,722. There were large changes in the production of some minerals. Thus the output of opal increased from $1,875 in 1911 to $10,925 in 1912; kunzite, from $75 in 1911 to $18,000 in 1912; turquoise decreased from $44,751 in 1911 to $10,140 in 1912; chrysoprase and emerald also decreased. The statistics represent nearly the first values that the rough material brings or might be expected to bring. The same gem material may increase four or five times in value after elaboration and placing on the market.

Production of precious stones in the United States, 1906–1912.

	1906	1907	1908	1909	1910	1911	1912
Agates, chalcedony, onyx, etc.	$800	$650	$1,125	$750	$2,268	$8,128	$9,978
Amethyst	700	850	210	190	....	725	363
Benitoite	....	1,500	3,638	500	....	....	150
Beryl, aquamarine, blue, pink, yellow, etc.	9,000	6,435	7,485	1,660	5,545	2,505	1,765
Californite	....	[a] 25,000	....	[a] 18,000	[a] 8,000	150	275
Catlinite	....	25	....	....	....	....	....
Chiastolite	25	20	....	....	....	25	....
Chlorastrolite	....	....	25	2,400	[a] 2,000	1,992	350
Chrysocolla	....	150	600	300	....	....	....
Chrysoprase	[a] 32,470	[a] 46,500	[a] 48,225	[a] 84,800	[a] 9,000	[a] 13,550	220
Cyanite	....	100	....	....	....	....	10
Diamond	....	2,800	[a] 2,100	2,033	[a] 1,400	[a] 2,750	[a] 1,475
Diopside	5	....	120	....	....	....	....
Emerald	....	1,320	....	[a] 300	[a] 700	[a] 9,500	2,375
Epidote	....	60	....	15	....	....	10
Feldspar, amazonstone, sunstone, etc.	100	1,110	2,850	[a] 2,700	2,510	175	1,310
Garnet, almandine, pyrope, hyacynth, etc.	3,000	6,460	13,100	1,650	3,100	2,065	860
Gold quartz	....	1,000	1,010	....	1,000	1,700	1,900
Jasper, petrified wood, bloodstone, etc.	150	1,000	....	100	475	2,240	6,005
Malachite, azurite, azurmalachite	....	250	5,450	2,000	550	800	1,085
Opal	....	180	50	200	270	[a] 1,875	[a] 10,925
Peridot	2,400	1,300	1,300	300	....	360	8,100
Phenacite	250	25	95	50	50	....	....
Prase	50	....	....	....	100	....	....
Pyrite	....	400	....	....	....	....	265
Quartz, rock crystal, smoky quartz, rutilated quartz, etc.	3,050	2,580	3,595	2,689	1,335	2,140	2,448
Rose quartz	4,000	6,375	568	2,970	2,537	1,744	865
Rhodocrosite	....	150	....	....	....	....	....
Rhodonite	....	....	1,250	125	[a] 6,200	1,300	550
Ruby	600	2,000	....	....	....	210	2,260
Rutile	....	200	....	25	....	....	....
Sapphire	39,100	[a] 229,800	[a] 58,397	[a] 44,998	52,983	[a] 215,313	[a] 195,505
Smithsonite	....	800	[a] 1,200	300	....	25	650
Spodumene, kunzite, hiddenite	14,000	14,500	[a] 6,000	15,150	33,000	75	18,000
Thomsonite	....	....	35	100	610	1,500	450
Topaz	1,550	2,300	4,435	512	884	2,675	375
Tourmaline	[a] 72,500	[a] 84,120	[a] 90,000	[a] 133,192	[a] 46,500	16,445	[a] 28,200
Turquoise and matrix	22,250	23,840	[a] 147,950	[a] 179,273	[a] 85,900	[a] 44,751	10,140
Variscite, amatrice chlorutahlite, utahlite	2,000	7,500	14,250	35,938	[a] 26,125	[a] 5,750	[a] 8,150
Miscellaneous gems	....	....	....	1,060	2,755	3,224	4,408
Total	208,000	471,300	415,063	534,380	295,797	343,692	319,722

[a] Estimated or partly so.

IMPORTS.

The imports of precious stones into the United States, as reported by the Bureau of Foreign and Domestic Commerce, were large and have been exceeded only by those of 1906. The greatest increase was in pearls, the value of which more than offset decreases in the value of imports of diamonds and other precious stones.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1906 to 1912, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1906–1912.

Year.	Diamonds.					Diamonds and other stones not set.	Pearls.	Total.
	Glaziers.	Dust or bort.	Rough or uncut.	Set.	Unset.			
1906	$104,407	$150,872	$11,676,529	$305	$25,268,917	$3,995,865	$2,405,581	$43,602,476
1907	410,524	199,919	8,311,912	....	18,898,336	3,365,902	680,006	31,866,599
1908	650,713	180,222	1,636,798	....	9,270,225	[1] 1,051,747	910,699	13,700,404
1909	758,865	50,265	8,471,192	....	27,361,799	[1] 3,570,540	24,848	40,237,509
1910	213,701	54,701	9,212,378	....	25,593,641	4,003,976	1,626,083	40,704,487
1911	199,930	110,434	9,654,219	....	25,676,302	3,795,175	1,384,376	40,820,436
1912	452,810	94,396	9,414,514	....	22,865,686	3,405,543	5,130,376	41,363,325

[a] Including agates. Agates in 1906, $20,130; in 1907, $22,644.

TEXT AND REFERENCE BOOKS.

[With publishers' prices.]

Bauer, Max, Precious stones; translated by L. J. Spencer, illustrated with colored plates; C. Griffin & Co., London, J. B. Lippincott Co., agents, Philadelphia. ($15.)

Claremont, Leopold, The gem cutter's craft; George Bell & Sons, London, 1906. ($5.)

Crookes, Sir William, Diamonds; Harper & Brothers, London and New York, 1909. (75 cents.)

Farrington, O. C., Gems and gem minerals; illustrated with colored plates; A. W. Mumford Co., Chicago, 1903. ($3.)

Goodchild, W., Precious stones; Archibald Constable & Co., Ltd., London, 1908. ($2.)

Kunz, G. F., Gems and precious stones of North America; illustrated with colored plates; Scientific Publishing Co., New York, 1890. ($10.)

——— Jewelers' materials and ornamental stones of California; Bull. California State Min. Bureau No. 37, San Francisco, 1905. (Price and postage, 45 cents.)

——— History of gems found in North Carolina; Bull. N. C. Geol. and Econ. Survey No. 12. (Free; postage, 10 cents.)

Rothschild, M. D., Handbook of precious stones; G. P. Putnam's Sons, New York, 1890. ($1.)

Smith, G. F. H., Gem stones; illustrated with colored plates; Methuen & Co., Ltd., London, 1912. ($2.10.)

Streeter, E. W., Precious stones and gems; illustrated with colored plates; George Bell & Sons, London, 1898. ($4.)

Tassin, Wirt, Catalogue of gems in the United States National Museum; Ann. Rept. U. S. Nat. Mus., 1900, pp. 476–670. Contains a good bibliography.

Williams, G. F., The diamond mines of South Africa; 2 vols., illustrated with colored plates; B. F. Buck & Co., New York, 1905. ($25.)

Wodiska, Julius, A book of precious stones; illustrated with colored plates; G. P. Putnam's Sons, New York, 1910. ($2.50.)

GRAPHITE.

By Edson S. Bastin.

INTRODUCTION.

The origin, properties, and uses of graphite were fully discussed in the report on the production of graphite in 1911. As copies of that report may be had on application, this information will not be repeated here. The 1911 report contained also a summary of existing knowledge in regard to the graphite deposits of the island of Ceylon and an index and bibliography of the more important publications dealing with the character, uses, and origin of graphite and its occurrence in the United States.

A considerable quantity of material is produced in Bartow County, Ga., which can not properly be classed as graphite, but is rather a slate carrying from 2 to 15 per cent of carbon, probably in part graphite. It is ground for use as a filler and drier in fertilizers. In 1909 the production of this material was included in the statistics under the heading "Amorphous graphite," but as it is not adapted for any of the purposes for which higher grades of amorphous graphite are used and as these higher grades are never used as fertilizer filler, it is deemed best not to include this material under the name graphite.

The bulk of the graphite consumed in this country continues to be derived from foreign deposits. In 1912 the quantity of graphite imported into the United States for consumption was 25,643 short tons, valued at $1,709,337. In contrast to this the total domestic production was 2,695 short tons of natural graphite, valued at $212,033, and 6,448 short tons of manufactured graphite, valued at $830,193.

PRODUCTION AND IMPORTS.

NATURAL GRAPHITE.

PRODUCTION.

In 1912, as in 1911, the total production of crystalline graphite came from Alabama, New York, and Pennsylvania. All of this crystalline graphite was of the variety known in the trade as "flake" graphite, that occurs as small flakes disseminated through crystalline schists, from which it is separated by more or less complicated milling processes. The production of crystalline graphite in the United States has decreased continuously since 1909, as is shown in the accompanying table. This decrease resulted mainly from the closing of numerous graphite properties, very few new properties having begun operation during the same period. The destruction by fire of the mill of the Allen Graphite Co., at Quenelda, Ala., was the cause of a part of the decrease in 1912.

Amorphous graphite was produced during the year by four firms, located in Michigan, Nevada, and Wisconsin. The Michigan product is a slate carrying 25 to 30 per cent of graphite and is all consumed in the manufacture of paints. The Nevada and Wisconsin products were very small. All the firms reported decreased production as compared with 1911.

Further details in regard to various properties are given in the summary by States and Territories.

Production of natural graphite, 1908–1912.

Years.	Amorphous.		Crystalline.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Pounds.*		*Short tons.*	
1908	1,443	$75,250	2,288,000	$132,840	2,587	$208,090
1909	[a] 5,096	32,238	6,294,400	313,271	8,243	345,509
1910	1,407	39,710	5,590,592	295,733	4,202	335,443
1911	1,223	32,415	4,790,000	256,050	3,618	288,465
1912	923	24,344	3,543,771	187,689	2,695	212,033

[a] Includes Georgia graphitic slate.

On account of the small number of producers, figures of production by States can not be published without revealing individual productions.

IMPORTS.

In 1912 there was a slight increase in the quantity of graphite imported from each of the four countries, Ceylon, Mexico, Canada, and Chosen (Korea) (via Japan). The total value of the graphite imported was $1,709,337, as compared with a total value of $1,037,226 for the domestic product, both natural and artificial.

The imports of graphite into the United States in 1911 and 1912 by countries are shown in the following table:

Imports of graphite for consumption into the United States, 1911 and 1912, by countries, in short tons.

Country.	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Ceylon	13,119	$1,132,678	16,791	$1,379,587
Mexico	3,368	254,060	3,518	163,107
Canada	2,289	78,196	2,688	122,216
Japan (Chosen via Japan)	1,256	18,486	1,574	22.875
Austria-Hungary	65	1,139	473	8,971
Italy	510	6,242	468	7,450
Germany	48	2,930	102	2,669
Other countries	47	1,998	29	2,462
Total	20,702	1,495,729	25,643	1,709,337

The following table shows the imports for consumption of graphite from 1908 to 1912, inclusive:

Imports for consumption of graphite into the United States, 1908–1912, in short tons.

Years.	Quantity.	Value.
1908	11,456	$762,367
1909	21,267	1,854,459
1910	25,235	1,872,592
1911	20,702	1,495,729
1912	25,643	1,709,337

As Ceylon continued to furnish most of the graphite consumed in this country, the following table is given to show the distribution of the Ceylon product. From the early days of the industry up to 1901, Great Britain consumed more Ceylon graphite than any other country. In 1901 the United States assumed the first place, with Great Britain second until 1909, when Germany took second place. The distribution of graphite exports from Ceylon for one year in each of these trade periods is given below.

Exports of graphite from Ceylon, in short tons.

Destination.	1885 [a]	1902 [a]	1912 [b]
Great Britain	7,670	7,586	5,348
United States	3,074	15,244	15,460
Germany	67	3,833	8,057
Belgium		1,096	2,874
Other countries	187	453	824
Total	10,998	28,212	32,563

[a] Figures from Ceylon Government Blue Book.
[b] Advance figures issued by the Ceylon Chamber of Commerce.

Some importations of flake graphite were received from Canada and of amorphous graphite from Mexico and from Chosen (Korea). As practically all of the Korean output is shipped via Japanese ports, it is reported in the customhouse returns as coming from Japan, but so far as can be learned little or no graphite is produced for exportation in Japan proper. The Ceylon deposits and industry were described at some length and the Korean deposits were briefly referred to in the report on the production of graphite in 1911.

Some small shipments of graphite from Madagascar are reported to have been received in this country during the year and some larger shipments are now on their way. The following information in regard to the graphite industry of Madagascar is taken from a report[1] by James G. Carter, United States consul at Tamatave:

Exports of graphite from Madagascar, 1909–1912.

	Quantity.	Value.
	Metric tons.	
1909	200	$14,320
1910	554	55,713
1911	1,281	86,188
1912 (first half)	1,121	60,246

[1] Daily Cons. and Trade Repts., Jan. 29, 1913, pp. 516–517.

Up to December 31, 1911, the total number of claims taken up was 200; by July 1, 1912, the number had increased to nearly 400.

The graphite deposits are found to extend nearly the whole length of the island from near Mount D'Ambre on the north to Ambalavao on the south. Those deposits that are now worked are in the central plateau and on the east coast.

The Madagascar graphite may be easily separated from the débris by simply washing it with the hands and, if the work is carefully done, may be concentrated up to 80 or 85 per cent. The graphite thus far produced, however, has averaged from 70 to 80 per cent, due to the fact that it has been washed almost wholly by natives with pans or sluices, the latter method giving the better results. By the use of machinery it is estimated that the concentration may be brought up to 95 or 98 per cent. As the decomposed quartzite and rotten schists retain moisture, only machinery suitable for handling such materials should be employed. Only three of the large producers of graphite have as yet installed machinery at their plants. These are the Maison Suberbie and the Syndicat Lyonnais, at Tananarive, and Arton et Allemand, at Mamjakandriana, with European headquarters at Antwerp.

The greater portion of the graphite is purchased on the island by local commercial houses for exportation to their European headquarters and by the local representatives of European crucible syndicates or companies. Of the local commercial firms active in the purchase and exportation of graphite are Messrs. Ulysse Gros & Darrieux, Wm. O'Swald & Co., and the Cie. Marseillaise de Madagascar (L. Besson & Co.), with European headquarters at Paris, Hamburg, and Marseille, respectively. The first-named concern is understood to be also purchasing for a European syndicate. The Morgan Crucible Co. (Ltd.), of London, through its established agency ar Tananarive, is also one of the largest purchasers of graphite. Another concern, with purchasing agents at Tananarive and Antsirabe, is the Syndicat d'Exploitation des Graphites de Madagascar, with headquarters at No. 50 Boulevard Haussmann, Paris. A representative of Arthur Bramwell & Co. (Ltd.), of London, has also been to Madagascar; but this office is without any information as to what purchasing connections the company has established on the island.

Purchasers of graphite for export either buy outright for cash or by contract for a certain number of tons per year at a stated price. The large purchasers also advance money to the holders of claims for working expenses. The contract usually binds the producer to sell to the contracting purchaser only. The large producers, however, except in one or two instances, are yet "unengaged" and export their own graphite.

If American concerns are interested, there seems to be no reason why they should not be able to establish direct relations with the producers of Madagascar graphite and purchase the product upon equal terms with European houses. A list of the largest producers, with whom correspondence might be carried on in regard to the purchase of graphite or the sale of machinery for working it, is herewith forwarded [and may be obtained from the Bureau of Foreign and Domestic Commerce]. The better plan, however, would be to have a representative in the place to establish the desired connections. An American prospector residing at Tananarive [name obtainable on application at the bureau] is familiar with graphite and mining conditions in Madagascar and would doubtless be pleased to correspond with American firms with a view to purchasing or working graphite for their account.

The present price of Madagascar graphite varies from 200 to 700 francs ($38.60 to $135) per ton f. o. b., according to the percentage of carbon and size of the flakes. Graphite averaging 80 per cent carbon sells for 350 to 400 francs ($67.55 to $77.20) and that averaging 88 to 90 per cent 675 francs ($130.28).

The freight per metric ton on graphite, as quoted by the Messageries Maritimes Steamship Co., is $17 from Tamatave to New York and $20 from Vatomandry and Mananjary, the two southern ports from which graphite is shipped.

Three samples of the crude and one each of the four following grades of refined Madagascar graphite accompany this report: No. 1, 88½ per cent carbon; No. 2, 86 per cent; No. 3, 84 per cent; "averages," 80 per cent. The samples of crude graphite were taken out of a body 3 meters (9.84 feet) wide, at a depth of 10 feet. [These will be loaned by the bureau to American firms interested.]

The samples of Madagascar graphite which accompanied Mr. Carter's report were examined by the writer. The crude material was in lumps as much as 3 inches across that showed a decided foliated structure, and more than half of it appeared to be crystalline graphite, the remainder being more or less decomposed and iron-stained feldspar, quartz, etc. In some of the lumps curved flakes of graphite 0.8 inch in length occur, but in general the graphite flakes are much smaller. Three samples of the refined product were graded as follows:

No. 1.—Said to average about 88½ per cent carbon. Thin flakes from 0.02 to 0.05 inch in width and from 0.03 to 0.15 inch in length. Luster more brilliant than No. 2 or 3.

No. 2.—Said to average about 86 per cent carbon. Slightly thicker flakes, averaging 0.03 to 0.07 inch in width and from 0.05 to 0.2 inch in length. Luster rather dull.

No. 3.—Said to average about 84 per cent carbon. Thicker flakes, averaging about 0.1 inch in width and from 0.1 to 0.4 inch in length. Luster rather dull.

A notable feature of all the samples is the apparent total absence of mica, but some altered mica (biotite) was observed in another sample reported to be Madagascar graphite obtained from a different source. The impurities consist of fragments of quartz and altered feldspar, more or less iron stained and possibly other minerals. In general, the refined product differs from the smaller grades of Ceylon material in being flaky and differs from most American flake in that the flakes are commonly somewhat elongate rather than nearly equidimensional.

WORLD'S PRODUCTION.

The world's production of graphite for the years 1908–1910 was as follows:

World's production of graphite, 1908, 1909, and 1910, in short tons.[a]

Country.	1908		1909		1910	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	2,587	$208,090	8,243	$345,509	4,202	$335,443
Canada	251	5,565	863	45,999	1,392	74,083
Mexico	1,742	28,426	1,878	25,301	2,571	36,207
Russia	94	1,285				
Germany	5,340	60,264	7,467	64,724	8,174	76,404
Austria	48,970	349,118	44,875	320,289	36,520	281,220
Norway	1,192	13,005			882	8,575
Sweden	73	2,046	29	779	1,526	1,844
France					606	5,353
Italy	14,235	71,758	12,768	71,148	13,790	74,808
Japan	195	8,592	136	5,290	162	5,202
Chosen (Korea)		48,154		75,012		56,719
India	3,218	69,814	3,508	60,972	4,761	99,661
Queensland	22	292				
Ceylon	28,916	2,593,160	36,056	3,237,751	35,310	2,577,600
Madagascar	90	6,395	220		601	21,218
South Africa	3		3		40	6,755

[a] Mines and quarries: General Report and Statistics, pt. 4. London.

MANUFACTURED GRAPHITE.

The following table shows the production of manufactured graphite by the International Acheson Graphite Co., at Niagara Falls, N. Y., for the years 1908–1912, inclusive:

Production and value of manufactured graphite, 1908–1912.

Years.	Quantity.	Value.	Average price per pound.
	Pounds.		*Cents.*
1908	7,385,511	$502,667	6.80
1909	6,664,017	480,000	7.20
1910	13,149,100	945,000	7.20
1911	10,144,000	664,000	6.55
1912	12,896,347	830,193	6.44

INDUSTRY BY STATES AND TERRITORIES.

ALABAMA.

The plant of the Quenelda Graphite Co. (formerly the Allen Graphite Co.), at Quenelda, was destroyed by fire but is now being rebuilt with a capacity for handling 400 tons of crude material in 10 hours. No production was reported for 1912.

The Ashland Graphite Co.'s plant, about 4½ miles west of Ashland, was idle during 1912. Some of the persons interested in this company are engaged, under the name of the Alabama Graphite Co., in developing a graphite deposit of similar character in the near vicinity. A mill was erected and began operations in August, 1912.

ALASKA.

During the year the Uncle Sam Alaska Mining Syndicate opened a new property in the Kigluaik Mountains, Port Clarence mining district. According to a description obtained through the courtesy of the manager of this company the property comprises nine locations of claims and two mill site locations, nearly 2 miles (10,168 feet) south of Graphite Bay, a branch of the Imuruk Basin. The elevation is about 500 feet above sea level. The graphite occurs associated with schists and gneisses which strike east and west and have steep dips. The richer graphitic portions can, it is claimed, be readily separated by hand sorting. Some graphite has been shipped to Everett, Wash., where a small mill is being erected for its treatment.

At the property of the Alaska Graphite Co., also in the Port Clarence district, development work was in progress during the latter part of 1912, but no graphite was shipped.

CALIFORNIA.

A company known as the California Graphite Co. was incorporated in January, 1913, to develop a graphite deposit near Saugus, in Los Angeles County. The material is similar in general to some of the graphitic schists of the eastern United States and it is planned to erect a mill at an early date.

COLORADO.

Some development work was in progress during 1912 on a new graphite property near the summit of Italian Mountains, in Gunnison County, Colo. The deposits are near the head of Cement Creek and are about 10 miles from the railroad. A company formed for their development is known as the Colorado Graphite Mining & Manufacturing Co., with office in Denver. According to a private report made to this company by S. C. Robinson, mining engineer, there appear to be three parallel "veins" of graphite about 50 feet apart, lying parallel to the inclosing beds of stratified rock, which here stand nearly vertical. The middle "vein" is the largest and has a width of 4 to 6 feet. All development has thus far consisted in open-cut mining. This locality lies either within or just east of the area covered by the Anthracite-Crested Butte folio (No. 9) of the Geologic Atlas of the United States. Within this area coal occurs in the Cretaceous formations. Though normally bituminous, it has locally been altered to anthracite as a result of dynamic metamorphism or of the proximity of igneous rocks. The occurrence of graphite as a result of still more intense alteration is therefore not at all surprising.

The mine of the Federal Graphite Co., near Turret, in Chaffee County, was idle in 1912.

IDAHO.

Graphitic schists are known to occur on Salmon River, near Grangeville, Idaho, and analysis of a specimen showed 7.6 per cent of fixed carbon.

MASSACHUSETTS.

Graphite has not been produced in Massachusetts for some years. Mr. F. C. Husbands states that at the famous Sturbridge mine (described in the report on the production of graphite in 1911) the main lode has been prospected for over half a mile west from the shore of Lead Mine Pond, for most of this distance to a depth of 50 to 60 feet. One lump, mostly graphite, taken out about 1904 weighed about 510 pounds.

MICHIGAN.

In Michigan the Detroit Graphite Co. and the Northern Graphite Works, whose mines are near L'Anse, Bargara County, conducted operations. The material is a graphitic slate, which is ground for paint pigment.

MONTANA.

At the property of the Crystal Graphite Co., near Dillon, Mont., development work was continued during 1912 at the tunnel workings, a new drift being driven on one of the veins and a winze sunk.

NEVADA.

The Black Lead Mining Co. continued operations at Carson, Nev., its product being ground, but not refined, and sold for paint pigment and as foundry facings.

Mr. E. Edwin, of Ludwig, Lyon County, reports the discovery of a graphite deposit in that county. He states that the graphite deposit is between 4 and 5 feet thick and is traceable on the surface for several hundred feet. A specimen sent to the Survey was an amorphous graphite of good quality.

NEW MEXICO.

A large body of amorphous graphite occurring in the canyon of Canadian River about 7 miles southwest of Raton, in Colfax County, has been described by W. T. Lee.[1] This graphite has been formed by the metamorphism of coal through the effect of igneous rocks intruded into it.

NEW YORK.

In New York the firms operating were the American Graphite Co. (Joseph Dixon Crucible Co.), at Graphite, Warren County; the Empire Graphite Co., at Greenfield, Saratoga County; the Sacandaga Graphite Co., at Conklingville, Saratoga County; and the International Acheson Graphite Co., at Niagara Falls. The Macomb Graphite Co., at Popes Mills, St. Lawrence County, was idle in 1912, and the Crown Point Graphite Co., at Crown Point, Essex County, has been idle since the fall of 1910.

NORTH CAROLINA.

A few tons of graphitic schist were mined at Barretts Mountain, in Alexander County, but none was refined or shipped.

PENNSYLVANIA.

The only firms operating in Pennsylvania during the year were Pettinos Bros., at Byers, and the Rock Graphite Mining & Manufacturing Co., at Chester Springs. The Eynon Graphite Co., with mine and mill near Coventryville, which took over the property of the Imperial Graphite Co., continued experimental and development work.

WISCONSIN.

The Wisconsin Graphite Co., at Stevens Point, in Portage County, reported a small production. The material is a graphitic slate and is ground for use mainly as a paint pigment.

MARKETS AND PRICES.

The prices paid by crucible makers and others for Ceylon graphite during 1912 were approximately as follows:

Prices of Ceylon graphite at New York City in 1912.

	Cents per pound.		Cents per pound.
Ordinary lump:		Chip:	
Best	8¼–10	Best	5¼–7
Medium	7 –8	Medium	4½–6
Poor	5½–7	Poor	3½–4½
Dust:		Flying dust:	
Best	3 –3½	Best	2 –2¼
Medium	2½–2¾	Medium	1¾–2
Poor	1⅞–2⅛	Poor	1¼–1½

In general the range in prices was somewhat greater than in 1911, and during the last half of 1912 there was a notable advance in prices.

[1] Lee, W. T., Graphite near Raton, N. Mex.: Bull. U. S. Geol. Survey No. 530–L, 1912.

The average price of Korean graphite during the year was about $25 a short ton, c. i. f. New York City. Most of this material is used for stove polish and foundry facings.

Most of the domestic producers of graphite who were operating during the year reported that market conditions were good. The prices for American flake graphite were very variable, but the following table will give some idea of their general range.

Prices of domestic flake graphite in 1912, f. o. b. mills.

	Cents per pound.
Best crucible flake	5½–7½
Medium grade flake	4 –6½
Inferior grade flake	2½–4
Dust	¾–3

In general the prices appear to be slightly higher than in 1911.

LITERATURE.

In an article entitled "The expansion coefficient of graphite"[1] Arthur L. Day and Robert B. Sosman report the results of measurements made in the Carnegie Geophysical Laboratory at Washington of the expansion coefficient of a bar of Acheson graphite. The writers compare their results with those obtained by others for other kinds of graphite and other forms of carbon. They are inclined to agree with Moissan and others that graphite can not be looked upon as a substance of fixed properties, basing this opinion on the variations observed not only in the coefficients of expansion of different graphites but also on other physical properties. To quote these writers:

If we look upon natural graphites as products of metamorphism from organic matter, whether by the direct action of heat alone or through the medium of solutions, we may imagine the complicated carbon chains and rings of the compounds that make up bituminous and anthracite coal as persisting after the removal of their hydrogen and oxygen, giving a whole series of "graphites" whose properties change progressively as the molecules become simpler. Berthelot held this view as regards amorphous carbon.

A detailed description with analyses of the occurrence of graphite near Raton, N. Mex., by W. T. Lee,[2] was published during the year by the United States Geological Survey.

In a book that was published in 1909 but has only recently come to the writer's attention, C. M. Johnson,[3] chief chemist of the Park Steel Works of the Crucible Steel Co. of America, devotes a chapter to the analysis of graphite and graphite crucibles.

"The geology of the graphite deposits of Pennsylvania" is the title of an article published during the year by Prof. B. L. Miller, of Lehigh University.[4] This article is a summary of a more detailed report to be published later by the Topographic and Geologic Survey Commission of Pennsylvania. It describes the mode of occurrence of graphite in that State and discusses its origin. A bibliography gives references to previous publications in which Pennsylvania graphite is mentioned.

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[1] Jour. Indust. and Eng. Chem., vol. 4, No. 7, July, 1912.
[2] Lee, W. T., Graphite near Raton, N. Mex.; Bull. U. S. Geol. Survey No. 530–L, 1912.
[3] Johnson, C. M., Rapid methods for the chemical analysis of special steels, steel-making alloys, and graphite. John Wiley & Sons, 1909.
[4] Econ. Geology, vol. 7, 1912, pp. 762–777.

MAGNESITE.

By Charles G. Yale and Hoyt S. Gale.

PRODUCTION.

Outside of the State of California no magnesite is produced in commercial quantity in the United States. In 1912 the California output was 10,512 tons of crude ore, valued at $105,120, as compared with 9,375 tons crude in 1911, valued at $75,000. The price of crude magnesite, on which the statistics of annual production are based, is a somewhat uncertain figure, since no crude ore is actually sold on the market; in fact, practically no ore is even shipped from the mines until it has been calcined. Calcination results in a loss of weight equivalent to the weight of carbon dioxide and moisture driven off, of which in perfectly pure material the carbon dioxide might reach a maximum of 52 per cent of the ore, and in the ore as ordinarily mined the moisture would constitute a variable percentage. This calcining, however, is to an extent a manufacturing or refining operation, whose cost need not be added to the value of the product as mined. It is desired to reduce the statistics of production quoted herewith to terms of raw material at the mine or at the point of shipment, and not to include values represented by more or less manufactured products where that can be reasonably avoided.

The price of $10 a ton has been accepted this year for crude magnesite as mined or at the point of shipment, against $8 a ton used in the report for 1911. The price for calcined magnesite in San Francisco is quoted at about $25 a ton unground. This is approximately equivalent to the $10 stated for crude magnesite if a small allowance is made for the cost of calcining, as it takes from 1¾ to 2 tons of crude ore to make 1 ton of the calcined product. Should this calcined material, unground as generally applied for refractory uses, be reduced to a fine powder and packed in barrels for sale in small quantities for use in cement it is estimated that locally produced ground magnesite would sell in San Francisco at $30 a ton. This has thus far been done only on a small scale in San Francisco, so that the higher prices for the Grecian material, finely ground and suitably packed, still prevail. The company at Winchester, in Riverside County, supplies the Los Angeles local market with the ground calcined magnesite, packed in barrels, and so obtains a higher price for its output than other mines of the State, which have not yet pursued this course.

It seems rather an odd circumstance that the makers of flooring, tiling, building material, artificial marble, etc., in California purchase most of their supplies of calcined magnesite from those who import the product, paying as high as $40 and $45 or even $50 a ton for it, when the California product ought to be procured for $25 to $30 a ton. One immediate reason stated for this is that these manufacturers always specify Grecian magnesite when asking for bids. This seems to indicate some reason or prejudice against the domestic product. However, it is believed that this is in fact the result of domestic market conditions. In order to establish production from domestic sources on an efficient basis so that the product shall compete on favorable terms, continuous operation both at the mines and in the factory should be sustained, whereby a standard and reliable product for cement use may be available to meet the demand. Domestic material of variable and uncertain composition is not suitable for the exacting requirements of the cement users. Few of the California miners are prepared to grind or pack their magnesite for the market in such form that it could be disposed of in small quantities as needed. Only recently establishments in San Francisco have arranged to grind the local product as it comes calcined from the mines and pack it in shape suitable to the wants of those using it in a small manufacturing way.

The demand for the domestic product is restricted to Pacific coast consumption, it being impossible to ship the material at present railroad freight rates to the points of largest consumption in the United States. For these reasons the imports of magnesite, when reduced to terms of the raw rock as mined, so as to be actually comparable with the figures of domestic production, are over twenty times that of the domestic production.

In answering the inquiries of the United States Geological Survey for the year 1912, numerous mine owners who had not worked their properties during the year expressed the belief that upon the opening of the Panama Canal they would be able to ship the magnesite by sea at a profit and would then open the mines and find a market. There are certainly numerous workable deposits in California, but, as stated, most of them are idle at present. Under these circumstances there is little incentive to prospect for magnesite deposits until a larger and steadier market can be developed.

The larger part of the output of magnesite in 1912, as has been the case for some years, was derived from the mines of the Tulare Mining Co., Tulare County. The material is calcined at the mine and shipped to the paper mills of the Willamette Pulp & Paper Co., Oregon, where it is used as a digester in the manufacture of paper from wood pulp. Small quantities are also sold to other manufacturers. Other producing mines in California in 1912 were the Fresno Magnesite Co., of Fresno County; California Magnesite Co., of Riverside County; Western Magnesite Co., of Santa Clara County; and the Eckert ranch deposit, of Sonoma County.

No crude ore was shipped from any of these mines except that at the Eckert ranch, that ore being calcined in San Francisco. The rest was all calcined in the furnaces at the mines and shipped in bulk for different manufacturing purposes. The substance is no longer used on the Pacific coast, as formerly, in the manufacture of carbon dioxide, other substitutes, including a product from distillery waste or from lime, having been found to be cheaper for the production of this gas.

The following table shows the quantity and value of the domestic output from 1891 to 1912, inclusive:

Quantity and value of crude magnesite produced in the United States, 1891–1912, in short tons.

	Quantity.	Value.		Quantity.	Value.
1891	439	$4,390	1902	2,830	$8,490
1892	1,004	10,040	1903	3,744	10,595
1893	704	7,040	1904	2,850	9,298
1894	1,440	10,240	1905	3,933	15,221
1895	2,220	17,000	1906	7,805	23,415
1896	1,500	11,000	1907	7,561	22,683
1897	1,143	13,671	1908	6,587	19,761
1898	1,263	19,075	1909	9,465	37,860
1899	1,280	18,480	1910	12,443	74,658
1900	2,252	19,333	1911	9,375	75,000
1901	3,500	10,500	1912	10,512	105,120

MINERALOGIC PROPERTIES OF MAGNESITE.

The mineral magnesite itself is the normal carbonate of magnesium, expressed by the formula $MgCO_3$. It is commonly a dense white massive mineral, rarely showing any crystalline structure, and in its common massive form entirely devoid of cleavage or regular partings. It has conchoidal fracture, showing a smooth white opaque surface, resembling broken porcelain. In less pure varieties it may be stained and colored or have a coarser granular structure.

According to Dana the mineral has a specific gravity of 3 to 3.12. Therefore, a cubic foot of the solid mineral weighs about 190 pounds. It is rated as 3½ to 4½ in the scale of hardness. The theoretically pure mineral contains 52.4 per cent of carbon dioxide (CO_2) and 47.6 per cent of magnesia (MgO). As the mineral occurs in nature it includes various proportions of silica, clay, or serpentine, and to a greater or less extent the oxides of iron.

GEOLOGIC RELATIONS OF DEPOSITS.

Most of the known deposits of magnesite are associated with basic intrusive igneous rocks, such as peridotite and allied basic rocks, which are composed essentially of minerals like olivine and the pyroxenes, rich in magnesia. As the magnesite occurs in veins and as lodes in part replacing the igneous rock, it seems clear that it is mainly derived from the alteration of the original intrusive magnesian rock. In the original rock the magnesia is present principally in the form of silicates. By alteration of the silicates to carbonate form, as of magnesite, it appears that silica should be set free. This is indeed borne out by observation, since the magnesite veins commonly occur in zones of extensive alteration in magnesian silicate rocks, and these zones are most conspicuously characterized by the secondary deposition of silica, as of opal, chalcedony, or quartz. One of the most common products of the decomposition by hydration or weathering of magnesia-rich silicate rocks is the green mineral serpentine, a magnesian silicate with water in combination, and the alteration to this mineral takes place so extensively over the surface areas of the exposures of these basic intrusive rocks that the whole mass is commonly referred to as "serpentine," although serpentine is strictly a specific mineral rather than a rock which has a more or less variable composition.

The rock "serpentine," using the term in its less strict sense, is widely distributed throughout the Coast Range, and also in the Sierra Nevada of California. Reports of magnesite occurrences elsewhere indicate that similar rocks also exist in Nevada and outside of the areas for which definite geologic data are now available.

DISTRIBUTION OF DOMESTIC DEPOSITS.

There are numerous known deposits of magnesite in California, most of which have been described in a bulletin of the Survey.[1] Other deposits discovered since the publication of that bulletin and recent developments on the old deposits have been described in the report on magnesite in the volume of Mineral Resources of the United States for 1911, and more completely in a current report.[2]

UTILIZATION OF MAGNESITE.

The principal uses of magnesite are summarized as follows, the data on this subject being as a matter of necessity to a considerable extent compiled from published references and from hearsay, although of course care has been exercised to make this statement as accurate as possible: (1) Various refractory uses, as brick, furnace hearths, crucibles, etc.; (2) as magnesium sulphite for the digestion and whitening of wood-pulp paper; (3) in crude form for the manufacture of carbon dioxide; (4) calcined and ground for oxychloride or Sorel cement; (5) miscellaneous applications in crude or calcined form; (6) miscellaneous uses of refined magnesia salts.

Refractory uses.—The refractory uses of calcined magnesite constitute perhaps its most important application. Made into refractory bricks it finds an important use as the linings for basic steel furnaces. In "dead burnt" calcined form either as brick or as originally burned, the magnesia is used as a refractory lining for open-hearth furnaces and converters in the steel industry, for rotary kiln linings in Portland cement manufacture, for furnace hearths, crucibles, cupels, etc.

It is commonly assumed that the most refractory magnesite is the "dead burnt" product derived from magnesite containing little or no lime, silica, oxide of iron, and alumina. The presence of lime in magnesite bricks used for high temperatures is said to cause them to disintegrate more readily, and in basic steel furnaces the lime is believed "to cause the phosphorus to pass into the hearth instead of the slag, the hearth thereby becoming rotten." Silica, oxide of iron, and alumina are supposed to be objectionable because they have a tendency to lower the fusing point. On the other hand, it is also contended that imported magnesite, over 90 per cent of which comes from Austria-Hungary and which constitutes by far the greater part of the product consumed in this country, may be assumed to represent a standard as to desirable composition for practical purposes in the metallurgical industry. Analyses of this foreign magnesite are

[1] Hess, F. L., Magnesite deposits of California: Bull. U. S. Geol. Survey No. 355, 1908.
[2] Gale, H. S., Late developments of magnesite in California and Nevada: Bull. U. S. Geol. Survey No. 540-S, 1913.

reported to show, within a maximum of 3 to 4 per cent in silica, 6 to 8 per cent in iron, and 4 per cent in lime. As to alumina, the percentage usually found is said to be so small that it need not be considered.

From this it appears that there is much latitude in the judgment offered as to the composition of magnesites most desired for metallurgical refractory uses.

Use in the paper-manufacturing industry.—The availability of magnesite in the California deposits has led to its considerable use when converted into the bisulphite in the manufacture of wood-pulp paper on the Pacific coast. Magnesia is said to have a more solvent action on the free resins of the wood than lime, and it also has an additional advantage in that the residues left in the paper stock are not afterwards injurious to sizing agents.

The process of making paper [1] in which magnesite is used is known as the sulphite process. The wood (mostly from coniferous trees) is boiled with a disintegrating agent so that it breaks down into a mass of pulp, which is afterward rolled into paper. The disintegrating agent in the sulphite process is sulphurous acid, or common bisulphite of calcium or magnesium. Magnesium bisulphite is more stable and it dissolves the noncellulose matter even more completely than calcium bisulphite. Sodium bisulphite gives a better product than either of the two mentioned, and strong liquors can be made from it; but it is too expensive for general use.

It is estimated that the greater part of the California magnesite is now used in the manufacture of paper by this process. The Porterville deposits, which have been for years the largest producers, have been worked primarily for the use of paper makers.

Manufacture of carbon dioxide.—The manufacture of carbon dioxide from raw magnesite consists in the decomposition of the magnesium carbonate by roasting with the recovery, purification, and compression of the carbon dioxide gas, the residual magnesia being also available as one of the important products of the process. The operation of this process is described by Hess,[2] with a diagram showing details of one of the plants. It is understood that the use of magnesite for this purpose has now been chiefly or wholly abandoned on the Pacific coast, as the gas can be produced more cheaply as a byproduct in other processes, as for instance, as one of the products of a distillery and from limestone.

Oxychloride or Sorel cement.—The use of magnesite for the manufacture of cement is apparently a promising field, and the product is likely to find an increasing use. This product is known as oxychloride or Sorel cement. It consists of a mixture of finely ground calcined magnesite with magnesium chloride which when it has been wet sets in an exceedingly strong cement. The cement thus produced is put out under many trade names, especially referred to as sanitary flooring. When well laid magnesite cement flooring has some decided advantages over other cements for this purpose. It produces a smooth, even floor, which may be laid in large surface areas without cracking. It takes colors advantageously, and is susceptible of good polish by oiling or waxing. It is thus laid in a plastic state on wood or concrete. Its surface seems to have a resilience not given by

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[1] Thorp, F. H., Outlines of industrial chemistry, 1909, pp. 522–523.
[2] Bull. U. S. Geol. Survey No. 355, 1908, pp. 8, 9.

ordinary cement, and it does not pulverize or grind to dust. This cement is said to have found a very extensive use abroad as flooring and to be gradually coming into more extended use in this country. It is also reported to have found a use in the manufacture of artificial marble and fine tiles.

It appears, however, that there are practical difficulties to be encountered in the manipulation of magnesia cements, which are not yet wholly understood and which have at times led to criticism and dissatisfaction with the material, possibly not always merited. It would seem to be desirable that a competent investigation of the technology of this subject should be undertaken in the interest of a potentially very useful product.

Miscellaneous applications in crude or calcined form.—Magnesite finds numerous miscellaneous applications in both crude and calcined form, among which may be mentioned its use in pipe covering as a nonconductor of heat, where it is commonly mixed with asbestos fiber. It is said to be used as an absorbent in the manufacture of dynamite, as an adulterant in paint, and to prevent scale in boilers in which sulphurous waters are used. It has been tried with some success as a binder for briquetting coal, where it has the disadvantage common to all inorganic binding materials, namely, that they increase the ash without adding to the combustible portion of the fuel.

The use of magnesite in a fireproof or fire-retarding paint is also reported to be coming to the fore. Wood or burlap coated with a paint made of magnesite are said to resist fire so that although they can be burned by direct application of heat and flame, the fire will not spread beyond the areas actually exposed to the flame.

Miscellaneous uses of refined magnesia salts.—Among the miscellaneous uses as refined magnesia salts may be suggested those for medicinal and toilet purposes. The commercial preparation known as magnesia alba is a basic carbonate of slightly varying composition, according to the conditions of production. It is usually prepared by precipitation of either the commercial sulphate or chloride of magnesium with sodium carbonate. Epsom salts (magnesium sulphate) is derived from the deposits at Stassfurt and is imported on a considerable scale; but it is also manufactured by chemical treatment of magnesite. A considerable quantity of magnesia quoted as "medical, calcined" is imported annually, probably representing a purified product for medicinal or other uses.

IMPORTS.

The following statistics concerning imports of magnesite are obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce. The statistics include imports for consumption for the calendar years 1909 to 1912, inclusive, and also imports for the fiscal years 1910 to 1912, inclusive, under which are two statements relative to the imports of magnesite, calcined not purified—one showing the countries of shipment or nominal origin and the other the ports and customs districts into which imported; there is but one statement with regard to imports of the crude magnesite by the fiscal year, data as to the countries from which imported not being available.

Imports, for consumption, of magnesite into the United States from 1909 to 1912, in pounds.

	1909		1910	
	Quantity	Value.	Quantity.	Value.
Magnesia:				
Calcined, medical	52,247	$8,697	61,471	$9,519
Carbonate of, medical	49,115	3,328	46,926	2,799
Sulphate of (Epsom salts)	6,612,956	28,180	6,748,388	23,565
Magnesite:				
Calcined, not purified	208,947,602	939,014	297,652,901	1,380,731
Crude	19,635,479	46,005	52,002,557	162,069

	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Magnesia:				
Calcined, medical	91,029	$13,694	104,106	$16,326
Carbonate of, medical	50,490	2,867	60,904	2,727
Sulphate of (Epsom salts)	5,950,861	22,559	10,703,209	41,739
Magnesite:				
Calcined, not purified	244,149,581	1,109,770	250,503,372	1,265,339
Crude	25,948,797	76,097	35,810,752	104,326

Imports of magnesite calcined, not purified, for fiscal years ending June 30, 1910–1912, by countries, in short tons.

Country.	1910	1911	1912
Europe:			
Austria-Hungary	101,751	143,392	99,104
Belgium	....	33	25
Germany	2,719	1,426	689
Greece	927	....	114
Italy	....	28	....
Netherlands	1,712	2,974	2,410
Norway	28	121	163
United Kingdom (England)	409	2	61
North America.			
Cânada	13	296	234
Mexico	....	....	81
Asia: East Indies, British	....	....	57
Total	107,560	148,272	102,938

Imports of magnesite, showing ports of receipt during the fiscal year ended June 30, 1912, by customs district, in short tons.

Customs district.	Crude.	Calcined.	Customs district.	Crude.	Calcined.
New York, N. Y	13,864	111	Philadelphia, Pa	....	76,171
Boston and Charlestown, Mass.	65	3,028	New Orleans, La	....	22,805
Newark, N. J	25	....	Puget Sound, Wash	1	23
Champlain, N. Y	276	27	Los Angeles, Cal	....	248
Buffalo Creek, N. Y	56	56	San Diego, Cal	96	96
Chicago, Ill	....	27	San Francisco, Cal	321	195
Memphremagog, Vt	....	90			
Vermont	3	61	Total	14,707	102,938

SURVEY PUBLICATIONS ON MAGNESITE.

Gale, H. S., Magnesite: Mineral Resources U. S. for 1911, pt. 2, 1912, pp. 1113–1127.
——— Late developments of magnesite in California and Nevada: Bull. 540–S. (In preparation.)
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MICA.

By Douglas B. Sterrett.

INTRODUCTION.

The mineral mica has become an important article in the industrial world, and large manufacturing companies are dependent on a regular supply of it. These are chiefly companies manufacturing electrical apparatus and machinery, wall papers, and stoves. The properties which render mica valuable in these trades are its perfect cleavage into tough, flexible, and elastic sheets, its transparency, its nonconductivity of electricity, and the brilliance of the small scales of the ground material. Mica is sometimes called isinglass when used in stoves and lamp chimneys, but it should not be confused with the original isinglass, a gelatinous material obtained from certain fish. The mica of commerce includes two principal varieties—muscovite and phlogopite—but small quantities of biotite have been used. Muscovite is known as clear or white mica, phlogopite as amber mica, and biotite as black mica.

OCCURRENCE.

Mica is a mineral of widespread occurrence in the rocks of the earth's surface. It is a constituent of many metamorphic and igneous rocks and is found in the clastic rocks formed by their disintegration, erosion, and sedimentation. The occurrence of mica in the clastic rocks is generally limited to small quantities and is not of commercial importance. Mica suitable for industrial purposes is found in coarse-grained rocks. Muscovite is obtained from pegmatite, and phlogopite is obtained from more basic rocks having a coarse texture, such as those composed largely of pyroxene. Pegmatite is allied to granite in composition, but has a coarser and more variable texture. Its principal constituents are quartz and feldspar, with or without mica and other accessories, such as garnet, tourmaline, beryl, apatite, and rare minerals.

Mica-bearing pegmatites are generally associated with highly metamorphic rocks of great age. Common varieties of these rocks are muscovite, biotite, garnet, cyanite, staurolite, hornblende, and granite gneisses and schists. Deposits of commercial value also occur in granite that has not been strongly metamorphosed.

Pegmatites occur in irregular masses, sheets, and lenses, which range in size from small deposits to those many yards in thickness and length. The limit of size below which they can not be profitably worked for mica might be placed arbitrarily at 1 to 2 feet in thickness for rich and regular "veins." In the very large bodies of pegmatite the mica is not evenly distributed through the mass but is richer in one portion than in another, so that the entire bulk of the rock does not have to be removed in mining. In such pegmatites the mica may occur in one or more streaks near the walls, or in the interior of the mass, or it may be found in clusters at intervals with or without connecting streaks. In some places the mica crystals are partly embedded in the wall rock.

Mica occurs in rough crystals and blocks, which range in size from a small fraction of an inch to several feet across. The rough blocks, as obtained from the mines, generally yield only a small percentage of trimmed sheet mica. A yield of 10 per cent of sheet mica is very high, and the remaining mica is suitable only for grinding.

LOCALITIES.

COMMERCIAL DEPOSITS.

Deposits of mica of commercial or possible commercial value are known in many countries, but the principal sources of supply at present are India, the United States, and Canada. Other countries in which mica has been mined in a small way, or is now being mined, are Brazil, Argentina, German East Africa, German Southwest Africa, Union of South Africa, Ceylon, Russia, Norway, South Australia, and Mexico. Some of these countries produce both muscovite and phlogopite, and others but one variety. In the United States muscovite is the only variety mined, but small quantities of biotite have been obtained as a by-product. No valuable deposits of phlogopite have been found.

Mica deposits of probable value are known in more than 20 States of the United States. Large productions have come at different times from North Carolina, South Dakota, New Hampshire, New Mexico, Idaho, Virginia, Colorado, Alabama, Georgia, South Carolina, and California. Promising deposits are known in several other States.

NEW ENGLAND STATES.

Deposits.—Mica deposits occur in all the New England States. The best are in New Hampshire and have produced large quantities of good mica. In Maine a few tons of scrap mica and some small sheet mica are obtained every few years during the course of mining for gems or feldspar at several localities in Oxford County. Similarly occasional productions of small sheet and scrap mica are reported from Massachusetts and Connecticut as a by-product in mining quartz and feldspar. Mica deposits are reported in Vermont near North Sherburne, Rutland County; Chester, Windsor County; and North Dorset, Bennington County; but none of these has been mined.

New Hampshire.—In New Hampshire mica deposits have been worked or prospected in Grafton, Cheshire, Sullivan, Merrimack, Belknap, and Coos counties. The Ruggles mine near Grafton was the first mica mine worked in the United States. It was opened early in the nineteenth century and operated in a desultory way until 1840. Operations were on a larger scale from that time until 1860, and then were pushed energetically until 1885. In the meantime many other mines were opened in New Hampshire and produced large quantities of mica. Mining for this mineral in New Hampshire declined a little with the opening of the deposits in the Southern States after 1869, and then received a heavy setback in 1885, when India mica was first imported in quantity. Since 1885 the production of mica in New Hampshire has been variable, the mines being opened at times when imports were light and production was low in other States and closed when the market was well supplied from other sources. During the last three years the production of mica in New Hampshire has been considerable, though only three to six mines have been in operation. The output could be increased many times if some of the larger deposits, now idle, were reopened. The quality of New Hampshire mica is good, and the product has proved suitable for glazing and electrical purposes during many years of such use.

NEW YORK, NEW JERSEY, AND PENNSYLVANIA.

Occurrences of mica of possible value have also been reported in New York, New Jersey, and Pennsylvania. In New York a deposit was worked during part of 1909 in Brewster County, about 1½ miles from Oswegatchie, on the north side of Oswegatchie River. Prospects of doubtful value have also been tested in Westchester County not far from New York City. In New Jersey there are mica prospects near Bloomingdale, in Passaic County, in the Blue Ridge Mountains, and in Pennsylvania there are a few prospects in Lebanon and Chester counties. No mica mining has been attempted in either of these regions so far.

SOUTHEASTERN STATES.

North Carolina.—Mica mining in the Southeastern States began in North Carolina in 1869 and has been continuous in that State ever since. Operations have been intermittent in other States in this region, but some of them have been extensive. At the majority of places in the Southeastern States, however, mica mining has been conducted in a rather small way. Some of the better deposits have been equipped with power drills, steam hoists, pumps, and mine cars and have been worked to depths ranging from 100 to 300 feet. Operations at some of these mines ceased because the equipment in use was not sufficient to meet the increasing flow of water and the other troubles incident to deep mining. Good mica-bearing ground was thus deserted and should be available under more modern mining methods. Referring to the mica mines of the southern Appalachian region, J. A. Holmes [1] quotes the following opinion regarding those of North Carolina:

> The question is often asked also whether or not those mica mines which have been already worked to a considerable depth can be considered as future producers of mica. Bearing upon this, it may be said that a majority of these mines have been worked only to a depth of less than 100 feet and for a horizontal distance of only 100 to 200 yards along the line of the vein. In some cases, as was true with the famous Clarissa mine, they were abandoned with valuable deposits of mica still in sight owing to the inability of the miners with their crude methods (having no steam pumps) to contend with the water flowing into the mines. In many other cases, where there was no great trouble from water, mines have been abandoned at depths where the vein began to

[1] Mica: Twentieth Ann. Rept. U. S. Geol. Survey, pt. 6, continued, 1899, pp. 704-705.

be too hard to be worked easily with a pick, for the reason that there were still other and softer deposits which could be worked at or near the surface.

There can be but little doubt that in the case of a considerable number of these mines, by the use of the steam pump, the steam drill, and other modern mining appliances, a number of these old mica mines could be opened up anew and worked at considerable profit. And thus, like the Clarissa, the Sink Hole, the Hawk, and Cloudland, in Mitchell County; the Ray mine, of Yancey County; the Iola, the Ray, and Burningtown mines, of Macon County, which together have yielded considerably more than a million dollars' worth of mica while being worked by crude mining methods, if opened up anew under more favorable conditions would undoubtedly yield a supply of mica for many years to come as great or greater than that which they have yielded in the past.

For many years North Carolina has been the largest producer of mica in the United States. Prior to 1895 the output came chiefly from the larger mines and consisted of big sheets of fine quality. At that time large quantities of small sheet mica that would cut plates less than 3 inches square were thrown on the dumps as waste. After the small sheet and scrap mica became valuable, the dumps at all the large mines were worked over and the quantity of mica produced was thereby greatly increased. Now that most of the dumps have been worked over and only a few large mines are in operation, the output is barely maintained by a large number of small mines and prospects, probably as many as a hundred. Many of these are worked by the mountaineer farmer and miner at times when crops are laid by, and occasionally one of the prospects develops into a large deposit. The bulk of the output of these prospects consists of smaller mica than is generally obtained from the large mines, several of which, if properly worked, could be made to supply as much mica as all the small mines now yield and in larger sizes.

A few mines have been operated on a fairly large scale during the last 10 years, such as the Ray, Gibbs, Poll Hill, and Flat Rock mines of Yancey and Mitchell counties, the Big Ridge mine of Haywood County, the Burningtown and Lyle Knob mines of Macon County, and the Thompson mines of Cleveland County. A quantity of fine-grade mica was obtained, but in some cases there was undue extravagance in the methods of operation. There are probably 40 or 50 deposits of mica in North Carolina which have been proved to be large and most of which are now idle. They are scattered through the mountain counties from Ashe to Macon and in several of the Piedmont counties, especially Cleveland and Lincoln. A few of these may have been practically worked out, but good deposits of mica will still be found below water level in many of them.

Virginia.—Mica mining began in Virginia about the same time as in North Carolina. T. L. Watson [1] states that mica has been mined or prospected in the following counties: Amelia, Bedford, Goochland, Pittsylvania, Henry, Hanover, Prince Edward, Amherst, and Charlotte. Indications of mica occur in several other counties. The majority of the deposits are in the Piedmont Plateau region, but some are located in the foothills southeast of the Blue Ridge. Watson's report includes a map on which the locations of a few of the mica mines are shown. Some of the mica mines of Amelia County have been worked on a fairly large scale, with a considerable output of high-grade mica. Thus, the Rutherfoord mine was operated by 2 shafts, 90 feet and 150 feet deep, respectively, with many drifts

[1] Annual report on the mineral production of Virginia: Bull. Virginia Geol. Survey No. 1-A, 1908, p. 102.

and stopes, and 1 large open cut. A clear rum-colored mica of fine quality and by-products consisting of amazonstone, spessartite garnet, moonstone, and valuable specimen minerals were obtained. Several of the Virginia deposits have been worked for both mica and feldspar. Interest has again been manifested in the Virginia mica deposits during the latter part of 1912 and early in 1913.

Georgia.—Mica deposits are widespread in Georgia and occur both in the Piedmont Plateau and in the mountain region. A few mines have been operated in Cherokee, Lumpkin, Union, Hall, and Rabun counties. Some of the deposits were opened many years ago and have been operated intermittently. At the present time none of the Georgia mica mines are being worked, but occasional examinations are made of some of the deposits by persons interested in this mineral.

South Carolina.—Mica deposits occur in several counties of South Carolina, but the best prospects have been found in Anderson and Greenville counties. Some of them have been mined on a fairly large scale and have produced a quantity of good mica. Mining has been intermittent, and during the last few years the production has come from only two or three mines. Rum-colored mica of fine quality occurs in many of the mines.

Maryland.—In Maryland deposits of mica were prospected or mined in Howard and Montgomery counties long ago. No regular mining has been carried on in the State recently, but a few of the deposits have been prospected during the last three years. The mines and prospects are in a belt extending from near Burtonsville northeast toward Ellicott City, near which place the pegmatite deposits have also been worked for feldspar. A prospect is being opened for feldspar on the old Thompson place, about 1½ miles northeast of Burtonsville, and a small quantity of mica has been obtained during this work.

WESTERN STATES.

In the Western States mica has been mined on a considerable scale in South Dakota, Idaho, New Mexico, and Colorado, and good prospects have been opened in Wyoming, Nevada, and California. Prospects are known also in Washington, Utah, Arizona, and Texas.

South Dakota.—In South Dakota the deposits are in the Black Hills, chiefly in the region around Custer. A great many prospects have been located and several mines have been developed extensively. The Westinghouse Electric & Manufacturing Co. has been the largest operator in this region. The New York mine of this company is probably the largest mica mine in the United States and has been operated in a systematic method with modern equipment. For several years prior to 1912 the production of mica from two to five mines in South Dakota amounted to about one-third of the total production in the United States. Other large deposits were idle, which if worked on a similar scale would have placed South Dakota first in the list of mica-producing States. The mica deposits of South Dakota are fairly well situated with respect to markets. Wagon hauls of 1 to 8 miles will place the product of most of the mines at shipping points on a branch of the Burlington Railroad.

Idaho.—Mica deposits occur in several counties of Idaho, but the principal developments have been in Latah County from 3 to 6 miles north of Avon. Large outputs of mica were obtained from the

Muscovite, Maybe, Luella, and Anderson mines some years ago. The deposits have been worked only intermittently for several years, but in 1912 renewed activity was manifested at two of the mines. The operators were the Producers Mica Co., working the old Muscovite mine, and E. H. Foster, of Seattle, reopening the Anderson mine. At the latter deposit a tunnel 233 feet long was driven from the mountain side to the vein. The Muscovite mine has been a large producer in the past, yielding as much as $40,000 worth of mica in a single year. It is favorably situated for development on a large scale, the outcrop of the vein extending over the summit of a mountain peak. Crosscuts, tunnels, and drifts from the mountain side can open the vein at considerable depth. Other counties in which mica deposits occur are Canyon, Cassia, and Washington.

New Mexico.—Extensive work was carried on for mica some years ago in Rio Arriba County, N. Mex. Several deposits were operated with large productions. The mines are far from exhausted, and in some of them good mica has been left exposed by recent prospecting. Probably the best known mine of this region is the Cribbensville mine. This was worked on a large scale from 1885 to 1889, and has been operated intermittently since that time. Other mines which have been largely worked are the American, Globe, Old Black Horse or Sandoval, Coyote, Bachelder, Summit, and Keystone. At present only assessment work is done at the different claims, and no regular mining is in progress. These deposits are from 8 to 15 miles west of the Denver & Rio Grande narrow-gage tracks between Santa Fe, N. Mex., and Alamosa, Colo. Shipping points are Servilleta and Barranca.

A group of claims is being developed by the Topeka Mica Manufacturing Co., of Topeka, Kans., in the Glorieta Mountains, about 10 miles northwest of Ribera, in San Miguel County.

Colorado.—Mica deposits occur at many localities in Colorado, several of which have been worked. At two localities near Canon City and Texas Creek, in Fremont County, and south of Grand Junction in Mesa County, are deposits which would yield only scrap mica for grinding, but the material occurs in considerable masses, and could be mined rather easily. The present lack of good wagon roads to the Texas Creek and Grand Junction prospects makes their development a matter of uncertainty. Other mica deposits in the Bare Hills, Fremont County, have yielded a quantity of sheet as well as scrap mica.

Mica prospects and mines have been reported also at the following places in Colorado: Black Mountain and Freshwater, Park County; Morrison, Jefferson County; Rye, Pueblo County; Marshall Pass, Saguache County; Blackhawk, Gilpin County; and in Custer, Routt, and Larimer counties.

Wyoming.—In Wyoming several mica deposits have been opened in the Haystack Hills, east of north of Guernsey, in Laramie County. Promising prospects were found, but no regular mining has been done. Other mica prospects have been found in Albany County, west of Fox Park, in the Medicine Bow Range.

Nevada.—In Nevada an attempt to mine mica was made in 1897, in the St. Thomas mining district, Lincoln County. Two deposits were opened, and small shipments were made, but transportation facilities were too unfavorable to permit successful mining. The deposits are in the Virgin Range, which extends east of north into Arizona. Prospects occur at other points in this range in both States.

California.—In California the Alamo mine, in the Pine mining district, Ventura County, was operated on a fairly large scale several years ago, and a good vein of mica was developed. Transportation facilities were unfavorable, and work was suspended indefinitely.

Utah and Washington.—Mica prospects have been opened northeast of Salt Lake in Utah, and near Chelan Falls, on Columbia River, in Washington. The work was confined to prospecting for brief periods, and no regular mining was done.

FUTURE SUPPLIES.

The mica mines of the United States are capable of a large annual production, and could be made to supply all but that small part of the domestic demand which calls for the softer Canadian amber mica. This output could be readily furnished if some of the mines in several of the mica-producing States were operated on a large scale, or even as they have been worked in the past. These mines are in North Carolina, New Hampshire, South Dakota, Idaho, New Mexico, Virginia, and Colorado. Other deposits in these States and in other States already mentioned could be developed to meet increasing future demands.

The cost of production of mica in the United States is considerably greater than in some other countries, especially India. It is probable that this difference in cost could be reduced by more extensive operation of the larger and better deposits by improved methods. The mica obtained from the large mines generally averages better in size and quantity than that from many small deposits. Were many large mines in operation, there would be little need of working small prospects, for the large mines would supply all the small sheet and scrap mica demanded by the trade along with their output of more valuable mica.

In some years the domestic production of sheet mica equals or exceeds the imports in quantity, but it is generally less in value. This is owing to the fact that small sheet mica can not be imported in competition with the domestic production protected by a duty of 20 per cent ad valorem with an additional 5 cents a pound for rough mica and 10 cents a pound for trimmed mica. Accordingly the imports consist of larger and more valuable sheets under less relative duty than the small mica. The unmanufactured sheet mica imported into the United States is graded and trimmed around the edges, so that there will be a minimum of waste in manufacturing. The quality of the best domestic mica as to transparency, color, cleavage, and flexibility is equal to that of the same variety produced in India and other countries. Some mica of inferior quality, however, produced during the mining and preparation of domestic mica, is sold as third and fourth grade in the United States, because material for these grades from foreign mines is not of sufficient value to pay the import duty and be placed on the market.

USES.

Mica has a wide commercial application, in the form both of sheet mica and of ground mica. The most extensive use of sheet mica is in the manufacture of electrical apparatus, but a considerable quantity is still used for stoves, for gas-lamp chimneys, for lamp shades, etc. The demand for mica for glazing is small, and only the best quality and the larger sheets are thus used. Both large and small sheet mica is used in the electrical industry. "Micanite," or built-up mica board, for the manufacture of which small sheet mica can be used, is substituted for large sheet mica in much electrical work. Mica serves as a perfect insulator in various parts of dynamos, motors, induction apparatus, switchboards, lamp sockets, and nearly every variety of electrical appliance.

The domestic or muscovite mica is satisfactory for all insulation except for commutators of direct-current motors and dynamos built up of bars of copper and strips of mica. For this purpose no mica is as satisfactory as the phlogopite or "amber mica." This mica is of about the same hardness as the copper of the commutator segments, and therefore wears down evenly without causing the machine to spark.

Statements have been made in the literature on mica that mica which contains inclusions of black "specks" of iron oxide is worthless for electrical insulation. That this is not the case is proved by the continued production of such mica from some of the mines of the United States and its use by large and reputable manufacturers. Tests made on domestic "specked" mica have shown a capacity to withstand currents of high voltage. The black "speck" of most domestic mica is caused by extremely thin magnetite dendrites between the laminæ. These dendrites are so thin in some mica as to be transparent, and apparently do not penetrate the mica sheets. They do not detract greatly from the insulating capacity of the mica. The ill favor with which black "specked" mica has been regarded arose from troubles caused by certain imported mica in which inclusions of metallic minerals penetrated the laminæ, thereby destroying the insulating qualities.

A large quantity of scrap mica—small sheets and the waste from the manufacture of sheet mica—is ground for different uses, among which are the decoration of wall paper and the manufacture of lubricants, fancy paints, and molded mica for electrical insulation. Ground mica applied to wall paper gives a silvery luster. When mixed with grease or oils finely ground mica forms an excellent lubricant for axles and other bearings. Mixed with shellac or special compositions, ground mica is molded into desired forms and is used in insulators for trolley wires. Ground mica for electrical insulation must be free from metallic minerals. Mica used for lubrication should be free from gritty matter. For wall paper and brocade paints a ground mica with a high luster is required, and such luster is best obtained by using a clean, light-colored mica and grinding it under water. Coarsely ground or "bran" mica is used in increasing quantities to coat the surface of composition roofing material to prevent the tar or other ingredients used in its manufacture from sticking when the sheets are rolled for shipping.

PRODUCTION.

The total value of the mica produced in the United States in 1912 was $331,896. The production came from eight States—North Carolina, New Hampshire, Idaho, New Mexico, South Carolina, Colorado, South Dakota, and New York, named in the order of the value of their output. Of these States no production was reported from Idaho, South Carolina, and New York in 1911. Production was reported from Alabama and Virginia in 1911, but during 1912 only prospecting was carried on and preparations were made to resume work at some of the mines. The value of the production of mica in 1912 was less by $23,908 than in 1911 and less by $5,201 than in 1910.

The production of sheet mica as reported to the Survey amounted to 845,483 pounds, valued at $282,823, as compared with 1,887,201 pounds, valued at $310,254, in 1911 and with 2,476,190 pounds, valued at $283,832, in 1910. The apparent discrepancies in the figures of production during these three years are due chiefly to the fact that each year an increasing proportion of the production is reported in more advanced stages of preparation for the market by the producers. This is a natural result of the policy of many of the companies in establishing factories in regions convenient to the mines. The total output of rough trimmed sheet mica amounted to over 2,000,000 pounds. The excess of this output over the 845,483 pounds reported in the table of production became scrap mica and is included in the figures for that material.

The production of scrap mica in 1912 amounted to 3,226 short tons, valued at $49,073, a decrease of 286 tons in quantity and an increase of $3,523 in value.

The value of the production of mica in North Carolina in 1912 was $256,549, as compared with $217,299 in 1911. The production reported consisted of 489,599 pounds of sheet mica, valued at $219,874, and 2,492 short tons of scrap mica, valued at $36,675. In 1911 the output consisted of 454,653 pounds of sheet mica, valued at $187,501, and 2,347 short tons of scrap mica, valued at $29,798.

In New Hampshire the total production of mica in 1912 was valued at $37,338, as compared with $44,927 in 1911. The output was reported as 308,047 pounds of sheet mica, valued at $32,238, and 264 tons of scrap mica, valued at $5,100. The production reported from other States came from only one or two producers, respectively, and is therefore not given separately.

The production of mica in the United States since 1880 is shown in the following table:

Production of mica in the United States, 1880–1912.

Year.	Rough trimmed and cut 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
1907	1,060,182	349,311	3,025	42,800	392,111
1908	972,964	234,021	2,417	33,904	267,925
1909	1,809,582	234,482	4,090	46,047	280,529
1910	2,476,190	283,832	4,065	53,265	337,097
1911	1,887,201	310,254	3,512	45,550	355,804
1912	845,483	282,823	3,226	49,073	331,896

PRICES.

The average price of sheet mica in the United States during 1912, as deduced from the total production, was 33.4 cents a pound, as compared with 16.4 cents a pound in 1911. The average price of sheet mica in North Carolina was 44.9 cents a pound, as compared with 41 cents a pound in 1911; in New Hampshire the average price was 10.4 cents a pound, as compared with 12.1 cents in 1911; in Idaho it was 62.9 cents. The average price of scrap mica in 1912, as deduced from the total production, was $15.21 a short ton, as compared with $12.97 in 1911 and with $13.10 in 1910.

IMPORTS.

The imports for consumption of unmanufactured and trimmed sheet mica into the United States during 1912, as reported by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, amounted to 1,989,132 pounds, valued at $748,973. These imports exceed those of 1911 by 660,364 pounds in quantity and $246,810 in value.

The quantity and value of mica imported for consumption into the United States annually from 1905 to 1912, inclusive, are shown in the following table:

Mica imported and entered for consumption in the United States, 1905–1912, in pounds.

Year.	Unmanufactured.		Cut or trimmed.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1907	2,226,460	848,098	112,230	77,161	2,338,690	925,259
1908	497,332	224,456	51,041	41,602	548,373	266,058
1909	1,678,482	533,218	168,169	85,595	1,846,651	618,813
1910	1,424,618	460,694	536,905	263,831	1,961,523	724,525
1911	1,087,644	346,477	241,124	155,686	1,328,768	502,163
1912	1,900,500	649,236	88,632	99,737	1,989,132	748,973

The average price of unmanufactured sheet mica imported in 1912, as deduced from these figures, amounted to 34.1 cents a pound, as compared with 31.8 cents in 1911. The price of both unmanufactured and trimmed mica imported in 1912 amounted to 37.6 cents a pound, as compared with 37.8 cents in 1911.

The total quantity of sheet mica produced in and imported into the United States in 1912 amounted to 2,834,615 pounds, valued at $1,031,796, as compared with 3,215,969 pounds, valued at $812,417, in 1911. If the domestic production of scrap mica be included in these figures, 9,286,615 pounds of mica, valued at $1,080,869, were produced and imported in 1912, as compared with 10,239,969 pounds, valued at $857,967, produced and imported in 1911.

CANADA.

The production of mica in Canada[1] during 1912 was valued at $104,393, as compared with $128,677, the revised figures for 1911. The exports during 1912, consisting largely of trimmed and manufactured mica, amounted to 895,338 pounds, valued at $334,054, as compared with 693,940 pounds, valued at $242,548, in 1911. A large part of the exports of amber mica are consumed by electrical manufacturers in the United States.

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MINERAL WATERS.

By George Charlton Matson.

INTRODUCTION.

The term "mineral waters" has a wide and varied use, differing with the idea of the user and with the character of the water. The range in quantity of mineral matter dissolved in natural waters is great, varying from a few parts to several thousand parts per million, and to the layman a water that is sold in limited quantities for medicinal or table use is classed as mineral even though the actual quantity of inorganic substances in solution is much smaller than that contained in many municipal water supplies.

The statistics included in this report are based on the value of waters when they are ready for the market, and the term "mineral water" is used to include natural waters, or those only slightly changed, that are sold for medicinal or table use. The water sold as public supplies is excluded, as are also those natural waters that have been greatly changed either by the addition of mineral substances or through concentration by evaporation. The line of demarcation, however, between natural and artificial mineral waters must necessarily be arbitrary, since there are all gradations from waters that have been placed on the market in the natural state to those that have been so extensively treated that they bear little resemblance to their natural condition. In general, the addition of carbon dioxide or small quantities of inorganic matter has not been considered sufficient change to prevent waters being classed as natural, but the addition of organic or large quantities of inorganic substances has caused waters to be regarded as artificial.

MEDICINAL AND TABLE WATERS.

The formulation of a satisfactory scientific classification of mineral waters for use in this report would require the expenditure of so much time that it has been regarded as impracticable. On the basis of use, the waters are grouped as medicinal and table waters, though some of the table waters might reasonably be expected to have greater therapeutic value than many of the medicinal waters if the kinds and amounts of dissolved salts are used as criteria. However, comparisons of analyses of the two groups of mineral waters show that the average percentage of mineralization is greater in the medicinal waters than in the table waters. Because of the fact that the consumption of an adequate supply of pure water is beneficial, it follows that table waters may, in some cases, be valuable for their therapeutic effect.

The most common terms used in describing medicinal waters are lithia, sulphur, sulphate, epsom, magnesia, and chalybeate (iron). The discovery of radium and its therapeutic uses, followed by the determination that many natural waters are radioactive, has attracted attention to some springs, and especially to the thermal waters of the West. Possibly these waters have medicinal value, but if their efficacy depends upon their radioactive character they should be used at the spring, because they lose this property rapidly after emerging from the earth.

Lithia waters, as the name is commonly used, are those that contain enough of the element lithium to be detected by analysis. In general, this element is present in minute quantities in the waters, the amount of water required to obtain the equivalent of a dose such as a physician would prescribe being much greater than any person could consume in a single day. However, the use of a copious supply of pure water might in itself be beneficial, and there is in most lithia waters a large number of substances that might have beneficial effects. There is, moreover, an astonishing lack of experimental information concerning the effect of the consumption at frequent intervals of small quantities of lithium and other substances found in natural waters, and it is therefore unwise to conclude that the inorganic matter present in these waters is not of value because it does not occur in as large amounts as a physician would prescribe.

Sulphur waters contain more or less hydrogen sulphide gas that may serve to distend the alimentary canal and may also produce some irritation. Probably the faith in the curative properties of such waters rests on the presence of sulphur, a substance that has been freely administered to children as a blood purifier. Most sulphur waters that are classed as medicinal carry large percentages of dissolved inorganic substances, and the active properties, aside from the effect of the waters, may be in a measure attributed to other elements.

The terms sulphate, epsom, and magnesia are in a measure synonymous because the epsom and magnesia waters are sulphate-bearing waters, but in addition some sulphate waters contain sodium. The sulphate waters are laxative, or purgative, and their efficiency varies not only with the percentage of the sulphur radicle in solution, but also with the amounts of magnesium and sodium present. Many sulphate waters are concentrated by evaporation; others are strengthened by the addition of epsom salts (magnesium sulphate) or glauber salts (sodium sulphate). Many waters classed as magnesia contain magnesium with many other substances, but with only a small percentage of the sulphate radicle. Such waters do not have the same effect as the sulphate waters.

The chalybeate (iron) waters are much more numerous than is generally supposed, for in addition to the springs which are widely distributed, many deep wells encounter such waters. The presence of iron in water has been noted in many wells on the Coastal Plain of Maryland, Delaware, and adjoining States. The chalybeate waters usually contain a variety of substances in solution, and the cause for their therapeutic activity has not been experimentally determined.

SOURCE OF MINERALIZATION OF WATERS.

Rainfall supplies practically all the mineral water with the possible exception of that derived from some thermal or saline springs. Since the meteoric waters are practically pure, the mineralization must take place after they enter the ground. In their progress through the earth the waters come into contact with many soluble substances from which they obtain their inorganic matter. There is a large variety of substances in the earth and the kind dissolved will depend upon a number of factors that need not be enumerated in this paper. The freedom of circulation and the distance the underground water percolates affect both the quantity and the quality of the mineralization, because where the water is long in contact with soluble substances it is enabled to dissolve them in large quantities, and in some localities there is apparently a redeposition of some materials and a solution of others, so that the composition of the water becomes changed. An excellent example of this change is shown by some of the wells on the Atlantic Coastal Plain. Wells located near the outcrop of a water-bearing bed and receiving water that has moved a relatively short distance underground yield what is ordinarily termed "hard water;" other wells, located at a greater distance from the intake, yield alkaline water from the same bed.

It is possible that some thermal springs located in regions of recent volcanic activity are supplied with water from beds of molten lava, for it is a well-known fact that water occurs in magmas that come from within the earth, and that in the processes of cooling and consolidation the included water is often set free. Such springs are comparatively rare, and it is impossible to differentiate them from thermal springs arising from beds that have been heated by being in proximity to the lava. It has also been suggested that the fracturing and movement of strata produce sufficient heat to account for some thermal springs.

Some of the saline springs may be supplied from oceanic waters included in sedimentary rocks at the time of their deposition, or introduced into porous beds that have been submerged beneath the sea. Other saline springs derive their salt and like substances by solution from formations through which they have passed. Inasmuch as the strata of different localities have the same general composition, it follows that there may be general groupings of mineral waters according to the character of the beds through which they have passed. However, there is apt to be great variation in the relative quantity of different substances dissolved and consequently the classification of mineral waters based on the character of the water-bearing beds would necessarily be artificial.

MARKET VALUE OF MINERAL WATERS.

The statistics presented in this report are those furnished by the owners of the springs and are based on the price received at the source of supply. There is a wide range in price from the cheaper table waters sold in jugs and barrels to the more expensive medicinal waters and the table waters that are put up in bottles and are often charged with carbon dioxide. Because of the great variation in price, the average for a State is of little importance, for it fluctuates from year to year with the relative proportions of cheap and expensive waters sold. The totals for States are of greater interest because they show the amounts paid for waters for different purposes and permit comparisons with the sales of previous years as well as with those of other States. Some springs neglect to send statements in time to have the figures incorporated in the annual reports, and for this reason the actual value of water sold in many States is somewhat greater than the tables indicate.

The full value of mineral water consumed in the United States can not be determined because the statistics furnished do not show the value of water given away at the springs. The discrepancy between the value of waters sold and the value plus that of the quantity given away is probably large, because many of the managers of springs furnish water free to guests of hotels and other places of entertainment located at the springs. There is, in addition, a large quantity of water classed as artificial that is not included in the general tables showing the waters sold, and, although the statistics relating to these waters are fragmentary, they indicate large sales.

MINERAL WATER TRADE IN 1912.

OUTPUT AND VALUE.

The year 1912, a prosperous one in the main, showed a slight decrease in the value and quantity of mineral waters sold, though the number of springs reporting increased. The total sales for 1912 amounted to 62,281,201 gallons, valued at $6,615,671; in 1911 these sales were 63,788,552 gallons, valued at $6,837,888. The decrease in 1912 was 1,507,351 gallons, or 2.36 per cent, and the decline in value amounted to nearly a quarter of a million dollars ($222,217), or 3.25 per cent. Thus there was not only a smaller quantity of water sold, but there was also a slight decline in the average price from about 11 cents a gallon in 1911 to 10.6 cents in 1912. The number of springs reporting in 1912 was 746 compared with 732 in 1911, an increase of 14. The following table gives the annual production and aggregate value of mineral waters in 1883, 1885, and each five years from 1885 to 1905, with the production and value for each year since 1908, inclusive.

Production of mineral waters, 1883–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Year.	Commercial springs.	Quantity sold (gallons).	Value.
1883	189	7,529,423	$1,119,603	1908	695	55,868,820	$6,712,680
1885	224	9,148,401	1,312,845	1909	760	64,674,486	6,894,134
1890	273	13,907,418	2,600,750	1910	709	62,030,125	6,357,590
1895	370	21,463,543	4,254,337	1911	732	63,788,552	6,837,888
1900	561	45,276,995	5,791,805	1912	745	62,281,201	6,615,671
1905	564	46,544,361	6,491,251				

The following table gives the production and value by States of mineral waters produced in 1911 and 1912. The number of springs reporting the retail price per gallon and the value of both medicinal and table waters are shown, as well as the total quantity and value. In this table and the preceding one no account is taken of sales of mineral waters used for the manufacture of soft drinks.

Production and value of mineral waters in the United States, 1911 and 1912, by States.

1911.

State.	Commercial springs.	Quantity sold (gallons).	Average price per gallon received.	Value of medicinal waters.	Value of table waters.	Total value.
Alabama	10	205,854	$0.15	$20,244	$6,738	$26,982
Arkansas	8	1,560,157	.07	68,554	50,440	118,994
California	40	2,310,237	.25	168,351	410,088	578,439
Colorado	14	1,436,066	.07	23,564	81,199	104,763
Connecticut	28	2,164,701	.08	5,843	176,901	182,744
Florida	9	114,416	.17	4,650	14,680	19,330
Georgia	15	981,080	.10	31,430	66,322	97,752
Illinois	14	1,304,950	.06	7,606	74,724	82,330
Indiana	15	1,084,428	.60	639,257	14,384	653,641
Iowa	6	176,000	.12	600	19,900	20,500
Kansas	18	456,341	.14	52,610	10,453	63,063
Kentucky	13	423,729	.12	25,782	24,045	49,827
Louisiana	5	1,520,550	.07	12,248	98,750	110,998
Maine	28	1,254,783	.34	11,029	420,711	431,740
Maryland	12	1,657,756	.09	3,000	147,966	150,966
Massachusetts	56	4,610,474	.05	20,459	198,411	218,870
Michigan	19	1,713,401	.04	12,156	60,097	72,253
Minnesota	17	8,703,319	.03	4,750	265,289	270,039
Mississippi	8	346,500	.22	67,050	8,000	75,050
Missouri	25	542,892	.16	57,303	29,444	86,747
Montana	4	74,750	.08	25	5,963	5,988
Nebraska	3	21,641	.09	505	1,420	1,925
New Hampshire	6	406,660	.34	125,034	14,096	139,130
New Jersey	12	2,233,627	.09	1,020	209,103	210,123
New Mexico	5	226,333	.18	33,400	8,433	41,833
New York	51	10,245,261	.09	92,554	846,449	939,003
North Carolina	16	231,510	.13	22,123	8,985	31,108
Ohio	28	1,958,547	.04	14,530	71,948	86,478
Oklahoma	10	497,074	.03	3,169	11,121	14,290
Oregon	7	56,300	.32	3,900	14,100	18,000
Pennsylvania	41	2,327,732	.09	42,914	173,905	216,819
Rhode Island	8	503,360	.05	0	27,036	27,036
South Carolina	15	285,389	.15	37,095	5,004	42,099
South Dakota	3	13,400	.18	550	1,860	2,410
Tennessee	19	1,073,115	.07	50,993	21,482	72,475
Texas	40	1,637,932	.10	124,766	33,601	158,367
Vermont	4	25,200	.37	3,111	6,235	9,346
Virginia	43	2,474,918	.12	116,052	182,649	298,701
Washington	5	148,800	.10	5,600	9,054	14,654
West Virginia	10	259,686	.26	50,155	17,532	67,687
Wisconsin	31	5,716,162	.17	93,023	862,965	955,988
Other States[a]	11	803,521	.09	2,038	67,362	69,400
Total	732	63,788,552	.11	2,059,043	4,778,845	6,837,888

[a] Includes Delaware, District of Columbia, Idaho, Nevada, North Dakota, Utah, and Wyoming.

Production and value of mineral waters in the United States, 1911 and 1912, by States—Continued.

1912.

State.	Commercial springs.	Quantity sold (gallons).	Average price per gallon received.	Value of medicinal waters.	Value of table waters.	Total value.
			Cents.			
Alabama	16	165,678	12.3	$9,610	$10,825	$20,435
Arkansas	11	1,396,032	9.5	63,902	68,355	132,257
California	41	2,089,951	25.5	174,620	358,351	532,971
Colorado	11	1,178,308	6.4	19,388	55,926	75,314
Connecticut	28	2,110,231	7.3	5,214	148,169	153,383
Florida	9	123,485	14.2	13,469	4,052	17,521
Georgia	16	861,365	6.4	11,632	43,399	55,031
Illinois	17	1,143,625	6.5	7,530	66,915	74,445
Indiana	15	993,163	68.2	658,681	19,037	677,718
Iowa	6	84,300	13.5	2,075	9,300	11,375
Kansas	16	428,677	17.7	63,078	12,841	75,919
Kentucky	13	477,341	11.8	28,152	28,403	56,555
Louisiana	4	561,660	5.9	5,545	27,800	33,345
Maine	31	1,179,192	36.7	115,039	317,726	432,765
Maryland	13	1,606,373	9.8	6,000	151,541	157,541
Massachusetts	54	4,502,806	5.5	23,829	223,568	247,397
Michigan	18	1,420,465	5.3	777	74,834	75,611
Minnesota	18	8,881,018	2.9	6,805	245,472	252,277
Mississippi	10	639,905	19.7	106,941	19,300	126,241
Missouri	30	608,385	13.3	54,782	26,332	81,114
Montana	3	160,150	8.2	810	12,388	13,198
New Hampshire	8	240,568	4.2	175	9,825	10,000
New Jersey	12	2,386,217	8.8	2,150	207,576	209,726
New York	57	10,008,801	10.3	106,407	928,070	1,034,477
North Carolina	16	144,708	15.5	17,881	4,504	22,385
Ohio	30	2,709,745	4.3	19,550	97,737	117,287
Oklahoma	10	1,015,512	3.2	3,067	29,904	32,971
Oregon	6	48,351	36.2	2,047	15,456	17,503
Pennsylvania	41	2,192,106	9.3	31,190	173,716	204,906
Rhode Island	7	466,893	6.2	0	29,126	29,126
South Carolina	15	360,404	19.5	39,926	30,422	70,348
Tennessee	21	796,568	6.7	41,951	11,609	53,560
Texas	34	1,292,992	11.7	149,600	1,795	151,395
Vermont	3	21,000	39.4	1,385	6,895	8,280
Virginia	45	2,762,319	12.6	162,380	186,875	349,255
Washington	5	156,171	11.2	8,008	9,534	17,542
West Virginia	11	309,245	19.5	28,819	31,626	60,445
Wisconsin	31	6,045,719	14.4	94,347	775,148	869,495
Other States[a]	14	711,772	7.7	2,470	52,087	54,557
Total	746	62,281,201	10.6	2,089,232	4,526,439	6,615,671

[a] Includes Delaware, District of Columbia, Nebraska, Nevada, New Mexico, South Dakota, Utah, and Wyoming.

The foregoing tables show that the rank of the various States varies according to whether the number of springs reporting sale, the quantity of water sold, or the value of the output is chosen as a basis of comparison. The relative importance of the 10 leading States is shown in the following table:

Rank of 10 leading States based on springs reporting, on quantity sold, and on value of output, 1912.

	Commercial springs reporting.	Quantity sold.	Value of medicinal waters.	Value of table waters.	Total value.
1	New York	New York	Indiana	New York	New York.
2	Massachusetts	Minnesota	California	Wisconsin	Wisconsin.
3	Virginia	Wisconsin	Virginia	California	Indiana.
4	{California Pennsylvania	Massachusetts	Texas	Maine	California.
5	Texas	Virginia	Maine	Minnesota	Maine.
6	{Maine Wisconsin	Ohio	Mississippi	Massachusetts	Virginia.
7	{Missouri Ohio	New Jersey	New York	New Jersey	Minnesota.
8	Connecticut	Pennsylvania	Wisconsin	Virginia	Massachusetts.
9	Tennessee	Connecticut	Arkansas	Pennsylvania	New Jersey.
10	{Michigan Minnesota	California	Kansas	Maryland	Pennsylvania.

New York leads in the number of springs, quantity of water, total value, and value of table waters, but falls to seventh place in the value of medicinal waters sold. Indiana takes first rank in the value of medicinal water sold and is third in the total value, but does not appear among the ten leading States in the number of springs, quantity of water sold, or value of table waters sold. Massachusetts ranks second in the number of springs reporting sales; drops to fourth place in the quantity of water sold; stands sixth and eighth, respectively, in the value of table waters and the total value of waters sold; and falls below tenth in the value of medicinal water sales. Other States show similar differences in rating, depending upon the standpoint of comparison.

The greatest number of springs reporting from a single State was 57 for New York with 54 from Massachusetts, making that State a close second. Seven States and the District of Columbia furnished reports from less than three springs each.

Only three States reported sales of over 5,000,000 gallons of water, as follows: New York 10,008,801 gallons, Minnesota 8,881,018 gallons, and Wisconsin 6,045,719 gallons. Of the remaining States fifteen report sales of more than a million gallons each, with the sales from Massachusetts (4,502,806 gallons) falling but little below 5,000,000 gallons. New York, where the total value of water sold amounted to $1,034,477, is the only State passing the million dollar line. Wisconsin, with sales amounting to $869,495, is a good second, while Indiana takes third rank with an income from mineral waters of $677,718. One of the other States, California, reports sales valued at more than $500,000, and the value of waters from Maine falls but little below that figure. In value of medicinal waters Indiana, with sales valued at $658,681, is far in advance of California, her nearest competitor, whose income from that source was $174,620, while five other States, Maine, Mississippi, New York, Texas, and Virginia, report sales valued at more than $100,000 each. The leading State in the value of table waters sold is New York, with an income of $928,070; Wisconsin is a good second, with $775,148; California a poor third, with $358,351; and Maine a close competitor for third place, with $317,726. Only seven other States report sales of table waters valued at more than $100,000 each.

CONDITION OF THE MINERAL-WATER TRADE.

The slight decline in the quantity and value of mineral waters sold during 1912 is but the natural result of the high cost of living with the consequent curtailment of expenditures wherever possible. Many persons regard such waters as a luxury, and a diminution in consumption is to be expected whenever, by reason of business depression or other cause, there is cause for reducing expenses. However, such conditions are transitory, and it is reasonable to expect that the mineral-water trade may soon show an increase over the sales of previous years.

Compared with 1911, the mineral-water sales for 1912 show a loss of 1,507,325 gallons, or 2.36 per cent, and a decline in value of $222,217, or 3.25 per cent, and a decrease in price per gallon from 11 cents to 10.6 cents. The number of commercial springs reporting was 14 greater in 1912 than in 1911, indicating that there must have been a decline in sales from springs previously reporting. Fourteen States report an increase in the quantity of water sold, ranging from 751,198 gallons to 7,371 gallons. The greatest increase, 751,198 gallons, was in Ohio; Oklahoma was second, with 518,438 gallons; Wisconsin third, with 329,557 gallons; Mississippi fourth, with 293,405 gallons; Virginia fifth, with 287,401 gallons; Minnesota sixth, with 177,699 gallons; and New Jersey seventh, with 152,590 gallons. None of the seven other States show increase of as much as 100,000 gallons. It may be noted that, with one exception, the States that show a large increase in the quantity of mineral water sold are located either in the South or in the Middle West where agriculture is an important pursuit and the increased cost of the necessaries of life would naturally have less effect than in the North and East where agriculture is relatively less important.

Some States that show an increase in the water sold show a decrease in the value of the output, and in some other States the reverse is true. The largest increase in value of water sold was $95,474 in New York where the decrease in sales was 236,460 gallons, and the second largest was $50,554 in Virginia where the increase in sales was 287,401 gallons. Reports from 16 other States show increase in the value of waters sold, but the decline in values in other States, ranging from $129,130 in New Hampshire to $1,066 in Vermont, more than counterbalances the gains so that the percentage of decrease in value of waters sold amounts to 3.25, and the actual net decrease is $222,217. The largest percentages of increase in value are 177.34 in South Dakota, 130.73 in Oklahoma, 120.41 in Montana, 68.21 in Mississippi, 67.10 in South Carolina, and less than 50 per cent in other States. The decline in value of mineral waters in some States is very pronounced, being 92.81 per cent in New Hampshire, 81.02 per cent in Utah, 69.96 per cent in Louisiana, 68.5 per cent in Nebraska, 60.09 per cent in Nevada, and 53.67 per cent in New Mexico.

Comparative production of mineral waters, 1911–1912.

State.	1911 Commercial springs.	1911 Quantity sold (gallons).	1911 Value.	1912 Commercial springs.	1912 Quantity sold (gallons).	1912 Value.	Increase (+) or decrease (−) in number of springs reporting.	Increase (+) or decrease (−) in gallons sold.	Percentage of increase (+) or decrease (−) in gallons sold.	Increase (+) or decrease (−) in value of product.	Percentage of increase (+) or decrease (−) in value of product.
Alabama	10	205,854	$26,982	16	165,678	$20,435	+ 6	− 40,176	− 19.52	− $6,547	− 24.26
Arkansas	8	1,560,157	118,994	11	1,396,032	132,257	+ 3	− 164,125	− 10.52	+ 13,263	+ 11.15
California	40	2,310,237	578,439	41	2,089,951	532,971	+ 1	− 220,286	− 9.54	− 45,468	− 7.86
Colorado	14	1,436,066	104,763	11	1,178,308	75,314	− 3	− 257,758	− 17.95	− 29,449	− 28.11
Connecticut	28	2,164,701	182,744	28	2,110,231	153,383	....	− 54,470	− 2.52	− 29,361	− 1.61
Delaware	1	(a)	(a)	1	(a)	(a)	....	(a)	(a)	(a)	(a)
District of Columbia	2	(a)	(a)	2	(a)	(a)	....	(a)	(a)	(a)	(a)
Florida	9	114,416	19,330	9	123,485	17,521	....	+ 9,069	+ 7.93	− 1,809	− 9.36
Georgia	15	981,080	97,752	16	861,365	55,031	+ 1	− 119,715	− 11.41	− 42,721	− 43.70
Idaho	1	(a)	(a)	....	....	....	− 1	(a)	−100.00	(a)	−100.00
Illinois	14	1,304,950	82,330	17	1,143,625	74,445	+ 3	− 161,325	− 12.36	− 7,885	− 9.58
Indiana	15	1,084,428	653,641	15	993,163	677,718	....	− 91,265	− 8.42	+ 24,077	+ 3.68
Iowa	6	176,000	20,500	6	84,300	11,375	....	− 91,700	− 52.10	− 9,125	− 44.51
Kansas	18	456,341	63,063	16	428,677	75,919	− 2	− 27,664	− 6.06	+ 12,856	+ 20.38
Kentucky	13	423,729	49,827	13	477,341	56,555	....	+ 53,612	+ 12.65	+ 6,728	+ 13.50
Louisiana	5	1,520,550	110,998	4	561,660	33,345	− 1	− 958,890	− 63.06	− 77,653	− 69.96
Maine	28	1,254,783	431,740	31	1,179,192	432,765	+ 3	− 75,591	− 6.02	+ 1,025	+ 0.24
Maryland	12	1,657,756	150,966	13	1,606,373	157,541	+ 1	− 51,383	− 3.10	+ 6,575	+ 4.36
Massachusetts	56	4,610,474	218,870	54	4,502,806	247,397	− 2	− 107,668	− 2.34	+ 28,527	+ 13.03
Michigan	19	1,713,401	72,253	18	1,420,465	75,611	− 1	− 292,936	− 17.10	+ 3,358	+ 4.65
Minnesota	17	8,703,319	270,039	18	8,881,018	252,277	+ 1	+ 177,699	+ 2.04	− 17,762	− 6.58
Mississippi	8	346,500	75,050	10	639,905	126,241	+ 2	+ 293,405	+ 84.68	+ 51,191	+ 68.21
Missouri	25	542,892	86,747	30	608,385	81,114	+ 5	+ 65,493	+ 12.07	− 5,633	− 6.49
Montana	4	74,750	5,988	3	160,150	13,198	− 1	+ 85,400	+114.25	+ 7,210	+120.41
Nebraska	3	21,641	1,925	2	(a)	(a)	− 1	(a)	(a)	(a)	(a)
Nevada	2	(a)	(a)	1	(a)	(a)	− 1	(a)	(a)	(a)	(a)
New Hampshire	6	406,660	139,130	8	240,568	10,000	+ 2	− 166,092	− 40.84	−129,130	− 92.81
New Jersey	12	2,233,627	210,123	12	2,386,217	209,726	....	+ 152,590	+ 6.83	− 397	− 0.19
New Mexico	5	226,333	41,833	2	(a)	(a)	− 3	(a)	(a)	(a)	(a)
New York	51	10,245,261	939,003	57	10,008,801	1,034,477	+ 6	− 236,460	− 2.31	+ 95,474	+ 10.17
North Carolina	16	231,510	31,108	16	144,708	22,385	....	− 86,802	− 37.49	− 8,723	− 28.04
North Dakota	1	(a)	(a)	....	....	....	− 1	(a)	(a)	(a)	(a)
Ohio	28	1,958,547	86,478	30	2,709,745	117,287	+ 2	+ 751,198	+ 38.35	+ 30,809	+ 35.63
Oklahoma	10	497,074	14,290	10	1,015,512	32,971	....	+ 518,438	+104.30	+ 18,681	+130.73
Oregon	7	56,300	18,000	6	48,351	17,503	− 1	− 7,949	− 14.12	− 497	− 2.76
Pennsylvania	41	2,327,732	216,819	41	2,192,106	204,906	....	− 135,626	− 5.83	− 11,913	− 5.49
Rhode Island	8	503,360	27,036	7	466,893	29,126	− 1	− 36,467	− 7.24	+ 2,090	+ 7.73

a Included under Miscellaneous States.

Comparative production of mineral waters, 1911–1912—Continued.

State.	1911			1912			Increase (+) or decrease (−) in number of springs reporting.	Increase (+) or decrease (−) in gallons sold.	Percentage of increase (+) or decrease (−) in gallons sold.	Increase (+) or decrease (−) in value of product.	Percentage of increase (+) or decrease (−) in value of product.
	Commercial springs.	Quantity sold (gallons).	Value.	Commercial springs.	Quantity sold (gallons).	Value.					
South Carolina	15	285,389	$42,099	15	360,404	$70,348	....	+ 75,015	+ 26.29	+$28,249	+ 67.10
South Dakota	3	13,400	2,410	2	(a)	(a)	− 1	(a)	(a)	(a)	(a)
Tennessee	19	1,073,115	72,475	21	796,568	53,560	+ 2	− 276,547	− 25.28	− 18,915	− 26.10
Texas	40	1,637,932	158,367	34	1,292,992	151,395	− 6	− 344,940	− 21.06	− 6,972	− 4.40
Utah	2	(a)	(a)	2	(a)	(a)	....	(a)	(a)	(a)	(a)
Vermont	4	25,200	9,346	3	21,000	8,280	− 1	− 4,200	− 16.67	− 1,066	− 11.41
Virginia	43	2,474,918	298,701	45	2,762,319	349,255	+ 2	+ 287,401	+ 11.62	+ 50,554	+ 16.92
Washington	5	148,800	14,654	5	156,171	17,542	....	+ 7,371	+ 4.95	+ 2,888	+ 19.71
West Virginia	10	259,686	67,687	11	309,245	60,445	+ 1	+ 49,559	+ 19.08	− 7,242	− 10.70
Wisconsin	31	5,716,162	955,988	31	6,045,719	869,495	....	+ 329,557	+ 5.77	− 86,493	− 9.05
Wyoming	2	(a)	(a)	2	(a)	(a)	....	(a)	(a)	(a)	(a)
Miscellaneous States [b]	....	803,521	69,400	....	711,772	54,557	....	− 353,123	− 29.44	− 61,011	− 52.79
Total	732	63,788,552	6,837,888	746	62,281,201	6,615,671	+14	−1,507,351	− 2.36	−222,217	− 3.25

[a] Included under Miscellaneous States.
[b] Includes, in 1911, Delaware, District of Columbia, Idaho, Nevada, North Dakota, Utah, and Wyoming; in 1912, Delaware, District of Columbia, Nebraska, Nevada, New Mexico, South Dakota, Utah, and Wyoming.

SOFT DRINKS.

The manufacture and sale of beverages known as "soft drinks" is an important industry, but the statistics available are too fragmentary to furnish a definite idea concerning the magnitude of the sales. In some localities the water from mineral springs is utilized for manufacturing soft drinks. The quantity may not in all cases have been reported, but the statistics supplied show that 5,139,527 gallons were thus used in 1912, and that the total quantity of mineral water sold for all other purposes amounted to 62,281,201 gallons. The quantity of spring water used in the manufacture of soft drinks is given in the accompanying table:

Quantity of water used in manufacture of soft drinks, 1912, by States, in gallons.

Rank.	State.	Quantity.
1	Massachusetts	899,066
2	Wisconsin	551,934
3	Pennsylvania	440,249
4	Minnesota	398,651
5	Connecticut	358,895
6	Arkansas	260,000
7	Maryland	220,000
8	Missouri	212,969
9	New Hampshire	182,933
10	New York	165,881
	Other States	1,448,949
	Total	5,139,527

IMPORTS.

The total imports of mineral waters as reported by the Bureau of Foreign and Domestic Commerce, Department of Commerce, including natural, semiartificial, and strictly artificial waters, in 1912 amounted to 3,499,497 gallons, valued at $930,091. The valuation is that assessed by customs officials and is supposed to be the value at which the mineral waters were sold at point of shipment before any freight commissions and duties had been added. It will be noted that the imports in 1912 decreased more than 100,000 gallons in quantity and more than $107,000 in value from those of 1911.

Mineral waters imported and entered for consumption in the United States, 1900, 1905, and 1908–1912, in gallons.

Year.	Mineral waters.		Year.	Mineral waters.	
	Quantity.	Value.		Quantity.	Value.
1900	2,382,410	$663,803	1910	3,306,303	$983,136
1905	3,150,030	926,357	1911	3 604 703	1,037,485
1908	2,912,398	1,033,047	1912	3,499,497	930,091
1909	3,464,524	1,085,177			

EXPORTS.

Considerable quantities of certain domestic waters are said to be shipped to Canada and other foreign countries, but no account of such shipments is taken by the Bureau of Foreign and Domestic Commerce, and no exports have been reported by the Government since 1883.

MINERAL-WATER TRADE BY STATES.

ALABAMA.

Returns from Alabama show that the output of mineral water declined both in quantity and in value during 1912. The total sales decreased from 205,854 gallons, valued at $26,982, in 1911, to 165,678 gallons, valued at $20,435, in 1912, a decline of 19.52 per cent in quantity and 24.26 per cent in value. The average price reported was 12.3 cents a gallon, against 15 cents as the average for 1911. Six new springs were reported during 1912, making a total of 16 springs. About one-half of the total sales of mineral water is used medicinally, and the water at six springs is said to be used for bathing purposes. In addition to the quantity reported as sold, 35,000 gallons were used for the manufacture of soft drinks.

The following 16 springs reported sales:

Alabama Mineral Springs, near Oakhill, Wilcox County.
Bailey Springs, Florence, Lauderdale County.
Bladon Springs, Bladon Springs, Choctaw County.
Blount Springs, Blount Springs, Blount County.
Bromberg Gulf Coast Lithia Springs, Bayou La Batre, Mobile County.
Cherokee Spring, near Citronelle, Mobile County.
Cooks Springs, Cooks Springs, St. Clair County.
Dixie Spring, Dixie Spring, Walker County.
Ingram Lithia Wells, near Ohatchee, Calhoun County.
Livingston Mineral Springs, Livingston, Sumter County.
Luverne Mineral Spring, Luverne, Crenshaw County.
MacGregor Spring, Spring Hill, Mobile County.
Matchless Mineral Wells, east of Greenville, Butler County.
Purity Spring, Spring Hill, Mobile County.
Shocco Spring, near Talladega, Talladega County.
White Sulphur Wells, near Jackson, Clarke County.

ARKANSAS.

According to reports received from spring owners in Arkansas, there was a falling off in the volume of business for 1912, the total sales decreasing from 1,560,157 gallons, valued at $118,994, to 1,396,032, valued at $132,257, a decline of 10.52 per cent in quantity and 11.15 per cent in value, despite the fact that there were three new springs reporting and that the average price per gallon rose from 7 cents to 9 cents.

The table below shows the record for the last five years:

Production and value of mineral waters in Arkansas, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	10	1,175,053	$212,835	18.1
1909	10	1,213,742	153,163	12.6
1910	10	1,065,676	89,772	8.4
1911	8	1,560,157	118,994	7.6
1912	11	1,396,032	132,257	9.5

Three new springs reported for the first time, 2 were idle, and 2 reentered the list of producing springs. Nearly one-half the sales was used for medicinal purposes. There were resorts at 7 of the springs, accommodating 4,000 guests, and the water at 2 springs is used for bathing. Besides the quantity reported as sold, there was about 260,000 gallons used in the manufacture of soft drinks.

The following 11 springs reported sales:

Arkansas Lithia Springs, near Hope, Hempstead County.
Arsenic Springs, Hot Springs, Garland County.
Blue Spring, Eureka Springs, Carroll County.
Box Spring, Siloam Springs, Benton County.
Chewankla Spring, Hot Springs, Garland County.
De Soto Springs, Hot Springs, Garland County.
Glenaqua Mineral Springs, Hot Springs, Garland County.
Mountain Blood Spring, near Hot Springs, Garland County.
Mountain Valley Springs, Mountain Valley, Garland County.
Ozarka Spring, Eureka Springs, Carroll County.
Potash Sulphur Springs, Hot Springs, Garland County.

CALIFORNIA.

There was a large decrease in the mineral-water sales of California during 1912, the sales reported being 2,089,951 gallons, as compared with 2,310,237 gallons in 1911, a decrease of 220,286 gallons, or 9.54 per cent. The value fell off $45,468, or 7.86 per cent, the average price of 25 cents per gallon remaining the same. The record for the last five years has been as follows:

Production and value of mineral waters in California, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Price per gallon received at springs.
				Cents.
1908	40	1,960,770	$393,920	20.1
1909	44	2,179,187	444,230	20.4
1910	41	2,008,697	394,841	19.7
1911	40	2,310,237	578,439	25.0
1912	41	2,089,951	532,971	25.5

Four new springs were added to the list of producers in 1912. Regardless of the fact that more than half of California mineral water is reported to be sold for table use, California is second in the value of the medicinal water output. There are resorts at 19 of the springs with accommodations for nearly 4,500 patrons, and the water at 17 springs is used for bathing. Spring owners reported a total of 40,000 gallons of water used for the manufacture of soft drinks.

The 41 springs reporting are as follows:

Adams Springs, Adams, Lake County.
Ætna Springs, Lidell, Napa County.
Alma Springs, Alma, Santa Clara County.
Barcal Mineral Springs, Preston, Sonoma County.
Bartlett Springs, Bartlett Springs, Lake County.
Boyes Hot Springs, Boyes Springs, Sonoma County.
Buckman Spring, Descanso, San Diego County.
Bythnia Springs, Santa Barbara, Santa Barbara County.
California Geysers, The Geysers, Sonoma County.

Castalian Spring, Inyo County.
Castle Rock Spring, Eubanks, Shasta County.
Console Mineral Spring, Colton, San Bernardino County.
Cooks Springs, near Williams, Colusa County.
Crystal Spring, Los Angeles, Los Angeles County.
El Granito Mineral Spring, El Cajon, San Diego County.
Elliotta White Sulphur Spring, Riverside, Riverside County.
Elysian Spring, Los Angeles, Los Angeles County.
Fouts Springs, Fouts Springs, Colusa County.
Grizzle Spring, near Sulphur Creek, Colusa County.
Lepori Vichy Springs, near Napa City, Napa County.
Lytton Spring, Lytton, Sonoma County.
Monterey Mineral Well, Monterey, Monterey County.
Napa Soda Springs, Napa Valley, Napa County.
Nuvida Springs, La Presa, San Diego County.
Paraiso Hot Springs, Paraiso Springs, Monterey County.
Pinkhams Spring, Santa Barbara, Santa Barbara County.
Purity Springs, Sausalito, Marin County.
Radium Sulphur Springs, Colegrove, Los Angeles County.
Redwing Springs, Middletown, Lake County.
Samuel Soda Springs, Monticello, Napa County.
San Benito Spring, near Hollister, San Benito County.
Shasta Springs, Shasta Springs, Siskiyou County.
Tamalpais Spring, San Rafael, Marin County.
Tassajara Hot Springs, near Jamesburg, Monterey County.
Tia Juana Springs, near Nestor, San Diego County.
Tolenas Spring, near Suisun City, Solano County.
Valley Springs, Valley Springs, Calaveras County.
Veronica Medicinal Springs, near Santa Barbara, Santa Barbara County.
Vito Nuevo Spring, Mono County.
Watters Springs, Pope Valley, Napa County.
Witter Medical Springs, Witter, Lake County.

COLORADO.

Reports from Colorado show that in 1912 the sales of mineral water suffered a decline, the sales reported being 1,178,308 gallons, as compared with 1,436,066 gallons in 1911, a decrease of 257,758 gallons, or 18 per cent. The value fell from $104,763 in 1911 to $75,314 in 1912, a decrease of 28 per cent. The average price dropped from 7 cents to 6 cents a gallon.

The following is the record for the last five years:

Production and value of mineral waters in Colorado, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Price per gallon received at springs.
				Cents.
1908	11	761,150	$127,720	14.8
1909	15	1,077,820	111,158	10.3
1910	14	1,638,984	115,289	7.0
1911	14	1,436,066	104,763	7.3
1912	11	1,178,308	75,314	6.4

No new springs reported during 1912; 1 was reported idle, 1 was out of business, and 1 was delinquent, which reduced the number of springs to 11. More than two-thirds of the total output is used for the table. Of the springs reporting sales, 3 are resorts, accommodating more than 5,000 people, and the water is used for bathing.

Besides the quantity reported sold, 153,500 gallons were used for soft drinks.

The 11 springs reporting are as follows:

Boulder Springs, Crisman, Boulder County.
Canon City Soda Spring, Canon City, Fremont County.
Clark Magnetic Mineral Spring, Pueblo, Pueblo County.
Columbia Well, Denver, Denver County.
Crystal Springs, Fowler, Otero County.
Horn Mineral Springs, Colorado Springs, El Paso County.
Navajo, Shoshone, Manitou, and Cheyenne Springs, Manitou, El Paso County.
Pueblo Mineral Springs, Pueblo, Pueblo County.
Ute Chief Spring, Manitou, El Paso County.
Ute, Ouray, and Little Chief Springs, Manitou, El Paso County.
Yampah Spring, Glenwood Springs, Garfield County.

CONNECTICUT.

Returns from Connecticut indicate a slight decline in the production of mineral water during 1912; the reported sales were 2,110,231 gallons, a decline of 2.52 per cent from 1911, and the value declined $29,361, or 1.61 per cent. The average price was 7 cents, a drop of 1 cent from 1911.

The record for the last five years is shown in the following table:

Production and value of mineral waters in Connecticut, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon at spring.
				Cents.
1908	15	424,826	$36,404	8.6
1909	22	691,296	42,375	6.1
1910	24	1,608,775	109,853	6.8
1911	28	2,164,701	182,744	8.4
1912	28	2,110,231	153,383	7.3

Three new springs were entered on the list, the Crystal, near Derby, the St. George, and Shantox. Three were dropped from the list, resulting in no change in the total number of springs for Connecticut. Practically the entire mineral-water output of the State is used for the table. There are no resorts at any of these springs and the water at only 1 is used for bathing.

The names of the 28 reporting springs follow:

Althea Spring, Waterbury, New Haven County.
Ansantawae Spring, Milford, New Haven County.
Arethusa Spring, Seymour, New Haven County.
Berkshire Spring, Cornwall Bridge, Litchfield County.
Buttress Spring, Woodbridge, New Haven County.
Chalybeate Spring, Oxford, New Haven County.
Cherry Hill Spring, Highwood, New Haven County.
Colonial Spring, Danbury, Fairfield County.
Crystal Spring, near Little River, Middlesex County.
Crystal Spring, near Derby, New Haven County.
Diamond Mineral Springs, Cheshire, New Haven County.
Elco Spring, Elco Springs, Hartford County.
Granite Rock Spring, Higganum, Middlesex County.

Gra-Rock Spring, Canton, Hartford County.
Hermitage Spring, Monotowese, New Haven County.
Highland Spring, near Mount Higbee, Middlesex County.
Hillside Spring, West Meriden, New Haven County.
Live Oak Spring, Meriden, New Haven County.
Mystic Spring, Old Mystic, New London County.
Nonquit Spring, Fairfield, Fairfield County.
Oak Spring, Middletown, Middlesex County.
Pequabuck Mountain Spring, Bristol, Hartford County.
Red Rock Spring, Meriden, New Haven County.
St. George Spring, Ridgefield, Fairfield County.
Shantox Spring, Uncasville, New London County.
Stafford Mineral Springs, Stafford Springs, Tolland County.
Varuna Spring, North Stamford, Fairfield County.
Venture Rock Spring, Stonington, New London County.

DELAWARE.

Only one spring reported from Delaware in 1912, as in 1911. The water is used entirely for the table, principally by residents of Wilmington.

This spring is:

Kiamensi Spring, near Wilmington, Newcastle County.

DISTRICT OF COLUMBIA.

The same two springs reported sales from the District of Columbia in 1912, as in 1911, the waters being distributed mainly in Washington for table use. The details of output have been included with other States having less than three reporting springs.

The two reporting springs are:

Gitchie Crystal Spring, Benning.
Red Oak Spring, near Langdon.

FLORIDA.

A slight increase in the output from Florida is noted by the returns, the sales advancing from 114,416 gallons in 1911 to 123,485 gallons in 1912, an increase of 9,069 gallons, or 7.93 per cent. The average price per gallon, however, fell to 9 cents from 17 cents, causing the total value to show a loss of $1,809, or 9.36 per cent. One new spring reported, the Chumuckla Mineral Spring, and one reported as idle leaves the total number unchanged. Nearly all the water sold was for medicinal purposes, and the water at four springs is used for bathing.

The following nine springs reported sales:

Chumuckla Mineral Spring, McDavid, Santa Rosa County.
Espiritu Santo Spring, Tampa Bay, Hillsboro County.
Lackawanna Spring, near Jacksonville, Duval County.
Magnolia Spring, Magnolia Springs, Clay County.
Newport Spring, Newport, Wakulla County.
Orange City Mineral Spring, Orange City, Volusia County.
Panacea Mineral Spring, Panacea, Wakulla County.
Quisisana Spring, Green Cove Springs, Clay County.
Wekiwa Springs, Wekiwa Springs, Orange County.

GEORGIA.

The returns from Georgia indicate a falling off in the trade during 1912, the sales decreasing from 981,080 gallons reported in 1911 to 861,365 gallons in 1912, a decline of 119,715, or 11 per cent. The value decreased in even greater ratio, from $97,752 in 1911 to $55,031 in 1912, a loss of $42,721, or 43.7 per cent. The average price reported in 1912 was 6 cents, as against 10 cents reported in 1911. One new spring reported foı the first time, the Duke, makes a total of 16 springs reporting in 1912. Nearly four-fifths of the output from these springs was used for the table. There are resorts at five of the springs with accommodations for 560 people, and the water at four of the springs is used for bathing.

The following is the list of the 16 reporting springs:

Benscot Lithia Springs, Austell, Cobb County.
Bowden Lithia Spring, Lithia Springs, Douglas County.
Catoosa Springs, Catoosa Springs, Catoosa County.
Chalybeate Spring, Chalybeate, Meriweather County.
Daniel Mineral Spring, Union Point, Green County.
Duke Spring, near Cedartown, Polk County.
Electric Spring, Hillman, Taliaferro County.
High Rock Spring, near Atlanta, Fulton County.
Jay Bird Spring, near Helena, Dodge County.
Miller's Spring, Milledgeville, Baldwin County.
Murrow Spring, Tifton, Tift County.
Pine Mountain Spring, West Point, Troup County.
Swift Lithia Spring, Elberton, Elbert County.
Utoy-Flora Spring, Utoy, Fulton County.
White Elk Spring, Macon, Bibb County.
White Oak Mineral Spring, Macon, Bibb County.

ILLINOIS.

The sales of mineral water in Illinois during the year 1912 fell off in both quantity and value. According to the returns received, there were sold during the year 1,143,625 gallons of water, valued at $74,445, at an average of 6 cents a gallon. These totals compared with those furnished for 1911 of 1,304,950 gallons, valued at $82,330, show a decrease of 161,325 gallons, or 12.36 per cent, in quantity and of $7,885, or 9.58 per cent, in value.

The record of the State for the last five years is as follows:.

Production and value of mineral waters in Illinois, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	17	685,763	$58,904	8.6
1909	14	639,460	49,108	7.7
1910	16	1,117,620	83,148	7.4
1911	14	1,304,950	82,330	6.3
1912	17	1,143,625	74,445	6.5

Three springs made returns for the first time, the Dixon, the Indian, and Scott's, the total number reporting being 17. Practically all of the water is used for the table. There are resorts at 2 of the springs, and the water of 3 is used for bathing. Besides the quantity reported as sold, 91,000 gallons were used in the manufacture of soft drinks.

The 17 springs reporting are as follows:

Abana Mineral Springs, Libertyville, Lake County.
Aqua Vitæ Mineral Spring, Maquon, Knox County.
Brady Spring, Joliet, Will County.

Central Park Sulphur Spring, Peoria, Peoria County.
Deerlick Mineral Spring, Deerfield, Lake County.
Glen Flora Mineral Spring, Waukegan, Lake County.
Gravel Spring, near Jacksonville, Morgan County.
Greenup Mineral Spring, Greenup, Cumberland County.
Indian Spring, Streator, Lasalle County.
Mokena Mineral Spring, Mokena, Will County.
Namononia and Old Ironsides Springs, Dixon Springs, Pope County.
Perry Mineral Springs, Perry, Pike County.
Ripley Mineral Spring, Cooperstown, Brown County.
Sanicula Spring, Ottawa, Lasalle County.
Scott's Springs, Galatia, Saline County
White Diamond Spring, South Elgin, Kane County.
White Eagle Spring, Edgemont, St. Clair County.

INDIANA.

Indiana returns show a decrease in quantity of output and an increase in value owing to the increase in the average price per gallon of 8 cents. The high value placed on the medicinal waters of French Lick springs accounts for the average price of 68 cents reported in 1912, giving Indiana first place in the United States in the value of production of medicinal waters. The total sales reported amounted to 993,163 gallons, valued at $677,718, a decrease of 91,265 gallons, or 8 per cent, and an increase in value of $24,077, or 3.68 per cent, over 1911. No new springs reported in 1912; the number, 15, remaining the same as in 1911. More than 97 per cent of the total sales is used medicinally. There are 7 resorts located at these springs, accomodating more than 2,000 people, and the water at 5 resorts is said to be used for bathing. Very little water from the springs reporting was used for the manufacture of soft drinks.

The 15 springs reporting sales are as follows:

Blue Cast Magnetic Spring, Woodburn, Allen County.
Blue Lick Spring, Blue Lick, Clark County.
Bronson Spring, Terre Haute, Vigo County.
Carlson Mineral Springs, Laporte, Laporte County.
Cartersburg Mineral Spring, Cartersburg, Hendricks County.
Colomagna Springs, Columbus, Bartholomew County.
Hunter Mineral Springs, Kramer, Warren County.
King's Mineral Spring, Dallas, Clark County.
Knott's Mineral Spring, Porter, Porter County.
Mudlavia Spring, Kramer, Warren County.
Paoli Lithia Spring, Paoli, Orange County.
Pluto, Proserpine, and Bowles Springs, French Lick, Orange County.
Reid Mineral Spa Lithia Spring, near Richmond, Wayne County.
West Baden Mineral Springs, West Baden, Orange County.
White Crane Spring, Dillsboro, Dearborn County.

IOWA.

The returns from Iowa show that the output of mineral water declined in 1912, the sales decreasing 52.1 per cent and the value 44.51 per cent. The total sales reported were 84,300 gallons, valued at $11,375. These figures, compared with the 1911 returns of 176,000 gallons, valued at $20,500, show a falling off of 91,700 gallons in quantity and of $9,125 in value. One new spring reported for the first time, the Egralharve. Only about one-fifth of the Iowa mineral water is used for medicinal purposes. It was also reported that

61,000 gallons were used during the year in the manufacture of soft drinks.

The six springs reporting sales are as follows:

Crystal Spring, Estherville, Emmet County.
Egralharve Spring, Montgomery, Dickinson County.
Fry's Spring, Colfax, Jasper County.
Heston's Spring, Fairfield, Jefferson County.
Red Mineral Springs, Eddyville, Wapello County.
White Sulphur Spring, Davenport, Scott County.

KANSAS.

The output of mineral waters in Kansas during 1912 showed a small decrease, the total sales amounting to 428,677 gallons, valued at $75,919, at an average price per gallon of 17.7 cents. The sales reporting in 1911 were 456,341 gallons, valued at $63,063, at an average price of 14 cents, making a decrease of 27,664 gallons, or 6 per cent.

The value, however, increased $12,856 in 1912, or 20 per cent. There were two new springs reporting in 1912, and four reported as not marketing mineral water, which reduced the number of reporting springs to 16. There are resorts at five of the springs with total accommodations for 300 people, and the waters are used for bathing. In addition to the figures given above, it was reported that 101,667 gallons went into the manufacture of soft drinks.

The following 16 springs have reported sales:

Abilena Spring, Abilene, Dickinson County.
Aganippe Spring, near Independence, Montgomery County.
Artesian Pure Spring, Hutchinson, Reno County.
Blasing's Springs, near Manhattan, Riley County.
California Spring, Ottawa, Franklin County.
Crystal Spring, Coffeyville, Montgomery County.
Geuda Springs, Geuda Springs, Cowley County.
Geyser Mineral Springs, Rosedale, Wyandotte County.
Hiatts Crystal and Mineral Springs, Winfield, Cowley County.
Magnesium and Choteau Springs, Independence, Montgomery County.
Kingman Spring, Kingman, Kingman County.
Phillip's Mineral Spring, Topeka, Shawnee County.
Riverview Spring, Winfield, Cowley County.
Sycamore Mineral Spring, Sabetha, Brown County.
Waconda Spring, Waconda Springs, Mitchell County.
Wetmore Spring, Wetmore, Nemaha County.

KENTUCKY.

There was a notable increase in the mineral-water sales of Kentucky during 1912, the figures reported being 477,341 gallons, valued at $56,555, as compared with 423,729 gallons, valued at $49,827, sold in 1911, a gain of 53,612 gallons, or 12.65 per cent, in quantity and of $6,728, or 13.5 per cent, in value. The average retail price remained about the same as in 1911. One new spring reported, the Kentucky Mineral Well; 2 were idle; and 1 reentered on the list, there being no change in the number of reporting springs in 1912 as compared with 1911. The total output is about equally divided between table and medicinal waters. There are resorts at 5 of the springs and the water at one is used for bathing. Exclusive of the total sales, about 20,000 gallons is used in the manufacture of soft drinks. The 13 reporting springs are as follows:

Anita Springs, La Grange, Oldham County.
Blue Rock Spring, Fisherville, Jefferson County.
Craborchard Springs, Crab Orchard, Lincoln County.
Glen Lily Spring, near Bowling Green, Warren County.
Hamby's Salts, Iron, and Lithia Springs, Dawson Springs, Hopkins County.
Kentucky Mineral Well, near Campbellsville, Taylor County.
Lexington Lithia Springs, Lexington, Fayette County.
Robertson Spring, Fort Thomas, Campbell County.
Royal Magnesian Spring, near La Grange, Oldham County.
Sanders Lithia Springs, Sanders, Carroll County.
Smith Mineral Wells, Kelly, Christian County.
Spring Rock Spring, Spring Lake, Kenton County.
White's Epsom Spring, Crab Orchard, Lincoln County.

LOUISIANA.

Returns from Louisiana show a decided decrease in the quantity of mineral water sold during 1912. The reported sales amounted to 561,660 gallons, a decrease of 958,890 gallons, or 63 per cent. The value reported for 1912 was $33,345, a decrease of $77,653, or 70 per cent, at an average price per gallon of 5.9 cents, a fall of 1 cent from 1911.

The record of sales for the last five years is as follows:

Production and value of mineral waters in Louisiana, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	3	400,500	$52,020	13.0
1909	5	1,375,000	103,850	7.6
1910	4	2,313,000	163,975	7.1
1911	5	1,520,550	110,998	7.3
1912	4	561,660	33,345	5.9

No new springs reported in 1912, the total number reporting was one less than for 1911. Nearly three-fourths of the output is sold for table use, principally in New Orleans. Exclusive of the total sales about 13,000 gallons were used in the manufacture of soft drinks.

The four springs that made returns are as follows:

Geyser Well, Hammond, Tangipahoa Parish.
Greenwell Spring, Magnolia, Harrison Parish.
Krotz Spring, Krotz Springs, St. Landry Parish.
Ozone Spring, Pearl River, St. Tammany Parish.

MAINE.

Maine showed a slight decrease in volume of trade in 1912. The total sales amounted to 1,179,192 gallons, a decrease of 75,591, or 6 per cent. The value increased, however, $1,025, or 0.2 per cent, the sales amounting to $432,765 in 1912, at an average price of 37 cents per gallon.

The record for the last five years is as follows:

Production and value of mineral waters in Maine, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	27	1,182,322	$394,346	33.4
1909	33	1,515,541	402,593	26.6
1910	29	1,238,171	404,539	32.7
1911	28	1,254,783	431,740	34.4
1912	31	1,179,192	432,765	36.7

Thirty-one springs reported in 1912, 4 of them for the first time. A little more than 25 per cent of the total output was used medicinally. Resorts are located at only 3 springs which accommodate over 600 people. More than 125,000 gallons were used for the manufacture of soft drinks.

The names of the 31 springs reporting are:

Bakers Puritan Spring, Pine Point, York County.
Blue Hill Mineral Spring, Blue Hill, Hancock County.
Forest Springs, Litchfield, Kennebec County.
Glenrock Mineral Spring, Greene, Androscoggin County.
Glenwood Spring, Augusta, Kennebec County.
Glenwood Mineral Spring, St. Albans, Somerset County.
Hanover Spring, Hanover, Oxford County.
Highland Mineral Spring, Lewiston, Androscoggin County.
Kennebunk Mineral Spring, Kennebunk Port, York County.
Keystone Mineral Spring, East Poland, Androscoggin County.
Littlefield Spring, Gardiner, Kennebec County.
Mount Desert Spring, Northeast Harbor, Hancock County.
Mount Kebo Spring, Bar Harbor, Hancock County.
Mount Zircon Spring, Milton Plantation, Oxford County.
Mystic Spring, Saco, York County.
Norway Mineral Spring, Norway, Oxford County.
Oak Grove Spring, Brewer, Penobscot County.
Paradise Spring, Brunswick, Cumberland County.
Pine Spring, Topsham, Sagadahoc County.
Pine Croft Spring, Freeport, Cumberland County.
Poland Spring, South Poland, Androscoggin County.
Purity Spring, West Scarboro, Cumberland County.
Raymond Spring, North Raymond, Cumberland County.
Redman Farm Spring, Belfast, Waldo County.
Rocky Hill Spring, Fairfield, Somerset County.
Seal Rock Spring, Saco, York County.
Skowhegan Spring, Skowhegan, Somerset County.
Thorndike Mineral Spring, near Thorndike, Waldo County.
Virginia Spring, Rumford, Oxford County.
Wawa Lithia Spring, Ogunquit, York County.
Windsor Spring, Lewiston, Androscoggin County.

MARYLAND.

The mineral-water trade of Maryland made a small decrease of 3 per cent in the reported sales and a gain of 4 per cent in value for 1912. The sales amounted to 1,606,373 gallons, valued at $157,541, in 1912, against 1,657,756 gallons, valued at $150,966, in 1911. The average price per gallon remained about the same in 1912.

The record for the last five years has been as follows

Production and value of mineral waters in Maryland, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	8	806,673	$75,858	9.4
1909	7	938,496	91,569	9.8
1910	8	1,163,828	102,371	8.8
1911	12	1,657,756	150,966	9.1
1912	13	1,606,373	157,541	9.8

Of the 13 springs reporting in 1912, 1 reported for the first time. Practically the entire output is used for the table. There are resorts at 2 of the springs, accommodating 240 guests. In addition to the sales, 220,000 gallons was reported as being used in the manufacture of soft drinks.

The 13 reporting springs are as follows:

Altamont Spring, near Deer Park, Garrett County.
Buena Vista Spring, Edgemont, Washington County.
Carroll Springs, Forest Glen, Montgomery County.
Castalia Spring, near Branchville, Prince Georges County.
Caton Spring, Catonsville, Baltimore County.
Chattolanee Spring, Chattolanee, Baltimore County.
Crystal Rock Spring, Berwyn, Prince Georges County.
Gneiss Rock Artesian Well, Ruxton Heights, Baltimore County.
Indian Spring, Hillsdale, Baltimore County.
Mardela Mineral Spring, Mardela, Wicomico County.
Rock Crystal Spring, Rognel Heights, Baltimore County.
Royal Spring, Franklintown, Baltimore County.
Spaws Spring, Easton, Talbot County.

MASSACHUSETTS.

Returns from Massachusetts for 1912 indicate a slight decline in the volume of the mineral-water trade and a slight increase in the value of water sold. The sales reported are 4,502,806 gallons, valued at $247,397, at an average price of 5½ cents a gallon. In 1911, the sales reported were 4,610,474 gallons, valued at $218,870, at an average price per gallon of 5 cents.

The statistics for the last five years are as follows:

Production and value of mineral waters in Massachusetts, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	61	4,395,049	$227,907	5.2
1909	60	5,424,082	228,067	4.2
1910	55	4,691,159	241,949	5.2
1911	56	4,610,474	218,870	4.7
1912	54	4,502,806	247,397	5.5

One new spring, the Mount Blue Mineral Spring, was added to the list of 1911; the number reporting was 54 for 1912. Less than 1 per cent of the total water reported was classed as medicinal water. There is a resort at 1 of the springs where the water is also used for bathing. In addition to the sales given, 900,000 gallons was used to manufacture soft drinks.

The 54 reporting springs are as follows:

Abbotts Spring, Methuen, Essex County.
Ballardvale Spring, Ballardvale, Essex County.
Belmont Crystal Spring, Belmont, Middlesex County.
Belmont Hill Spring, Everett, Middlesex County.
Burnham Spring, Methuen, Essex County.
Cadwells Crystal Spring, East Woburn, Middlesex County.
Chapmans Crystal Spring, Stoneham, Middlesex County.
Cold Spring, South Braintree, Norfolk County.
Crescent Spring, Brockton, Plymouth County.
Deep Glen Spring, West Lynn, Essex County.
El-Azhar Spring, Lowell, Middlesex County.
Farrington Silver Spring, Milton, Norfolk County.
Goulding Spring, Whitman, Plymouth County.
Granite Rock Spring, Brockton, Plymouth County.
Highland Spring, West Abington, Plymouth County.
Holyoke Spring, West Lynn, Essex County.
Indian Spring, Brockton, Plymouth County.
King Philip Spring, Mattapoisett, Plymouth County.
Klines Spring, Lawrence, Essex County.
Leicester Polar Spring, Spencer, Worcester County.
Los Altos Spring, Stoneham, Middlesex County.
Massasoit Spring, West Springfield, Hampden County.
Milton Spring, Milton, Norfolk County.
Mount Blue Mineral Spring, Hingham, Plymouth County.
Mount Holyoke Lithia Spring, South Hadley, Hampshire County.
Mount Pleasant Spring, Lowell, Middlesex County.
Mount Vernon Spring, Lawrence, Essex County.
Nemasket Spring, Middleboro, Plymouth County.
New Abbott Spring, Methuen, Essex County.
Nobscot Mountain Spring, Framingham, Middlesex County.
Norwood Spring, Norwood, Norfolk County.
Oak Hill Spring, Brockton, Plymouth County.
October Mountain Spring, Lenox, Berkshire County.
Orient Spring, West Pelham, Hampshire County.
Pearl Hill Mineral Spring, Fitchburg, Worcester County.
Pepperell Spring, Pepperell, Middlesex County.
Pine Crest Spring, Pittsfield, Berkshire County.
Pocahontas Spring, Lynnfield Center, Essex County.
Puritan Spring, Andover, Essex County.
Purity Spring, Spencer, Worcester County.
Ravenwood Spring, Gloucester, Essex County.
Robbins Springs, Arlington Heights, Middlesex County.
Roberge Mineral Spring, Worcester, Worcester County.
Sand Spring, Williamstown, Berkshire County.
Shawmut Spring, West Quincy, Norfolk County.
Simpson Spring, South Easton, Bristol County.
Sippican Spring, Marion, Plymouth County.
Sterling Spring, West Lynn, Essex County.
Stevens Spring, Lawrence, Essex County.
Twin Elm Spring, Lexington, Middlesex County.
Valpey Spring, Lawrence, Essex County.
Whitman Spring, Whitman, Plymouth County.
Wilbraham Mountain Spring, Wilbraham, Hampden County.
Ye Cape Cod Pilgrim Spring, South Wellfleet, Barnstable County.

MICHIGAN

The returns for Michigan for 1912 show a decrease in volume and an increase in value. The sales were 1,420,465 gallons, a decrease of 17.10 per cent (292,936 gallons) from those for 1911. The total value for 1912 was $75,611, a small increase of $3,358, or 4.65 per cent, over the value in 1911; the average price per gallon was 5 cents in 1912 and 4 cents in 1911.

The record for the last five years has been as follows:

Production and value of mineral waters in Michigan, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	24	2,004,433	$88,910	4.4
1909	19	2,760,604	104,454	3.8
1910	17	1,454,020	69,538	4.8
1911	19	1,713,401	72,253	4.2
1912	18	1,420,465	75,611	5.3

One new spring, the Mount Clemens Crystal Spring, reported sales along with 17 old ones in 1912. Nearly 99 per cent of the total output was used for the table. There were resorts at 3 of the springs accommodating 500 people, and the water at these was used for bathing. Not included in the sales was 121,000 gallons used in the manufacture of soft drinks.

The 18 reporting springs are as follows:

Andrews Magnetic Mineral Spring, St. Louis, Gratiot County.
Arctic Spring, Grand Rapids, Kent County.
Arctic Lithia Spring, Harvey, Marquette County.
Bromo-Hygeia Well, Coldwater, Branch County.
Charlevoix Mineral Spring, Charlevoix, Charlevoix County.
Cooper Farm Spring, Birmingham, Oakland County.
Crystal Springs, Grand Rapids, Kent County.
Eastman Springs, Benton Harbor, Berrien County.
Lake Superior Mineral Spring, Marquette, Marquette County.
Maple Leaf Springs, Mount Clemens, Macomb County.
Mount Clemens Crystal Springs, Mount Clemens, Macomb County.
Ogemaw Spring, Maltby, Ogemaw County.
Osseo Spring, Osseo, Hillsdale County.
Pantland Spring, Grand Rapids, Grand Rapids County.
Ponce de Leon Spring, Paris Township, Kent County.
Sanitas Spring, Topinabee, Cheboygan County.
Sterling Spring, Crystal Falls, Iron County.
Victory Spring, Mount Clemens, Macomb County.

MINNESOTA.

In quantity of mineral water sold, Minnesota held second place in 1912, though the number of commercial springs is smaller than in several States of much less output. In 1912 there were sold 8,881,018 gallons, a gain of 177,699, or 2 per cent over the output reported in 1911. The value decreased from $270,039 in 1911 to $252,277 in 1912, a loss of $17,762, or 6.58 per cent. The average selling price remained about the same, 3 cents, as in 1911.

The following table shows the record for the last five years:

Production and value of mineral waters in Minnesota, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	11	10,985,536	$551,986	5.0
1909	20	13,746,142	614,291	4.5
1910	19	9,962,370	281,009	2.8
1911	17	8,703,319	270,039	3.1
1912	18	8,881,018	252,277	2.9

In 1912 one new spring reported for the first time, the Silver Spring, at Ortonville. With the exception of about 7,000 gallons used for medicinal purposes, the water sold was for the table. There are no resorts at any of these springs, nor is the water at any used for bathing. There was, however, a large quantity, nearly 400,000 gallons, reported as used in the manufacture of soft drinks.

The 18 reporting springs are as follows:

Bryn Mawr Spring, Minneapolis, Hennepin County.
Clear Spring, Hopkins, Hennepin County.
Deep Mineral Spring, Crookston, Polk County.
Donaldson Artesian Well, Minneapolis, Hennepin County.
Fifield Artesian Well, Winona, Winona County.
Glenwood-Inglewood Spring, Minneapolis, Hennepin County.
Highland Spring, St. Paul, Ramsey County.
Indian Medical Spring, Elk River, Sherburne County.
Mankato Mineral Springs, near Eagle Lake, Blue Earth County.
Owatonna Vichy Spring, Owatonna, Steele County.
Owens Spring, Glenwood, Pope County.
Pokegama Spring, near Detroit, Becker County.
Red Star Spring, Cold Spring, Stearns County.
Rock Spring, Shakopee, Scott County.
Silver Spring, Marshall, Lyon County.
Silver Spring, Ortonville, Big Stone County.
Swasteka Spring, Cold Spring, Stearns County.
Trio Siloam Spring, Austin, Mower County.

MISSISSIPPI.

There was a decided increase in the returns for the State of Mississippi. The total sales were 639,905 gallons, valued at $126,241, as against 346,500 gallons, valued at $75,050, in 1911, an increase of 293,405 gallons, or 84.68 per cent, in quantity and of $51,191, or 68.21 per cent, in value. Of the 10 springs reporting sales, 1—the Alkanasia—reported for the first time. Eighty-five per cent of the total output is used for medicinal purposes. There are resorts at 5 springs, accommodating 600 guests; at 1 the water is said to be used for bathing.

The names of the 10 reporting springs are:

Alkanasia Spring, Jackson, Hinds County.
Arundel Lithia Spring, near Meridian, Lauderdale County.
Browns Wells, near Hazelhurst, Copiah County.
Castalian Spring, near Durant, Holmes County.
Donald Mineral Spring, Vosburg, Jasper County.
Heidelberg Mineral Spring, Heidelberg, Jasper County.
Mammoth Mineral Springs, Hattiesburg, Forrest County.
Robinson Springs, near Pocahontas, Hinds County.
Stafford Mineral Springs, Vosburg, Jasper County.
Vosburg Lithia Spring, Vosburg, Jasper County.

MISSOURI.

According to statements received from spring owners in Missouri, the output, 608,385 gallons, was 65,493 gallons, or 12.07 per cent, greater for 1912 than in 1911. The value decreased from $86,747 in 1911 to $81,114 in 1912, a loss of $5,633, or 6.49 per cent. The average selling price decreased to 13 cents a gallon, a loss of 3 cents from 1911. About two-thirds of the total output is said to be used medicinally. Five new springs made returns. The total number reporting was 30. At 7 of these springs are resorts accommodating in all about 1,500 people, and the water at 8 springs is used for bathing. In addition to the sales reported, about 213,000 gallons was used in the manufacture of soft drinks.

The following 30 springs made returns of sales:

American Spring, St. Louis, St. Louis County.
B. B. Springs, Bowling Green, Pike County.
Belcher Artesian Well, St. Louis, St. Louis City.
Blue Lick Springs, Blue Lick, Saline County.
Bokert Springs, near De Soto, Jefferson County.
Carrollton Mineral Spring, Carrollton, Carroll County.
Chalybeate Springs, Paris Springs, Laurence County.
Chouteau Springs, near Boonville, Cooper County.
Crystal Lithium Spring, Excelsior Springs, Clay County.
Cusenbary Spring, near Kansas City, Jackson County.
El Dorado Springs, Eldorado Springs, Cedar County.
Grand River Mineral Spring, near Mercer, Mercer County.
Haymaker Spring, Mercer County, near Lineville, Iowa.
Hornet Mineral Springs, Bowling Green, Pike County.
Jackson Lithia Spring, Mount Washington, Jackson County.
McAllister Spring, Sedalia, Saline County.
Musick Spring, Eldorado Springs, Clay County.
Old Orchard Spring, Old Orchard, St. Louis County.
Regent, Siloam, Soterian, and Sulpho-Saline Springs, Excelsior Springs, Clay County.
Salax Spring, Excelsior Springs, Clay County.
Salt Sea Well, Excelsior Springs, Clay County.
Salt Sulphur Well, Excelsior Springs, Clay County.
Sweet Springs, Sweet Springs, Saline County.
Vaile Springs, Independence, Jackson County.
White Springs, Independence, Jackson County.
Windsor Spring, Windsor, Henry County.
Wyaconda Spring, LaGrange, Lewis County.

MONTANA.

Considerable increase was noted in the sales from the three commercial springs reporting in 1912, the total output for 1912 being 160,150 gallons, a gain of 85,400 gallons, or 114 per cent, over that of 1911; the value was reported as $13,198, a gain of $7,210, or 120 per cent. The water at two of these springs is used principally for the table; at one it is used entirely for medicinal purposes, and at two it is used for bathing.

The 3 reporting springs are as follows:

Hunters Hot Springs, Hunters Hot Springs, Park County.
Rock Creek Spring, Red Lodge, Carbon County.
White Sulphur Spring, White Sulphur Springs, Meagher County.

NEBRASKA.

Nebraska reported productions from two springs in 1912. The output of one of the springs was used for the table and for the manufacture of soft drinks. The water of the other spring was used medicinally; the spring is also the site of a resort and the water was used for bathing. The details of production are included with other States having less than three springs.

The names of the 2 springs reporting are:

Brown Park Spring, South Omaha, Douglas County.
Curo Mineral Spring, South Omaha, Douglas County.

NEVADA.

Only one spring in Nevada reported during 1912. The water from this spring is used principally for the table and for the manufacture of soft drinks.

The name of the spring is:

Shoshone Spring, Franktown, Washoe County.

NEW HAMPSHIRE.

Returns from New Hampshire in 1912 indicate that the mineral-water trade suffered a decline, both in quantity and in value. The reported sales amounted to 240,568 gallons, valued at $10,000, as compared with 406,660 gallons, valued at $139,130, reported in 1911, a decrease of 166,092 gallons, or 40.84 per cent, in quantity, and of $129,130, or 92.81 per cent, in value. Of the eight springs reporting one made returns for the first time, the Crystal. By far the greater portion of the water is sold for table use. There are no resorts at any of these springs, nor is the water used for bathing. Exclusive of the reported sales, about 183,000 gallons went into the manufacture of soft drinks.

The names of the eight reporting springs are:

Crystal Spring, East Concord, Merrimack County.
Granite State Springs, Plaistow, Rockingham County.
Lafayette Mineral Springs, Derry, Rockingham County.
Mount Gunstock Spring, Lakeport, Belknap County.
Mount Madison Spring, Gorham, Coos County.
White Mountain Mineral Spring, Conway, Carroll County.
Willow Spring, South Nashua, Hillsboro County.
Wilton Spring, near Wilton, Hillsboro County.

NEW JERSEY.

In New Jersey the mineral-water trade increased 6.83 per cent in quantity and decreased 0.19 per cent in value. The sales reported for 1912 were 2,386,217 gallons, valued at $209,726, compared with 2,233,627 gallons, valued at $210,123, in 1911, an increase of 152,590 gallons, and a loss of $397 The average selling price remained about the same.

The following table shows the output for the last five years:

Production and value of mineral waters in New Jersey, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	13	1,199,023	$126,603	10.6
1909	11	1,419,500	127,025	8.9
1910	11	1,583,050	133,139	8.4
1911	12	2,233,627	210,123	9.5
1912	12	2,386,217	209,726	8.8

Two new springs reported, the Grey Rock and the Indian Lady Hill, in 1912, and two discontinued, there being no change in the number of reporting springs from 1911. None of these springs is used as a resort, nor is the water at any of them used for bathing. Practically the entire output is classed as table water, and about 45,000 gallons of water was reported as being used for making soft drinks.

The following 12 springs made returns of sales:

Alpha Mineral Spring, Springfield, Union County.
Culm Rock Spring, Pluckemin, Somerset County.
Grey Rock Artesian Well, Trenton, Mercer County.
Indian Spring, near Rockaway, Morris County.
Indian Lady Hill Spring, Asbury Park, Monmouth County.
Kailum Spring, Collingswood, Camden County.
Kanouse-Oakland Spring, Oakland, Bergen County.
Pilgrim Spring, Ridgefield Park, Bergen County.
Red Rock Spring, Hackensack, Bergen County.
Trinity Springs, Ridgefield, Bergen County.
Washington Rock Spring, Warrenville, Somerset County.
Watchung Spring, North Plainfield, Union County.

NEW MEXICO.

Of the five springs reporting from New Mexico in 1911, only two reported sales during 1912. The entire output was used for the table. The details of production are included with other States having less than three reporting springs.

The two reporting springs are:

Aztec Spring, Taylor, Colfax County.
Coyote Springs, Albuquerque, Bernalillo County.

NEW YORK.

New York, which leads all the States in the number of commercial mineral springs, quantity of water sold, value of table water, and total value, reported a slight decrease in the volume of business during 1912. The sales were 10,008,801 gallons, valued at $1,034,477, a loss of 236,460 gallons, or 2 per cent, in quantity, and an increase of $95,474, or 10 per cent, in value. There was a small gain in average price per gallon of 1 cent over sales of 1911, the average sale price being 10 cents per gallon in 1912.

The last five years show a record as follows:

Production and value of mineral waters in New York, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	47	8,007,092	$855,148	10.7
1909	52	8,813,563	948,325	10.8
1910	46	8,780,903	858,635	9.8
1911	51	10,245,261	939,003	9.2
1912	57	10,008,801	1,034,477	10.3

Seven new springs were added to the list in 1912, a gain of six reporting springs over the previous year. Only about one-tenth of the total output is said to be used medicinally. Exclusive of the sales, a considerable quantity of the water was used for making soft drinks.

The 1912 list of 51 commercial springs is as follows:

Aldena Park Mineral Wells, Alden, Erie County.
Arlington Spring, Arlington, Dutchess County.
Arrowhead Spring, Weedsport, Cayuga County.
Artesian Lithia Spring, Ballston Spa, Saratoga County.
Baldwin Mineral Spring, Cayuga, Cayuga County.
Black Rock Mineral Spring, Rensselaer, Rensselaer County.
Breesport Spring, Breesport, Chemung County.
Briarcliff Spring, Briarcliff Manor, Westchester County.
Cascadian Spring, Nyack, Rockland County.
Chemung Spring, Chemung, Chemung County.
Clinton Lithia Spring, Franklin Springs, Oneida County.
Cold Springs, Whitesboro, Oneida County.
Comstock Spring, Ballston Spa, Saratoga County.
Crystal Springs, near Oswego, Oswego County.
Deep Rock and Os-We-Go Springs, Oswego, Oswego County.
Diamond Rock Spring, Cherry Creek, Chautauqua County.
Elixir Spring, Clintondale, Ulster County.
Elk Spring, Lancaster, Erie County.
Franklin Lithia Spring, Franklin Springs, Oneida County.
Garden City Spring, Garden City, Nassau County.
Geneva and Red Cross Mineral Springs, Geneva, Ontario County.
Glen Alex Spring, Washington Mills, Oneida County.
Gramatan Spring, Bronxville, Westchester County.
Great Bear Spring, near Fulton, Oswego County.
Greendale Crystal Spring, Greendale, Columbia County.
Hillside Spring, White Plains, Westchester County.
Lithaca Spring, Ithaca, Tompkins County.
Lithia Polaris Spring, near Boonville, Oneida County.
Madrid Indian Mineral Spring, Madrid Springs, St. Lawrence County.
Mammoth Spring, North Greenbush, Rensselaer County.
Mohawk Springs, Amsterdam, Montgomery County.
Mohican Spring, Ballston Spa, Saratoga County.
Mount Beacon Spring, near Matteawan, Dutchess County.
Mount View Spring, Poughkeepsie, Dutchess County.
Orchard Spring, Yorktown Heights, Westchester County.
Pleasant Valley Spring, Rheims, Steuben County.
Real Rock Spring, Breesport, Chemung County.
Red Jacket Mineral Spring, Seneca Falls, Seneca County.
Red Rock Spring, Fine View, Jefferson County.
Saratoga Springs, Saratoga County:
  Arondack Spring.
  Coesa Spring.
  Hathorn No. 1 Spring.
  Hathorn No. 2 Spring.
  Saratoga Gurn Spring.
  Saratoga Vichy Spring.
Setauket Spring, Setauket, Suffolk County.
Shell Rock Spring, near Rensselaer, Rensselaer County.
Sparkling Spring, Buffalo, Erie County.
Split Rock Lithia Spring, Franklin Springs, Oneida County.
Standard Spring, Troy, Rensselaer County.
Sun-Ray Spring, Ellenville, Ulster County.
Trėspur Spring, McGraw, Cortland County.
Valley Spring, near Clayton, Jefferson County.
Vita Spring, Fort Edward, Washington County.
White Sulphur Spring, Richfield Springs, Otsego County.
White Sulphur Spring, Sharon Springs, Schoharie County.

NORTH CAROLINA.

The returns show that the mineral-water trade of North Carolina suffered a decline in 1912, both in quantity and in value. The sales reported amount to 144,708 gallons, valued at $22,385, against

231,510 gallons, valued at $31,108, reported in 1911, a loss of 86,802 gallons, or 37.49 per cent, in quantity and of $8,723, or 28 per cent, in value. The average selling price increased from 13 to 15 cents a gallon.

The number of springs reporting in 1912 remained the same as in 1911. More than four-fifths of the water sold is used medicinally. At 11 of the springs are resorts, accommodating 1,500 guests, and the water at 4 is used for bathing. Only a small quantity was reported used in the manufacture of soft drinks.

The following 16 springs made returns of sales for 1912:

All Healing Springs, Alkalithia Springs, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Spring, Bullock, Granville County.
Connelly Mineral Springs, Connelly Springs, Burke County.
Haywood White Sulphur Spring, Waynesville, Haywood County.
Huckleberry Spring, Durham, Durham County.
Jackson Springs, Jackson Springs, Moore County.
Mida Spring, near Huntersville, Mecklenburg County.
Moores Springs, Moores Springs, Stokes County.
Mount Vernon Springs, Mount Vernon Springs, Chatham County.
Panacea Springs, Warren County, near Littleton.
Seven Springs, Seven Springs, Wayne County.
Shelby Lithia Spring, Shelby, Cleveland County.
Sherrill Mineral Spring, near Harrisburg, Cabarrus County.
Smith Lithia Spring, Oxford, Granville County.
Vade Mecum Spring, Vade Mecum, Stokes County.

OHIO.

The mineral-water trade of Ohio made a decided gain during 1912, the sales rising from 1,958,547 gallons reported in 1911 to 2,709,745 gallons, an increase of 751,198 gallons, or 38.35 per cent; and the value increased from $86,478 to $117,287, a gain of $30,809, or 35.63 per cent. The average price per gallon was the same in 1912 as in 1911.

The record for the last five years follows:

Production and value of mineral waters in Ohio, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	27	2,409,598	$124,938	5.2
1909	31	2,709,060	112,775	4.2
1910	30	2,226,188	95,989	4.3
1911	28	1,958,547	86,478	4.4
1912	30	2,709,745	117,287	4.3

Two new springs reported in 1912 for the first time, the Glenwood Mineral and the Minnehaha Natural Springs. Less than one-fifth of the total output is used medicinally. There are resorts at 4 of the springs and the water at 2 is said to be used for bathing. A considerable quantity was also used in the manufacture of soft drinks.

The 30 reporting springs are as follows:

Beech Rock Spring, near Zanesville, Muskingum County.
Bellmore Springs, near Signal, Columbiana County.
Belmont Spring, Bridgeport, Belmont County.

Chalybeate Spring, Newark, Licking County.
Collingwood Springs, Toledo, Lucas County.
Crum Mineral Spring, Austintown, Mahoning County.
Crystal Spring, Newark, Licking County.
Crystal Fountain Springs, Plainville, Hamilton County.
Deerfield Spring, Deerfield, Portage County.
Fargo Mineral Springs, Ashtabula, Ashtabula County.
Fisher's Magnesia Spring, Clintonville, Franklin County.
Glenwood Mineral Spring, near Chillicothe, Ross County.
Highland Springs, Akron, Summit County.
Maple Grove Mineral Spring, near Chillicothe, Ross County.
Minnehaha Natural Spring, West Park, Cuyahoga County.
Oak Ridge Mineral Springs, Greenspring, Sandusky County.
Painesville Mineral Spring, Painesville, Lake County.
Peerless and Puritas Springs, West Park, Cuyahoga County.
Purtlebaugh Spring, Urbana, Champaign County.
Quakerdale Spring, Colerain, Belmont County.
Reynold's Artesian Well, Greenspring, Sandusky County.
Ripley Bromo Lithia Spring, Ripley, Brown County.
Sandrock Spring, Canton, Stark County.
Spring Grove Lithia Spring, Springfield, Clark County.
Sulphur Spring, Norwalk, Huron County.
Sulphur Lick Spring, Chillicothe, Ross County.
Tallewanda Mineral Spring, College Corner, Preble County.
Wheeler Mineral Spring, Youngstown, Mahoning County.
Woods Lithia Spring, Bridgeport, Belmont County.

OKLAHOMA.

According to returns from spring owners in Oklahoma, the output for 1912 showed a decided gain in both quantity and value, the sales amounting to 1,015,512 gallons, an increase of 518,438 gallons, or 104 per cent, and the value to $32,971, a gain of $18,681, or 130 per cent, over the returns for 1911. The average selling price increased very slightly.

The record since 1908 has been as follows:

Production and value of mineral waters in Oklahoma, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	9	534,114	$52,779	9.9
1909	12	563,475	35,194	6.2
1910	4	115,000	4,950	4.3
1911	10	497,074	14,290	2.9
1912	10	1,015,512	32,971	3.2

Of the 10 springs reporting in 1912, 1 entered the list for the first time, the Standard Well. There is a resort at 1 of these springs accommodating 2,000 patrons, and the water at 3 is used for bathing. A comparatively small quantity of the output is used medicinally.

The list of commercial springs in Oklahoma now covers the following names:

Bromide Spring, Sulphur, Murray County.
Comanche Spring, Comanche, Stephens County.
Guthriewell, Guthrie, Logan County.
Hercules Spring, Guthrie, Logan County.

Kailum Spring, Faxon, Comanche County.
Lewis Lithia Wells, Oklahoma City, Oklahoma County.
Sand Spring, Sand Springs, Tulsa County.
Shanoan Spring, Chickasha, Grady County.
Standard Well, Tulsa, Tulsa County.
Works Excelsior Spring, Comanche, Stephens County.

OREGON.

Sales of mineral water in Oregon amounted in 1912 to 48,351 gallons, valued at $17,503, as compared with 56,300 gallons, valued at $18,000 in 1911, a decrease of 7,949 gallons, or 14 per cent, in quantity and of $497, or 2.76 per cent, in value. One less spring reported, making the number of commercial springs 6 for 1912. With the exception of about 2,000 gallons used medicinally, the entire output is sold for table use. There are resorts at 4 of these springs accommodating 300 patrons, and the water at 3 springs is used for bathing. About 6,000 gallons were reported used in the manufacture of soft drinks.

The names of the 6 reporting springs are as follows:

Calapooya Spring, London, Lane County.
Cascade Mineral Spring, Cascadia, Linn County.
Colestin Spring, Colestin, Jackson County.
Sam-O Spring, Baker City, Baker County.
Selah Spring, Silverton, Marion County.
Siskiyou Spring, Soda Springs, Jackson County.

PENNSYLVANIA.

The record of the mineral-water trade of Pennsylvania for 1912 shows a slight falling off in both quantity and value. The sales reported amounted to 2,192,106 gallons, valued at $204,906, compared with 2,327,732 gallons, valued at $216,819, in 1911, a decrease of 135,626 gallons, or 5.83 per cent, in quantity and of $11,913, or 5.49 per cent, in value. The average price per gallon remained 9 cents.

The following are the statistics of the State since 1908:

Production and value of mineral waters in Pennsylvania, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	32	1,430,489	$180,889	12.6
1909	42	2,177,967	240,856	11.1
1910	44	2,536,337	221,685	8.7
1911	41	2,327,732	216,819	9.3
1912	41	2,192,106	204,906	9.3

The number of new springs reporting sales in 1912 was 4, as follows: Bartlett, Crystal-Cray, Prospect Rock, and Unamis. Nine springs failed to report and 5 reentered the list, making the total number 41, as in 1911. About one-sixth of the total output is used medicinally. There are resorts at 12 of the springs, with accommodations for about 2,000 people, and the water at 6 is used for bathing.

In addition to the water sold, 440,000 gallons were used in the manufacture of soft drinks.

The following 41 springs reported sales in 1912:

Bartlett Spring, Cambridge Springs, Crawford County.
Battering Ram Spring, Berwick, Luzerne County.
Bedford Mineral Springs, near Bedford, Bedford County.
Carnegie Alkaline and Lithia Mineral Spring, Carnegie, Allegheny County.
Chadwick Spring, Cambridge Springs, Crawford County.
Cloverdale Lithia Spring, near Newville, Cumberland County.
Cold Spring, Lotell, Lebanon County.
Colonial Spring, Valley Forge, Chester County.
Colvin White Sulphur Spring, Sulphur Springs, Bedford County.
Crystal-Cray Spring, Stoneham, Warren County.
Deprofundus Spring, Saegertown, Crawford County.
De Vita Mineral Spring, Cambridge Springs, Crawford County.
Dorney Park Spring, Dorney Park, Lehigh County.
East Mountain Lithia Spring, near Factoryville, Wyoming County.
Franklin Lithia Spring, Cambridge Springs, Crawford County.
Glenn Crystal Spring, Harbor Creek, Erie County.
Glen Summit Spring, Glen Summit Springs, Luzerne County.
Gray Mineral Spring, Cambridge Springs, Crawford County.
Harrison Valley Mineral Spring, Harrison Valley, Potter County.
Kecksburg Artesian Mineral Spring, Kecksburg, Westmoreland County.
Keystone Spring, near Taylorsville, Bucks County.
Magnesia Springs, Cambridge Springs, Crawford County.
Magnetic Mineral Spring, Sizerville, Cameron County.
Massassauga Mineral Spring, Erie, Erie County.
Mount Hickory Spring, Sharpsville, Mercer County.
Mount Laurel Spring, Temple, Berks County.
Pavilion Spring, Wernersville, Berks County.
Petticord Spring, Cambridge Springs, Crawford County.
Pocono Mineral Spring, near Wilkes-Barre, Luzerne County.
Polar Springs, Morrisville, Bucks County.
Prospect Rock Spring, Laurel, Luzerne County.
Pulaski Natural Mineral Spring, Pulaski, Lawrence County.
Puritas Spring, near Erie, Erie County.
Ross Common Spring, Ross Common, Monroe County.
Springfield Spring, Springfield Township, Delaware County.
Sylvia White Sand Spring, near Seward, Westmoreland County.
Thurston's Carbonate Spring, Meadville, Crawford County.
Tuckahoe Mineral Spring, near Northumberland, Northumberland County.
Unamis Mineral Spring, Unamis, Somerset County.
Whann Lithia Spring, Franklin, Venango County.
White House Spring, Neversink Mountain, Berks County.

RHODE ISLAND.

No new springs were reported from Rhode Island in 1912, and there was 1 delinquent, making the total number in the commercial list 7. There was a slight decline in the volume of output, the sales decreasing from 503,360 to 466,893 gallons, a decrease of 36,467 gallons, or 7 per cent, from 1911. The value increased about the same ratio, the returns amounting to $29,126, a gain of $2,090, or 7.73 per cent over the previous year, the average price increasing 1 cent to 6 cents a gallon. The entire output was used for the table.

The names of the 7 springs reporting are as follows:

Berry Spring, Pawtucket, Providence County.
Girard Spring, North Providence, Providence County.
Gladstone Spring, Narragansett Pier, Washington County.
Hermit Spring, East Providence, Providence County.
Holley Mineral Spring, East Woonsocket, Providence County.
Ochee Spring, Johnston, Providence County.
Prophet Spring, near Providence, Providence County.

SOUTH CAROLINA.

The returns from South Carolina are notable in showing a decided gain in output. The reported sales amounted to 360,404 gallons, indicating a gain of 75,015 gallons, or 26.29 per cent over the figures reported for 1911, of 285,389 gallons. The value increased from $42,099 to $70,348, a gain of $28,249, or 67 per cent, at an average selling price of 19½ cents a gallon, an increase of 4 cents over 1911. One new spring, Crystal Carbon, entered the list of 15 reporting springs. A little more than half of the total output is used medicinally. Six springs have resorts accommodating 1,000 patrons. A comparatively large quantity of water was used to make soft drinks.

The following 15 springs reported sales:

Antley Springs, St. Matthews, Calhoun County.
Bryan Springs, Young Island, Colleton County.
Buffalo Lick Springs, Carlisle, Union County.
Cherokee Springs, Cherokee, Spartanburg County.
Chick Springs, Chick Springs, Greenville County.
Clementia Spring, near Meggett, Colleton County.
Cokesbury Mineral Spring, near Cokesbury, Greenwood County.
Crystal Carbon Spring, Spartanburg, Spartanburg County.
Glenn Springs, Glenn Springs, Spartanburg County.
Harris Lithia Spring, Harris Springs, Laurens County.
Piedmont Spring, Kings Creek, Cherokee County.
Shivar Spring, Shelton, Fairfield County.
Steele Mineral Spring, Rock Hill, York County.
Turner Magnalithia Spring, Cowpens, Spartanburg County.
Verner Spring, Greenville, Greenville County.

SOUTH DAKOTA.

South Dakota reported productions from 2 springs in 1912, 1 being new, the Culbert. The water of both these springs is used principally for the table, and a large quantity is used to make soft drinks. The details of production are included with other States having less than 3 springs.

The names of the 2 springs are:

Culbert Spring, Aberdeen, Brown County.
Minnehaha Springs, Sioux Falls, Minnehaha County.

TENNESSEE.

Returns received from Tennessee in 1912 showed a decided decline as compared with those of 1911. The sales amounted to 796,568 gallons, valued at $53,560, as compared with 1,073,115 gallons, valued at $72,475, in 1911, a loss of 25.28 per cent in quantity and of 26.10 per cent in value. The average price remained about the same. Two new springs reported, the Paris Mineral Well and the Tucker Springs. Twelve of the 21 reporting springs are resorts accommodating 2,000 guests, and the water at 3 was used for bathing. Nearly four-fifths of the output was used medicinally.

The following 21 springs reported sales:

East Brook Springs, Eastbrook, Franklin County.
Epperson Spring, Macon County, near Westmoreland.
Galbraith Epsom Lithia Springs, Galbraith Springs, Hawkins County.
Gammons Spring, near Tate Spring, Grainger County.
Gladstone Spring, near Chattanooga, Hamilton County.

Hamilton Springs, near Lebanon, Wilson County.
Horn Springs, Horn Springs, Wilson County
Idaho Springs, near Clarksville, Montgomery County.
Larkin Spring, Madison, Davidson County.
Neubert Spring, near Knoxville, Knox County.
Paris Mineral Well, near Paris, Henry County.
Pioneer Lithia Spring, near Nashville, Davidson County.
Red Boiling Springs, Red Boiling Springs, Macon County.
Rhea Springs, Rhea Springs, Rhea County.
Richardsons Lockeland Spring, near Nashville, Davidson County.
Tate Spring, Tate Springs, Grainger County.
Thompson Spring, near Nashville, Davidson County.
Tucker Springs, near Chattanooga, Bradley County.
Whittle Springs, Whittle Springs, Knox County.
Willow Brook Spring, Craggie Hope, Cheatham County.
Wright's Epsom-Lithia Spring, Mooresburg, Hawkins County.

TEXAS.

Returns from the State of Texas indicated a decline in the mineral-water business. The output reported was 1,292,992 gallons, valued at $151,395, a decrease of 344,940 gallons, or 21 per cent, in quantity, and of $6,972, or 4.4 per cent, in value. The average price increased 2 cents, to 11.7 cents a gallon.

The following tables show the statistics of production for the last five years:

Production and value of mineral waters in Texas, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	36	1,586,634	$151,032	9.5
1909	34	1,033,476	98,499	9.5
1910	31	1,241,248	128,549	10.4
1911	40	1,637,932	158,367	9.7
1912	34	1,292,992	151,395	11.7

One new spring, the Olympia, reported in 1912, the total number reporting being 34. Practically the entire output is said to be used medicinally. Resorts are situated at 14 of the springs, accommodating 6,700 patrons, and the water at 11 is reported as being used for bathing. In addition to the sales, a considerable quantity is used in the manufacture of soft drinks.

The following is the list of the 34 springs reporting sales in 1912:

Aqua Vitæ Wells, Nacogdoches, Nacogdoches County.
Brock's Mineral Well, near Denton, Denton County.
Capp's Wells, Longview, Gregg County.
Carlsbad Well, Blossom, Lamar County.
Crystal Spring, Terrell, Kaufman County.
Farrier Spring, Dalby Springs, Bowie County.
Georgetown Mineral Wells, Georgetown, Williamson County.
Ghio Spring, Texarkana, Bowie County.
Hume Sour Water Well, Sutherland Springs, Wilson County.
Key's Wells, Salado, Bell County.
Mangum Wells, Mangum, Eastland County.
Marlin Hot Wells, Marlin, Falls County.
Maurice Wells, Mangum, Eastland County.

Mineral Wells, Palo Pinto County:
- Austin Well.
- Barber Wells.
- Crazy Well.
- Gibson Well.
- Lamar Well.
- Minala Well.
- Olympia Well.
- Rock Bottom Well.
- Star Well.
- Texas Carlsbad Wells.

North Park Mineral Well, Abilene, Taylor County.
Orono Crystal Spring, Oran, Palo Pinto County.
Putnam Mineral Well, Putnam, Callahan County.
Riviere Wells, 1, 2, and 3, Tyler, Smith County.
Roach Well, near Mount Pleasant, Titus County.
St. Mary's Mineral Well, near Hallettsville, Lavaca County.
Sour Wells, Sulphur Springs, Hopkins County.
South Austin Wells, South Austin, Travis County.
Texarkana Lone Star Mineral Well, near Texarkana, Bowie County.
Tioga Mineral Wells, Tioga, Grayson County.
Weatherby Spring, Garrison, Nacogdoches County.

UTAH.

There was no change in the list of mineral springs reporting from Utah in 1912. The details of production are included in other States having less than three operating springs. Neither of the two springs credited to the State is used as a resort. Their names are as follows:

Deseret Lithia Spring, Deseret, Millard County.
Utanah Springs, Wasatch Mountains, Salt Lake County.

VERMONT.

One spring that reported in 1911 was idle in 1912, and no additions were made to the list of commercial springs in Vermont. The sales reported show a decline of 4,200 gallons from 1911 with a loss of $1,066 in value. The total output amounted to 21,000 gallons, valued at $8,280, a loss of 16.67 per cent in quantity and 11.41 per cent in value. The average price increased to 39 cents a gallon. With the exception of water valued at $1,385 for medicinal purposes, the entire quantity sold was for the table. Exclusive of the sales, a considerable quantity of the water was used for soft drinks.

The following 3 springs reported sales in 1912:

Clarendon Spring, Clarendon Springs, Rutland County.
Equinox Spring, Manchester, Bennington County.
White Sulphur Spring, Brunswick, Essex County.

VIRGINIA

Virginia's output of mineral water for 1912 showed a small increase both in quantity sold and in value. The figures for 1912 are 2,762,319 gallons sold at a value of $349,255, an increase of 287,401 gallons and of $50,554 over the production of 2,474,918 gallons, valued at $298,701, reported in 1911. The price of 12 cents a gallon remained the same.

The following table shows the record of production during the last five years:

Production and value of mineral waters in Virginia, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	46	2,009,614	$207,115	10.3
1909	49	1,504,530	203,455	13.5
1910	40	2,441,923	301,523	12.3
1911	43	2,474,918	298,701	12.1
1912	45	2,762,319	349,255	12.6

One new spring, Healing Springs, was added to the list of those reporting, giving Virginia third place in the number of commercial springs of the United States, the same as in 1911, and also third place in the value of medicinal waters sold. Nearly one-half of the output is sold for medicinal use. There are resorts at 11 of the springs, accommodating 1,400 people, and at 6 the water is used for bathing. About 91,000 gallons is used to make soft drinks in addition to the sales.

The 45 springs reporting sales are as follows:

Alleghany Spring, Alleghany Spring, Montgomery County.
Bear Lithia Spring, near Elkton, Rockingham County.
Beaufont Spring, near Manchester, Chesterfield County.
Berry Hill Mineral Spring, Elkwood, Culpeper County.
Blue Ridge Springs, near Blue Ridge Springs, Botetourt County.
Bowman Spring, near Staunton, Augusta County.
Broad Rock Mineral Spring, near Richmond, Chesterfield County.
Brugh Spring, Nace, Botetourt County.
Buckhead Spring, Buckhead Springs, Chesterfield County.
Buffalo Lithia Spring, Buffalo Lithia Springs, Mecklenburg County.
Burnett Spring, Hudson Mill, Culpeper County.
Campfield Lithia Spring, near Richmond, Chesterfield County.
Carper Lithia Springs, Radford, Montgomery County.
Como Spring, East Richmond, Henrico County.
Coppahaunk Mineral Springs, Waverly, Sussex County.
Crockett Arsenic Lithia Spring, Crockett Springs, Montgomery County.
Erup Mineral Spring, near Glencarlyn, Alexandria County.
Farmville Lithia Springs, Farmville, Prince Edward County.
Fonticello Lithia Spring, near Manchester, Chesterfield County.
Harris Anti-Dyspeptic Spring, Burkeville, Nottoway County.
Healing Springs, Healing Springs, Bath County.
Jeffress Spring, Jeffress, Mecklenburg County.
Kayser Lithia Springs, Staunton, Augusta County.
Landale Spring, Norfolk County.
Lithia Magnesia Spring, Rocky Mount, Franklin County.
Magee Chlorinated Lithia Spring, Clarksville, Mecklenburg County.
Massanetta Spring, near Harrisonburg, Rockingham County.
Mecklenburg Spring, Chase City, Mecklenburg County.
Mico Well, Alexandria, Alexandria County.
Mulberry Island Artesian Well, Mulberry Island, Warwick County.
Nye Lithia Springs, Wytheville, Wythe County.
Otterburn Lithia Spring, near Amelia, Amelia County.
Paeonian Spring, Paeonian Springs, Loudoun County.
Pickett Spring, Worsham, Prince Edward County.
Roanoke Lithia Springs, Roanoke, Roanoke County.
Rockbridge Alum Springs, Rockbridge Alum Springs, Rockbridge County.
Rubino Healing Springs, Healing Springs, Bath County.
Seawright Spring, near Staunton, Augusta County.
Stribling Springs, Stribling Springs, Augusta County.
Trepho-Mineral Spring, Claremont, Surry County.

Virginia Etna Springs, Vinton, Roanoke County.
Virginia Lithia Spring, near Richmond, Chesterfield County.
Virginia Magnesian Alkaline Spring, near Staunton, Augusta County.
Wallawhatoola Springs, Millboro, Bath County.
Wyrick Mineral Spring, Crockett, Wythe County.

WASHINGTON.

Washington returns show an increase in quantity and value of business for 1912. The sales amounted to 156,171 gallons, valued at $17,542, a gain of 7,371 gallons, or 4.95 per cent, in quantity, and of $2,888, or 19.71 per cent, in value over 1911, the average price per gallon remaining about the same. The sales were about equally divided for table and medicinal use. No new springs reported in 1912, the same 5 reporting as in 1911, the names of which are as follows:

Artesian Mineral Spring, North Yakima, Yakima County.
Diamond Mineral Spring, Auburn, King County.
Klickitat Spring, Klickitat, King County.
Olympia Hygeian Spring, Tumwater, Thurston County.
Soda Spring, North Yakima, Yakima County.

WEST VIRGINIA.

The returns for the mineral-water industry from West Virginia for 1912 show a gain of 19 per cent in quantity and a loss of 10.70 per cent in value. The sales amounted to 309,245 gallons, valued at $60,445, against 259,686 gallons reported in 1911, valued at $67,687. The average price dropped from 26 cents in 1911 to 19½ cents a gallon in 1912. No new springs reported, and 1 reentered the list, making the total number of commercial springs 11. About half of the water produced is sold for medicinal use. There are resorts at 4 of the springs, accommodating 2,500 patrons, and the water at 2 is used for bathing. In addition to the sales, about 6,000 gallons is used for making soft drinks.

The following are the names of the 11 commercial springs reporting in 1912:

Alderson Spring, Alderson, Monroe County.
Borland Mineral Springs, Borland, Wood County.
Greenbrier Alum Spring, Maxwelton, Greenbrier County.
Green Sulphur Spring, Green Sulphur Springs, Summers County.
Man-A-Cea Irondale Spring, Independence, Preston County.
Pence Spring, Pence Springs, Summers County.
Saline-Chalybeate and Vigoro Springs, Woodsdale, Ohio County.
Walnut Hill Spring, near Charleston, Kanawha County.
Webster Springs, Webster Springs, Webster County.
White Sulphur Springs, White Sulphur Springs, Greenbrier County.

WISCONSIN.

Wisconsin showed a small increase in the output of mineral waters, though the value decreased. The sales reported amounted to 6,045,719 gallons, valued at $869,495, as compared with 5,716,162 gallons reported in 1911, valued at $955,988, an increase of 5.77 per cent in quantity, and a decrease of 9 per cent in value, the average price per gallon for the year being 14 cents as against 17 cents received in 1911. In total value of sales and value of table waters, Wisconsin holds second place in the output for the United States.

The record for the past five years has been as follows:

Production and value of mineral waters in Wisconsin, 1908–1912.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon received.
				Cents.
1908	28	6,084,571	$1,239,907	20.4
1909	34	6,101,882	1,132,239	18.6
1910	36	6,400,812	974,366	15.2
1911	31	5,716,162	955,988	16.7
1912	31	6,045,719	869,495	14.4

One new spring entered the list for the first time, the Willnette, the number reporting in 1912 being 31. By far the greater part of the output was for table use. There are resorts at 4 springs accommodating 1,800 guests, and the water at 3 was used for bathing. In addition to the sales, more than 550,000 gallons were reported as being used in the manufacture of soft drinks.

The following is the list of the 31 reporting springs:

Allouez Mineral Spring, Green Bay, Brown County.
Arbutus Mineral Spring, Oconto, Oconto County.
Bay City Spring, Ashland, Ashland County.
Bethania Spring, Osceola, Polk County.
Bryant Silver Spring, Madison, Dane County.
Castalia Spring, Wauwatosa, Milwaukee County.
Chippewa Spring, Chippewa Falls, Chippewa County.
Crystal Spring, Sheboygan, Sheboygan County.
Darlington Mineral Springs, Darlington, Lafayette County.
Elysian Spring, Prairie du Chien, Crawford County.
Fontana Lithia Spring, Fontana, Walworth County.
Kusche Spring, Oshkosh, Winnebago County.
Lebenswasser Spring, Green Bay, Brown County.
Maribel Mineral Spring, Maribel, Manitowoc County.
Maskanozes Spring, Butternut, Asland County.
Nee-Ska-Ra Spring, Wauwatosa, Milwaukee County.
Sheboygan Mineral Spring, Sheboygan, Sheboygan County.
Sheridan Mineral Springs, near Lake Geneva, Walworth County.
Spring Grove Epsom Spring, Green Lake, Green Lake County.
Waukesha Springs, Waukesha County:
- Anderson's Spring.
- Arcadian Spring.
- Bethesda Spring.
- Clysmic Spring.
- Crystal Rock Spring.
- Fox Head Spring.
- Glenn Rock Spring.
- Horeb Crystal Spring.
- Roxo Spring.
- Silurian Spring.
- White Rock Spring.

Willnette Spring, Cooper Station, Racine County.

WYOMING.

Returns from the two reporting springs of Wyoming indicate a small decline from the two preceding years. At one of the two springs reporting was a resort, and at one the water was used for bathing. The details of output are included with the other States having less than three operating springs.

The two springs reporting are:

De Maris Spring, Cody, Park County,
Red Rock Spring, near Basin, Big Horn County.

TALC AND SOAPSTONE.

By J. S. Diller.

TALC AND SOAPSTONE DISTINGUISHED.

Talc and soapstone are closely related mineralogically. Talc is a definite mineral of which soapstone, as the term is generally used, is only an impure massive form.

Talc is a magnesium silicate, $H_2Mg_3(SiO_3)_4$, containing silica 63.5 per cent, magnesia 31.7 per cent, water 4.8 per cent. It has foliated structure, with pearly luster on its cleavage face, greasy feel, and may be easily scratched by the thumb nail.

In talc schist the folia of talc are arranged approximately parallel to the schistose structure and form rock masses that split readily into flattish fragments. In other places the talc folia are not parallel, but lie in all directions, bind the mass more firmly, and give the rock a coarse to fine granular texture and a massive structure which characterizes soapstone (steatite) and enables it to be sawed into slabs for various manufacturing purposes.

Talc is generally mined in small fragments by underground methods; soapstone is generally quarried in large blocks in open pits. Heretofore in the Survey reports talc and soapstone have been considered together. In the first part of the present report they will be considered together, but in the last part separately.

DISTRIBUTION OF TALC AND SOAPSTONE IN THE UNITED STATES.

The distribution and character of the talc mines and soapstone quarries of the United States are shown on the accompanying maps and list.

Talc mines and soapstone quarries of the United States in 1912, by States and products.

[Numbers refer to locations shown on figs. 1 and 2.]

State.	Material.	Product.	Status.
California:			
1. Lindsay, Tulare County	Talc	Ground	Mine and mill active
2. Zabriskie, Inyo County	do	do	Mine active.
2. Tecopa, San Bernardino County.	do	do	Do.
3. Riggs, San Bernardino County.	do	do	Do.
3. Avawatz, 30 miles northwest of Silver Lake, San Bernardino County.	do	do	Not yet mining.

Talc mines and soapstone quarries of the United States in 1912, by States and products—Continued.

[Numbers refer to locations shown on figs. 1 and 2.]

State.	Material.	Product.	Status.
Georgia:			
4. Chatsworth, Murray County.	Talc	Blanks, pencils, ground.	Three mines; two active, one idle.
Maryland:			
5. Marriottsville, Carroll County.	Soapstone	Rough, slabs, washtubs, ground.	Active, until plant was destroyed by fire.
Bald Friar, Cecil County	Talc	Ground	Mine and mill active.
Massachusetts:			
6. Zoar, Franklin County	do	do	Mine active.[a] Mill burned and rebuilt. Active [a] for seven months.
6. Rowe, Franklin County	do	do	Mine and mill active.
New Jersey:			
7. Phillipsburg, Warren County.	Talc and serpentine.	Rough and ground.	Do.
New York:			
8. Talcville	Talc	Ground	Three mines and mills active.[a]
9. Fullerville	do	do	Mine and mill active.[a]
10. Fowler	do	do	Two mines. Both active.[a]
11. Natural Bridge	do	do	Mine and mill active.[a]
North Carolina:			
12. Kinsey, Cherokee County	do	Blanks, ground	Mine and mill active.
13. Beta, Jackson County	do	Rough and ground	Do.
13. Nantahala, Swain County	do	Rough	Mine active.
13. Hewitts, Swain County	do	Pencils, blanks, ground.	Mine and mill active.
14. Glendon, Moore County	Pyrophyllite	Ground	Three mines and mills active.
15. Piney Creek, Alleghany County.	Soapstone	Slabs	Quarry active.
Pennsylvania:			
16. Easton, Northampton County.	Talc and serpentine.	Rough and ground	Two mines and mills active.[a]
Rhode Island:			
17. Manville, Providence County.	Soapstone	Rough	Quarry active.
Vermont:			
18. Windham, Windham County.	Talc	Ground	Mine, Windham, active. New mill, Chester; completed Nov. 15, 1912; active.
18. Chester (2½ miles northwest), Windsor County.	do	do	Mine and mill active.
18. Chester (3 miles southwest), Windsor County.	Soapstone	Washtubs, etc	Do.
19. Perkinsville, Windsor County.	do	do	Quarry idle; mill active.
19. Reading, Windsor County.	Talc	Ground	Mine and mill practically idle.
20. Stockbridge, Windsor County.	do	do	Mine active.[a] New mill nearly completed.
20. Rochester, Windsor County.	do	do	Mine and mill active.[a]
20. East Granville, Addison County.	do	do	Do.
21. Waterbury, Washington County.	do	do	Mine and mill in construction.
21. Johnson, Lamoille County	do	do	Mine and mill active.[a]
Virginia:			
22. Asbestine, Nelson County	Soapstone	Washtubs, etc	Quarry and mill active.
22. Arrington, Nelson County	do	do	Quarry and mill active.[a]
23. Shipman, Nelson County	do	do	Quarry and mill idle.
23. Elmington Nelson County.	do	do	Do.
24. Schuyler, Nelson County.	do	do	Quarry and mill active.[a]
24. Damon, Albemarle County	do	do	Do.
24. Alberene, Nelson County	do	do	Mill active.[a]
25. Verdierville, Orange County.	Talc	Crayons, blanks	Quarry and mill active.
26. Clifton, Fairfax County	do	Ground	Two mines and mills active.
26. Wiehle, Fairfax County	do	Rough	Mine active.

[a] Production large.

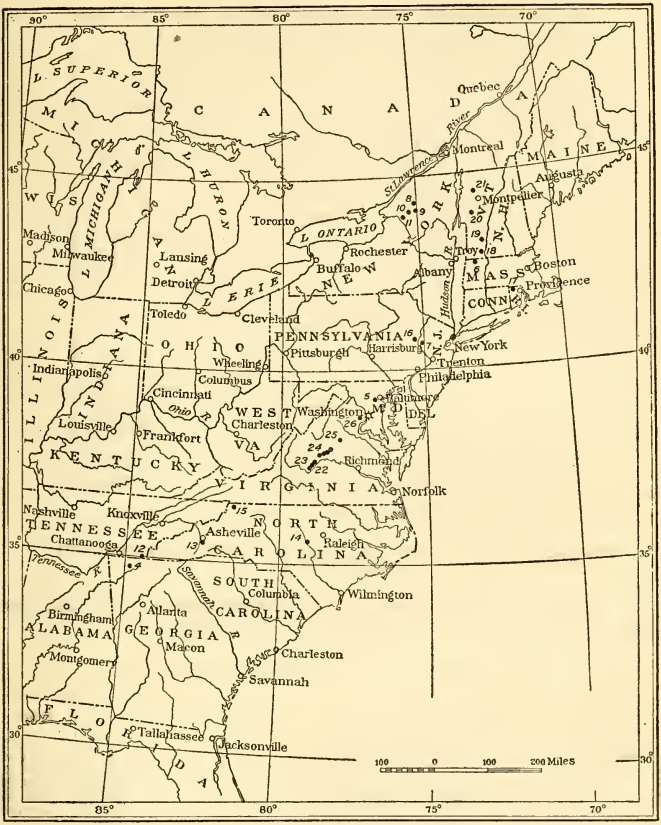

FIGURE 9.—Map of the eastern part of the United States showing distribution of talc mines and soapstone quarries in 1912. Numbers refer to table in text.

FIGURE 10.—Map showing talc mines in California in 1912. Numbers refer to table in text.

DEVELOPMENT OF THE TALC AND SOAPSTONE INDUSTRY.

The following tables illustrate the development of the talc and soapstone industry in the United States since 1880:

Production of talc and soapstone in the United States, 1880–1912, in short tons.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
1880-1900	969,928	$11,224,652	1907	139,810	$1,531,047
1901	97,843	908,488	1908	117,354	1,401,222
1902	97,954	1,140,507	1909	130,338	1,221,959
1903	86,901	840,060	1910	150,716	1,592,393
1904	91,189	940,731	1911	143,551	1,646,018
1905	96,634	1,082,062	1912	159,270	1,706,963
1906	120,644	1,431,556			

The total marketed production of talc and soapstone in the United States during 1912 was 159,270 short tons, an increase of 10.95 per cent as compared with the production of 1911. In the following table this production, with the per cent of increase or decrease with reference to 1911, and its value are shown by States. The succeeding table shows the production in marketed forms from 1909 to 1912. Rhode Island produces soapstone alone. The other States, except Maryland, North Carolina, Vermont, and Virginia, produce talc only.

Marketed production of talc and soapstone in the United States, 1911–12, with increase and decrease in 1912, in short tons.

State.	1911		1912		Increase (+) or decrease (−) in quantity, 1912.	Percentage of increase (+) or decrease (−) in quantity.	Increase (+) or decrease (−) in value, 1912.	Percentage of increase (+) or decrease (−) in value.
	Quantity.	Value.	Quantity.	Value.				
California	(a)	(a)	1,169	$15,653	+ 1,027	+723.24	+$13,949	+818.60
Massachusetts	7,642	$36,883	(a)	(a)	(a)	(a)	(a)	(a)
New Jersey and Pennsylvania	12,131	54,319	10,400	50,519	− 1,731	− 14.27	− 3,800	− 7.00
New York	62,030	613,286	66,867	656,270	+ 4,837	+ 7.71	+ 42,984	+ 7.01
North Carolina	3,548	57,101	3,542	63,304	− 6	− 0.17	+ 6,203	+ 10.86
Vermont	29,488	200,015	42,413	275,679	+12,925	+ 43.83	+ 75,664	+ 37.83
Virginia	26,759	660,926	25,313	576,473	− 1,446	− 5.40	− 84,453	− 12.78
Other States [b]	1,953	23,488	9,566	69,065	+ 113	+ 1.20	+ 10,398	+ 17.68
Total	143,551	1,646,018	159,270	1,706,963	+15,719	+ 10.95	+ 60,945	+ 3.70

a Included in other States.
b Includes California, Georgia, Maryland, and Rhode Island, 1911; Georgia, Maryland, Massachusetts, and Rhode Island, 1912.

Marketed production of talc and soapstone in the United States, 1909–1912, in short tons.

Condition in which marketed.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
	1909			1910		
Rough	27,412	$79,499	$2.90	15,425	$56,872	$3.69
Sawed into slabs	2,893	54,009	18.67	9,352	78,042	8.34
Manufactured articles [a]	22,646	502,447	22.19	22,363	503,391	22.51
Ground [b]	77,387	586,004	7.57	103,576	954,088	9.21
Total	130,338	1,221,959	9.38	150,716	1,592,393	10.57
	1911			1912		
Rough	13,304	$56,387	$4.24	15,510	$66,798	$4.31
Sawed into slabs	3,504	70,641	20.16	2,642	50,334	19.05
Manufactured articles [a]	23,179	660,219	28.48	21,557	600,105	27.84
Ground [b]	103,564	858,771	8.28	119,561	989,726	8.28
Total	143,551	1,646,018	11.47	159,270	1,706,963	10.72

a Includes bath and laundry tubs; fire brick for stoves, heaters, etc.; hearthstones, mantels, sinks, griddles, slate 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.

The importance of the talc and soapstone industry as compared with that of other countries is illustrated by the following table of the world's production. The figures for 1911 and 1912 are not yet complete, but it will be noted that the United States contributes more than all the other countries combined.

Production of talc and soapstone in the principal producing countries, 1904–1911, in short tons.[a]

Country.	1904	1905	1906	1907	1908	1909	1910	1911
United States [b]	91,189	96,634	120,644	139,810	117,354	130,338	150,716	143,551
Argentine Republic [c]				28	7			(f)
Austria [c]								15,212
Canada [c]	840	500	1,234	1,534	1,016	4,350	7,112	7,300
France [d]	23,206	25,956	29,061	38,262	37,053	38,433	42,316	44,092
German Empire (Bavaria [e])	1,884	2,064	2,131	2,203	2,424	2,567	3,398	3,782
India [e]	19	13	11	9	856	652	274	(f)
Italy [c]	7,716	7,154	9,624	13,574	12,048	13,228	13,727	17,218
Spain [e]	5,693	4,810	3,978	15,294	5,214	6,154	(f)	(f)

[a] Figures 1904–1910 taken from mines and quarries: General Rept. and Statistics, pt. 4, London, except Italy, the latter being credited to Rivista del Servizio Minerario, Rome. Figures for 1911 taken from The Mineral Industry, New York, and Production der bayerischen Bergwerks, Hütten und Salinentriebe im Jahre 1911.
[b] Talc and soapstone.
[c] Talc.
[d] Talc, soapstone, and asbestos.
[e] Soapstone.
[f] Statistics not available.

This large production accounts for a considerable export trade, especially in grades suitable for the manufacture of paper.

The production of the best grades of talc in the United States such as are used for toilet powders, electric insulators, gas tips, and the like is not equal to the demand, which is supplied chiefly by importations from Italy and France.

TALC.

PRODUCTION.

The production of talc in the United States, California excepted, is limited to the belt of crystalline rocks extending more or less continuously through the Atlantic States from Vermont to Georgia. The 10 producing States are California, Georgia, Maryland, Massachusetts, New Jersey, New York, North Carolina, Pennsylvania, Vermont, and Virginia.

The total marketed production of talc for 1912 was 133,289 short tons, valued at $1,097,483, a decided increase as compared with the production of 1911.

The relative rank of the producing States as to quantity and value of the production in 1912 is given in the following table. The production of Pennsylvania and New Jersey, and also that of Georgia, Maryland, and Massachusetts, are combined to conceal the output of individual producers.

Quantity and value of the talc produced and marketed in the various States in 1912, in short tons.

Rank and State.	Quantity.	Value.	Rank and State.	Quantity.	Value.
1. New York	66,867	$656,270	5. North Carolina	3,492	$63,004
2. Vermont	41,270	245,679	6. Virginia	3,255	17,186
3. Pennsylvania and New Jersey	10,400	50,519	7. California	1,169	15,653
4. Georgia, Maryland, and Massachusetts	6,836	49,172	Total	133,289	1,097,483

New York continues to be the leading producer, with an output of more than 52 per cent of the total production of the United States, and far outranking all other States except Vermont, which has in recent years greatly increased its production.

Of the total output, by far the greater portion, 121,171 short tons, was sold as ground talc; 463 tons were sold as pencils or blanks for making gas tips, etc., and 11,655 tons were sold rough as it came from the mine.

The variation in the annual production of the different States, although due in part to irregularities in the available deposits, which are in most States large, depends also on the market demand.

IMPORTS.

The total imports of talc for consumption in 1912 were 10,989 short tons, valued at $122,956, an increase of 54 per cent in quantity and of nearly 40 per cent in value as compared with the corresponding imports for 1911.

Talc imported for consumption into the United States, 1903–1912, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1903	1,791	$19,677	$10.99	1908	7,429	$97,096	$13.07
1904	3,268	36,370	11.13	1909	4,417	56,287	12.74
1905	4,000	48,225	12.05	1910	8,378	106,460	12.71
1906	5,643	67,818	12.02	1911	7,113	88,050	12.38
1907	10,060	126,391	12.56	1912	10,989	122,956	11.19

As shown by the accompanying table, 38 per cent of the imported talc came from Italy, nearly 36 per cent from France, 18 per cent from Canada, and 7 per cent from Austria-Hungary.

Imports of talc, ground or manufactured, into the United States, 1912, by countries, in short tons.

Country.	1912		Average price per ton.	Country.	1912		Average price per ton.
	Quantity.	Value.			Quantity.	Value.	
Argentina	1	$25	$25.00	France	3,941	$20,260	$5.14
Austria-Hungary	774	18,224	23.55	Germany	7	261	37.29
Belgium	7	133	19.00	Italy	4,184	61,640	14.73
Canada	1,974	21,045	10.66				
England	101	1,368	13.54	Total	10,989	122,956	11.19

The production of talc in Canada in 1912 was 8,270[1] short tons, of which nearly 24 per cent, 1,974 tons, came to the United States, as compared with 816 tons imported from Canada in 1911.

The imported talc is chiefly of the higher grades, such as is used for making toilet powder, gas tips, etc., for which purposes the supply in the United States is not equal to the demand.

PRICES.

The highest priced talc is that which is manufactured into pencils and blanks for insulators and burners. In manufactured form it ranges in value from $40 to $248 per ton. Pyrophyllite in the same form and grade is less valuable than talc.

The highest average price for ground talc, $12.62 per ton, is reported from the Pacific coast, and near it ($12.06) stands the average price of the best grade of ground talc from western North Carolina. The

[1] Preliminary report on the Mineral Production of Canada during the calendar year 1912.

ground fibrous talc of New York averages nearly $10 a ton, and the averages for the other States range from $5 to nearly $7 a ton; but it should be understood that the lowest average is considerably above the lowest selling price. The lowest prices are in the regions of most active competition and result from overproduction.

In the market report in the Journal of Industrial and Engineering Chemistry, under "Wholesale prices of standard chemicals," American talc is quoted throughout the year 1912 at $15 to $20 a ton, and soapstone in bags at $10 to $12 a ton.

The general condition of trade in the talc industry is regarded by some of the large producers as "showing some improvement over 1911, caused to a large extent by the manufacturers of news print papers facing an unsettled condition in the clay industry abroad, and this has opened a market for our better grades of talc, selling around $6 and $7 per ton."

USES OF TALC.

The properties of talc which render it useful for many purposes are its foliated or fibrous structure, its softness, its whiteness or light color and luster, its medium weight, its sectile and flexible but not elastic quality, its greasy feel, its low conductivity but high absorption of heat and electricity.

The uses of talc are many, and as there are large resources available to maintain continued production its uses may be extended with advantage to both producer and consumer.

By far the most important use of talc is in the manufacture of paper. Paper is made from cotton, linen, and hemp rags and waste, from chemically prepared woods, from straws, and from woods not chemically prepared.[1] In order that the paper made by a series of chemical and mechanical processes may be written or printed on without the ink spreading over the sheet it is necessary to size it by adding starch, rosin, or glue. As paper made of these materials only is more or less transparent, a feature which is particularly objectionable in paper for printing, white mineral fillers are used to render the paper opaque. China clay has long been used for this purpose, but the advantages of talc, especially fibrous talc, are recognized, and talc is gradually replacing the clay in the manufacture of paper. In the United States talc, especially in the fibrous form, is used mainly as a filler for book and writing paper.

In Austria-Hungary much attention has been given to the use of talc in the manufacture of paper, and an article [2] on that subject has been compiled at the request of the Union of Talc Operators of Austria-Hungary by Heinrich Rosenberg, with the advice and assistance of prominent paper experts.

The following notes have been compiled from a translation of this article made in the Survey. It must be remembered, however, that the conditions described and opinions stated in these notes are not domestic but foreign:

> The mineral fillers used in the manufacture of paper have not only the property of loading the paper, but they give the paper its necessary whiteness, opaqueness, absorption, and capacity for polish. Some authorities consider that minerals have been wrongfully called fillers because they not only serve as fillers, but when rightly used improve the quality of the paper for certain purposes.

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[1] Veitch, F. P., Suitable paper for permanent records: Yearbook U. S. Dept. Agr., 1908, p. 262.

[2] Die Verwendung von Talkum in der Papierfabrikation: Sonderabdruck aus der Festnummer des "Wochenblatts für Papierfabrikation," 1912.

All attempts in Austria-Hungary to manufacture Chinese absorbent paper failed until talc was used, nor did they succeed in making a really superior quality of paper for rotation printing or for fine art printing until fine talc was used.

Talc was used with wood pulp to make blotting paper and cartridge paper.

It is much easier to produce a heavily sized paper than to meet the requirements for printing and blotting. But this is made possible by the use of mineral fillers, and for papers for the higher kinds of typography talc easily takes first place. Its opaqueness and yield under normal conditions of recovery from waste water are very marked.

Views as to the use of minerals differ widely. Essential facts are not numerous either in practice or in the literature of the subject. The result is that with increasing competition the paper manufacturers make more or less effort to keep secret the results obtained.

It may be uncertain whether the use of greater quantities of starch, water glass, casein, etc., is suitable for binding the minerals; but this much is sure, that the extremely fine particles of talc stick fast in the material, whether it be rag or surrogate, even though little or no binder of this sort is used. No mineral equals talc in superficial attraction (Oberflächenanziehung), and in combination with the indispensable resin milk (Harzmilch) talc offers a relatively strong resistance to the penetration of water into paper surfaces. A well-known lithographer said a short time ago that the paper made with talc which had been delivered to him fulfilled in every respect the strictest requirements. I became convinced of the special retention (Haftenbleiben) of talc in paper by an importation of Chinese specialties in a paper factory. A microscopic section of absorbent paper containing both kaolin and talc showed a retention of more than twice as much talc as kaolin.

The results obtained in papers for art printing with a content of ash of 15 per cent (19 to 20 per cent was put into the cylinder) were surprisingly good. The fine paper thus produced may be regarded as first quality lithograph paper, as it is adapted for the softest half tones as well as for the deepest shadings and the heaviest colors.

Below is given a statement of the action of talc in the various processes pertaining to paper manufacture and also an exposition of the various kinds of paper, with a brief discussion whether talc can be utilized therefor, and if used what beneficial effects on the various papers result.

Talc in paper effects a more uniform distribution of the moisture, improves the polishing, rolling, and cutting as well as the strength of the paper. Of the various forms of paper in the manufacture of which talc is used this article mentions 36.

In writing paper it improves the quality and facilitates erasures. Small quantities of talc may be used to advantage in document paper and book paper. The use of fine grades of talc in making the thicker letter papers produced a fine quality which could hardly be distinguished from the best rag product. The same is true of typewriter paper and letterpress copying paper. Envelope paper, like certain wrapping papers, must have the characteristics of rag paper, and in such case talc was used with highly satisfactory results.

On account of its high absorption talc is recommended for use in the manufacture of filter papers, blotting papers, and porous papers generally where a good degree of absorption is desired.

Talc is used to advantage in a wide range of wrapping papers, particularly in those in which a high percentage of ash is not objectionable. Talc has a decided superiority over kaolin and gypsum.

As music papers are much exposed to the light the papers heavily filled with talc have proved particularly popular because of the opacity of talc.

Talc is being more and more used for photochemic and autotype papers, as well as for lithographic printing papers, map printing, illustration, and advertising papers, for roofing, sheathing, and wall papers.

Since talc increases the printing capacity and diminishes the transparency and gives to the paper a better character it is suited both for flat and for rotary newspaper printing presses. The advantages especially appear in dealing with rather thin newspapers with which transparency is the difficulty and where a plastic appearance of the printing is desired.

In a large Scandinavian paper factory Chinese and Japanese absorbing papers were made from French, American, and Styrian talc. Eighty per cent of the French talc, 85 per cent of the American talc, and 90 to 95 per cent of the Styrian talc remained in the paper. Since under similar conditions with these kinds of paper only 35 per cent of kaolin remains in the paper the superiority of talc was shown beyond question.

It is stated by some of the large producers of talc in the United States that general conditions of trade show some improvement over 1911, caused to a large extent by the manufacturers of newsprint papers facing an unsettled condition in the clay industry abroad and that this has opened a market for the better grades of American talc. It is believed that the time is not distant when the American paper manufacturers following the lead of some of those abroad will more readily accept talc as a better filler than clay because of its higher retention, its fibrous and strengthening qualities, and its quick absorption of the inks in presswork, qualities which are being demanded by the press and by printers generally.

One of the uses of talc for which there is a large demand is in the manufacture of rubber. Talc is not only mixed in the rubber throughout its body, to the deformation of which the soft slippery particles readily adjust themselves, but it is used on the surface to free the rubber from the molds.

There is an important use of talc in sizing and bleaching cotton cloth. It is claimed by at least some of the producers in Moore County, N. C., that for bleaching, pyrophyllite is better than talc.

On account of its high insulating qualities with reference to both electricity and heat talc is employed in the manufacture of many forms of insulators, among which may be mentioned the covering of electric wires, switchboards, and the flooring for electric stations. A considerable content of fine grains of iron ore may be expected to impair the talc for electric insulators. However, the injurious particles of iron ore may be removed, apparently, as from asbestos, by treatment with phosphoric acid according to United States patent No. 1049972, granted to W. C. Arsem January 7, 1913.

Talc is said to be used in the manufacture of certain forms of shade cloth and curtains, and it forms an important ingredient in many soaps, especially the lower grades. Its slippery feel fits it to be used alone or mixed with oil for lubricators. In dry form it is commonly used to dust into gloves or shoes, as well as into tubes or conduits through which other bodies are to be moved.

In the manufacture of toilet powders it has a wide application, and in its purest form is used for medical purposes.

Much powdered talc is used in the manufacture of paints, particularly of waterproof paints, as well as for foundry facing in casting iron. It is also used in dressing skins and leather and in the ceramic arts.

Considerable fibrous talc is used by the manufacturers of gypsum [1] wall plasters, in which as a binder it takes the place of hair, asbestos, or wood fiber. It is used also for covering steam pipes.

The talc for which there is perhaps the greatest demand in the United States is the compact variety used for pencils, gas tips, and high-grade insulators.

COMMERCIAL TALC.

Some of the large producers have one or more trade names, such as "Verdolite," "Asbestine," "Agalite," and "Talclay," by which their special products are known in the market, but all these products are included under "commercial talc."

Much of the material included under commercial talc does not belong to that mineral species. Perhaps the most common material of this sort is pyrophyllite, which resembles talc so closely that it is

[1] Newlands, D. H., The mining and quarry industry of the State of New York, production in 1911: Bull. Education Dept. No. 522, July 1, 1912.

not easily distinguished by the naked eye. Chemically, however, the difference is great—talc is a silicate of magnesia, $H_2Mg_3Si_4O_{12}$; pyrophyllite is a silicate of alumina, $H_2Al_2Si_4O_{12}$.

Fibrous talc is generally derived by alteration from fibrous tremolite. Where the alteration to talc is not complete the two minerals are closely associated. Both are mined, but are for the most part separated. The fibrous tremolite, being hard, yields a more gritty powder than talc, and it is more difficult than talc to reduce to uniform fineness.

In some localities talc is derived from the alteration of serpentine. A large proportion of serpentine is associated with the talc, and hence finds its way into the commerce of the talc industry.

MODES OF OCCURRENCE.

There are three distinct modes of occurrence of talc—(1) as an altered sedimentary rock; (2) as an altered igneous rock; (3) as a definite vein. The first two modes of occurrence are of commercial importance; the third mode though yielding the purest talc is of little if any commercial significance.

Distinct as these three modes of occurrence appear to be, yet on account of the fact that talc is associated with highly disturbed and altered rocks, it is not always easy to determine the mode of particular occurrence, especially when the talc is not associated with belts of limestone. However, as the most important bodies of commercial talc are either within or near belts of limestone with which they are approximately parallel it seems probable that the greater portion of commercial talc is derived from the alteration of sedimentary rocks.

Talc as an altered sedimentary rock.—This mode of occurrence is best illustrated in the Gouverneur region of New York, where the origin of the material has been studied in detail by C. H. Smyth, jr.,[1] and more recently by D. H. Newlands,[2] from whose account the following is abstracted:

The rocks belong to same general classes as compose the central Adirondack region described in other reports. "The talc deposits are associated immediately with crystalline limestone and schists of Grenville age." Three belts are mentioned. One, the largest, begins in Antwerp, Jefferson County, and crosses the towns of Gouverneur and De Kalb in St. Lawrence County, and has important marble quarries at Gouverneur:

> The second belt, 12 miles long and from 1 to 3 miles wide, is found a few miles to the east, in the towns of Fowler and Edward. It is this area that contains the fibrous talc deposits. The third belt, to the south and east of the latter and lying across the St. Lawrence and Lewis County line, includes the Natural Bridge talc occurrence that has been recently under development.
>
> The limestones are bordered by members of the Adirondack gneisses, some of which are light in color and have the composition and appearance of slightly modified granites and diorites. A very prominent member in the stretch between Gouverneur and the talc district is a dark hornblende variety, which is usually well laminated and garnetiferous and is injected by light red granite. In places the granite forms a branching network that incloses the darker rock in its meshes, producing a mosaic pattern. These granite injections are no doubt offshoots of some of the larger bodies

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[1] Report on four townships in St. Lawrence and Jefferson counties, N. Y. State Mus. Rept. 47, 1894, pp. 491–515. Also Report on talc industry of St. Lawrence County, N. Y. State Mus. Rept. 49–2, 1898, pp. 661–671.

[2] The mining and quarry industry of the State of New York; Production of 1911: Bull. Education Dept., No. 522, 1912, pp. 91–100, July 1.

of that rock, while the darker gneiss may belong to the sedimentary series. Of the general relations of the gneiss group it can be said that the igneous types are apparently the youngest and are all later than the limestones. It is not clearly demonstrated as yet whether any of the gneisses in the region are older than the Grenville.

The talc deposits occur along minor belts within the Grenville limestones and schists. They are locally called veins and have been described as such by some writers, though they have nothing in common with mineral veins, being layers or beds included within the limestones. They have the same strike and dip as the latter and show a fair degree of regularity and persistence. In thickness they range from seams of a few inches up to 50 feet or more. The dip is uniformly to the northwest at angles that vary usually between the limits of 30° and 60°.

The associated schists are mainly composed of tremolite, but in some places carry considerable quartz. They are singularly free from other minerals. The tremolite is white or light gray in color and is usually developed in finely fibrous individuals, which when felted form a compact and tough rock. The pink variety, known as hexagonite, is of limited occurrence. Bands and irregular masses of the tremolite occur within the talc deposits and the immediate walls generally consist of the schist, the border being marked by alternating layers of talc and schist.

The association is suggestive of the derivation of the talc, which has been the subject of study by C. H. Smyth, jr.[1] The tremolite is no doubt the parent mineral. As explained by Prof. Smyth, the limestones were originally impure calcareous sediments and by metamorphic influences have taken on a crystalline character and became impregnated with silicates. Certain limestone beds seem to have contained sufficient magnesia and silica to permit their complete transformation to tremolite, forming a tremolite schist, while other layers, with a predominance of lime, have undergone a partial change, showing scattered crystals and aggregates of silicates within the limestone. The subsequent change of tremolite to talc is the result of weathering and takes place through the agency of ground waters holding carbon dioxide. The alteration may be formulated chemically as follows: $CaMg_3Si_4O_{12}+H_2O+CO_2=H_2Mg_3Si_4O_{12}+CaCO_3$. The change is accompanied by an increase in volume of talc and calcite, amounting to 25.61 per cent, though if the talc above is considered there is a decrease of 0.83 per cent, as compared with the tremolite. There is little or no calcite in the talc, so that it probably has been removed with the progress of the alteration.

The talc is really a pseudomorph after tremolite, and it is due to this that it possesses a fibrous character. Microscopic examination of specimens from almost any of the mines will show a little residual tremolite in the centers of the fiber aggregates, and in some samples there is a very considerable proportion of unaltered mineral. Foliated talc accompanies the fibrous variety, being more abundant apparently the further the process of alteration has gone. It is of course a separate development deposited by the circulating waters which have taken the materials of the schists into solution.

The view that the tremolite has been formed by metamorphism from the ingredients of the limestones without addition of material from other sources is perhaps the least conclusive part of the explanation given. This entails a rather unusual chemical composition that is hardly in conformity with the character of the limestones in the district. As a rule they are not particularly siliceous or impure. An alternative to this view which would seem equally probable in the circumstances may be found in the introduction of silica and magnesia along certain beds by underground circulation fter the limestones were formed.

The high-grade talc of western North Carolina occurs in essentially the same way as that of New York. Arthur Keith, of the United States Geological Survey, has described it in the Nantahala folio.[1]

The talc bodies are lenticular, ranging in size from a mere fiber up to 50 feet in thickness and several hundred feet in length. It is closely associated with more or less crystalline limestone and is in general more compact than that of New York, so as to be suitable for cutting into various shapes.

Although many lenses of talc have been found in the limestone belt throughout a distance of nearly 50 miles, the lenses are for the most part small, and but few mines have been developed.

Talc as an altered igneous rock.—Talc derived from the alteration of basic igneous masses has been found at many places among the

[1] Keith, Arthur, Nantahala folio (No. 143), Geol. Atlas U. S., U. S. Geol. Survey, 1907.

older crystalline rocks from New England to Georgia. Keith has mapped and described such occurrences in North Carolina in the Mount Mitchell, Nantahala, and other folios. The talc is commonly associated with soapstone. In most cases there were found in addition to talc a number of other silicates containing magnesia, such as chlorite and varieties of hornblende. As a rule the talc is equaled or exceeded in quantity by the other silicates. The purer soapstone and talc are usually found on the borders of the mass.

Although the available amount of talc of this class, as shown by Keith in the folios referred to above, is considerable, but little is now produced.

One of the most notable of this class of occurrences is the talc mined in the vicinity of Chatsworth, Ga., where, according to Otto Veatch,[1] the talc results from the alteration of peridotite, which has been intruded into quartzite and quartz schist.

QUARRYING AND MINING TALC.

Where talc is won from the ground on a small scale only, as at many points in the Southern States, it is taken out of open cuts, practically quarries; but where the operations are more extensive, it is usually obtained from underground workings in veritable mines.

As the talc generally occurs in the form of an inclined layer or sheet the method usually employed is to run an incline on the dip and stope from levels. Talc is a slippery mineral, and proper support requires large pillars. Compressed air is used to operate the drills generally, but the rock is in many places so soft that it can be bored.

PREPARING FOR MARKET.

The first operation in preparing the material for market consists in assorting the material mined so as to get together all that which is for the same grade. In a few mines, all in the Southern States, there is a small quantity of talc of a grade suitable for cutting and carving into various forms. After this grade of material is picked out, all the remainder is ground. In many mines only one grade is produced, and in order to maintain a uniform standard of ground talc output the selection consists in rejecting that which is off-color. Where several grades based on quality are produced the assorted material is milled separately. Difference in color is generally the basis of selection, and as many as half a dozen color grades may be found in the same mine.

The milling process consists in drying, crushing, grinding, and grading the material. In the great majority of mills the only drying practiced is exposure in covered storage, but a few mills have steam pipes on floors. In the most rapidly running mills only the fines are steam dried.

Jaw crushers are used in a few mills before rotary crushers or rolls, which reduce the rock to $\frac{1}{4}$-inch fragments or less. In some other mills the rotary crusher is the only machinery used before the grinder. Among the crushers used are the Sturtevant, Raymond, Buchanan, Gardiner, and others.

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[1] Mineral resources of Georgia, 1910, p. 187.

From the crusher of one form or another the material goes to the grinder, which is not only the most important instrument in the reduction of talc rock to fine particles, but is the one of greatest variety of form and principle.

The simplest grinders are ordinary burrstones like those introduced many years ago from flour mills in New York and still used very effectively in portions of the Southern and Middle States. Considering their economy and efficiency, it is a wonder that they are so largely replaced by later forms of mills.

In the great talc region of New York the grinder which has been for years considered essential to the industry is the cylindrical pebble mill, because it presents the largest extent of efficient grinding surface with a given expenditure of energy.

First was introduced the plain cylinder pebble mill, long or short, with intermittent or continuous feed, but later came the conical pebble mill with different-sized pebbles. The conical mills are less used for final grinding than the cylindrical mills, but the practice of using a series of different-sized pebbles in a succession of cylinders is said to yield good results as to quantity and finish, although it requires larger power.

The grinders which are the most widely used to pulverize talc in the United States are the Sturtevant mills and the Raymond mills, and both have their warm advocates. Besides these the Abbe, the Holmes-Blanchard, and other mills are employed locally.

Talc flour is made up of grains of talc of many sizes, and for those uses requiring a uniform size of grain (mesh) it is necessary so to grade the flour that all the grains of the same size may be together to make one grade.

Bolting and screening have generally been resorted to with partial success as a means of grading, but much attention has been given also to the use of air currents for this purpose, and many forms of separators more or less pneumatic have been devised and patented.

A pneumatic process has been sucessfully applied for many years to the milling of asbestos both in the United States and Canada; but when applied to talc, which is generally foliated instead of fibrous, the process has not always given satisfactory results.

A large part of the ground talc produced in the United States is used in the manufacture of paper, and it is important that the ground talc should be so prepared as to facilitate advances in the paper industry. For the latest machines used in the manufacture of paper the talc should be free from grit and uniformly fine so as to avoid friction and consequent wear of parts in rapid motion.

In the report on the production of talc in 1910 there was published a brief account of the pneumatic separation as applied so successfully by the Massachusetts Talc Co. at Zoar, Mass. The mill has since been burned but will soon be rebuilt, following essentially the plan described in the previous report, from which the following is taken:

The talc rock is crushed to ¼-inch size and under, then conveyed to ore bin, where it is discharged into vertical pulverizing, emery, and burrstone mill with center feed. Here it is finely ground, thence conveyed to loft storage, from which it is discharged into an octagonal collector whose bottom is funnel shaped. The ground material drops upon the apex of a conical spreader within the collector. The heavier particles naturally fall the quickest and are returned through the funnel to the mill for regrinding. The finer particles are caught up in the circulating air within and carried around within the collector until it is completely filled with fine particles.

Here the first strong air blast is applied by suction at a point about midway of the depth of the octagonal part of the collector. The material is thence withdrawn and discharged into a second collector, where it falls upon a second conical spreader and then repeats its first movement. The funnel-shaped hopper at the bottom of this second collector discharges the heavier particles into bags ready for shipment.

A second lighter blast is applied by suction within the second collector, about midway between center and top of the octagonal part, and the particles are withdrawn and carried into the third collector. As the particles have become very small and require more space for equalizing the float, the third collector is of larger dimensions, with hopper bottom, where the next finer grade is collected and bagged for shipment.

The third or final air blast, of greater force than either the first or the second blasts, is here applied by suction, the intake being at the extreme top of the octagonal part of the collector. The lightest or impalpable particles float nearer the top and, as before, the heavier particles descend into another hopper ready for bagging, thus furnishing our third finer grade, the impalpable particles being discharged into flumes of porous textile, thus permitting the air to escape sufficiently to prevent any back pressure within the system, and the material is discharged into hopper, ready for bagging. This is the last and finest mesh obtainable.

We have thus obtained four entirely different sizes of finished product, four entirely different colors, the last being the lightest, the first the darkest, and each of a uniform mesh, the entire process of which is automatic in operation; and from the time the rock is fed into the crusher until all four grades are milled requires less than 10 minutes.

Any desired meshes can be obtained by this process by regulating the pulverizing mill and then opening or closing the blast gates that control the vacuum or velocity required.

The practices of no two talc mills are exactly alike. Each mill varies according to the circumstances of its operator and environment. This feature may be illustrated in a general way by a series of flow cards without publishing the methods and arrangement of any particular mill. Each flow card may be taken with certain exceptions as the general practice of a region. No. 1 illustrates the practice of New York, No. 2 of New England, and Nos. 2 and 3 of the Southern States.

No. 1.

Storage
↓
Jaw crusher
↓
Rolls
↓
Conical pebble mill
↓
Cylindrical pebble mill
↓
With or without bolts
↓
Bags.

No. 2.

Storage
↓
Steam drier
↓
Jaw crusher
↓
Rotary crusher
↓
Elevator
↓
Sturtevant or Raymond mill
↓
Air separator consisting of one to three collecting chambers, fans, and porous textile flumes.
↓
Bags.

No. 3.

Storage
↓
Rotary crusher
↓
Elevator
↓
Storage bins
↓
Burrs
↓
Elevator
↓
Short pebble mill → Bags
Bolts → Bags

TALC INDUSTRY BY STATES.

CALIFORNIA.

The production of talc has increased more rapidly during 1912 in California than in any other State. In 1911 there was only one producer, and in 1912 there were four producers—one near Lindsay, in Tulare County, and three in the region between Silver Lake and Death Valley, in San Bernardino and Inyo counties—who had a total output of 1,169 short tons of ground talc.

The talc belt in San Bernardino County is said to have a width of 30 to 50 feet and a length of many miles, possibly with numerous large interruptions. Tests of two samples from the vicinity of Silver Lake by W. T. Schaller, in the chemical laboratory of the Survey, show the talc to contain very little water, a small quantity of alumina, little or no iron or lime, but a large proportion of silica and magnesia, indicating that it is impure talc.

The quarries on this belt are not very far from the railroad. The material is shipped by rail to Los Angeles, where it is ground and sold for use chiefly in the manufacture of toilet powder, paper, soap, and paint. The demand in 1912 did not equal the supply, and a considerable stock of ground talc is reported on hand, notwithstanding the fact that the talc mines of California are the only producers west of the Mississippi.

GEORGIA.

The production of talc in 1912 in Georgia was limited to the vicinity of Chatsworth in Murray County in the northwest portion of the State. Within the last few years three companies have been more or less active, but in 1912 only two companies, the Cohutta Talc Co., and the Georgia Talc Co., reported a production. According to Veatch:[1]

> The mills of the Cohutta Talc Co. and the Georgia Talc Co. are located at Chatsworth and the mines are on Fort and Cohutta Mountains, about 3 miles distant. Talc has been mined at Fort and Cohutta Mountains for a period of about 40 years, and in all, 140 pits, tunnels, and shafts have been dug in exploration and mining work. The mineral represents an alteration of peridotite, which has been intruded in quartzite and quartz schist. The talc occurs on the borders of the intrusions, which are mainly massive and in the nature of soapstone, and the beds are reported to vary in thickness from 2 to 30 feet. The peridotite has a northeast-southwest strike, and shows a dip of 30° to 45° southeast. The talc is sawed or turned into pencils, and pulverized mainly for foundry facing. The impurities, or "grit," are magnetite, quartz, and pyrite. Small veins of very pure talc, foliated or in plates, appear and the associated minerals are chlorite, serpentine, asbestos, and magnesite or dolomite, but they are not of commercial importance.

Veatch describes the talc and the mode of occurrence at numerous other localities in Georgia. Three different sources have been distinguished in Georgia—(1) from the alteration of peridotite intrusions; (2) from the alteration of pyroxenite intrusions; (3) from the alteration of magnesian sediments, dolomite or magnesian shales. At the present time it is only the talc from altered peridotite that is mined.

MARYLAND.

For some years there has been a production of talc, chiefly ground at Bald Friar, on Susquehanna River and the Pennsylvania Railroad,

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[1] Veatch, Otto, Mineral resources of Georgia: Bull. Georgia Geol. Survey No. 23, 1910, p. 187.

a few miles above Havre de Grace. The quarry is on a steep rocky but open slope of the river terrace facing the mill, and all operations are greatly facilitated by gravity. The talc forms irregular schistose masses in the altered basic igneous rocks included under serpentine on the geologic map of Cecil County by the State Geological Survey of Maryland.

MASSACHUSETTS.

The talc belt of New England which traverses more or less continuously the entire length of Vermont and is successfully mined at a number of localities enters western Massachusetts and affords a number of prospects in Berkshire and Franklin counties, but the only productive localities in 1912 were in the town of Rowe near Zoar.

The production of talc in Massachusetts decreased decidedly in 1912 as compared with the output in 1911, a feature due almost wholly to the total destruction of the new talc mill at Zoar. There were two producing companies with two mines and mills for a portion of the year. One company producing in 1911 reported no production in 1912.

The Massachusetts Talc Co.'s mine is on the upland, 4 miles north of Zoar station of the Fitchburg Railroad. It is opened by an incline more than 200 feet in length and developed recently for the most part on the 50-foot and 100-foot levels. There is a large mass of undeveloped talc in the immediate vicinity.

The new mill built in 1911 at Zoar, on Deerfield River, was totally destroyed by fire June 18, 1912. Plans are complete for a new mill to be built at the same place. It is to be equipped with Sturtevant mills and a separator of which F. K. Daggett[1] has described the essentials in the report on talc and soapstone for 1910.

The management of the Massachusetts Talc Co. is operating not only its own plant but also the plant of the Vermont Talc & Soapstone Co., 40 miles farther northeast, in the same belt, in the neighborhood of Chester, Vt.

A short distance from the mine of the Massachusetts Talc Co., in Rowe, Mass., is the mine and mill of the Foliated Talc Co., the output of which is increasing annually. The product is delivered at Zoar for shipment.

NEW JERSEY AND PENNSYLVANIA.

The talc region of Pennsylvania and New Jersey is limited to the vicinity of Easton, with a total production in 1912 of 10,400 short tons, valued at $50,519. There are 3 producers, 1 in New Jersey and 2 in Pennsylvania. Their total output was about 14 per cent less in quantity and 7 per cent less in value than their production in 1911.

The talc is associated with serpentine, which imparts a greenish tinge to much of the rock and gave rise to the trade name "verdolite." The rock is ground to rock flour, "mineral pulp," which is used largely in the manufacture of paint, plaster, paper, soap, and rubber goods.

This talc region of Pennsylvania and New Jersey has been fully described by F. B. Peck in recent reports of the geological surveys of the States mentioned.

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[1] Mineral Resources U. S. for 1910, pt. 2, U. S. Geol. Survey, 1911, pp. 978–979.

NEW YORK.

New York has been for many years the premier State among those producing talc. In 1912 its production of 66,867 short tons, valued at $656,270, was an increase of 4,837 tons, as compared with the output of 1911 and only 4,843 tons less than the maximum of 71,710 tons in 1910.

The importance of New York in the talc industry is illustrated by the following table showing the annual quantity and value of the production since 1901, as compared with that of the talc and soapstone industries of all the others combined.

Production and value of the talc of New York, 1880–1912, as compared with that of all the other States combined, in short tons.

Years.	New York.			All other States.	
	Quantity.	Value.	Price per ton.	Quantity.	Value.
1880-1900	629,925	$5,933,501	$9.42	340,003	$5,291,151
1901	69,200	483,600	6.99	28,643	424,888
1902	71,100	615,350	8.65	26,854	525,157
1903	60,230	421,600	7.00	26,671	418,460
1904	64,005	507,400	7.93	27,184	433,331
1905	56,500	445,000	7.88	40,134	637,062
1906	61,672	557,200	9.03	58,972	874,356
1907	67,800	626,000	9.23	72,010	905,047
1908	70,739	697,390	9.86	46,615	703,832
1909	48,536	359,957	7.42	81,802	862,002
1910	71,710	728,180	10.15	79,006	864,213
1911	62,030	613,286	9.89	81,521	1,032,732
1912	66,867	656,270	9.81	93,413	1,050,693
Total	1,400,314	12,644,734	9.03	1,002,828	14,022,924

Four important producing companies—the International Pulp Co., the Union Talc Co., the Ontario Talc Co., and the Uniform Fibrous Talc Co.—are now operating in the Gouverneur district. The general distribution of their mines and mills is shown on the accompanying map.

International Pulp Co.—The International Pulp Co., with its mines in the vicinity of Talcville, unites under the same management the Union Talc Co., with three mines southwest of Fowler, and the United States Talc Co., which has ceased to be an active producer, as its mill burned a few years ago and its mine lease expired in 1911.

The two mines of the International Pulp Co., numbered 2½ and 3, were operated continuously during the year and have been the principal producers of the region. In this portion of the field several of the mines opened by steep slopes attain a depth of 450 feet, with four or five levels extensively developed. The talc bodies, though more or less variable, are thick and fibrous like the adjoining tremolite schist. The schist itself when slightly altered to talc affords excellent paper stock and is largely mined. By a selection of the material at the mines two grades are maintained, differing chiefly in the relative proportion of talc contained.

The material from these mines is shipped by rail to the mills near Hailsboro for grinding. Mills numbered 3, 5, and 6 were operated in 1912. Mill known as No. 4 at Hailesboro has been converted into a power plant.

Union Talc Co.—The Union Talc Co., associated with the International Pulp Co., operates three mines, the Arnold, the Wight, and the Balmat between Fowler and Sylvia Lake in the southwest portion of the district. The Wight mine was opened in 1911 and has been operated continuously. The Balmat and the Arnold mines have been operated with more or less intermission for years, because the talc can be taken out much more rapidly than it can be hauled away. The hauling has been practically continuous.

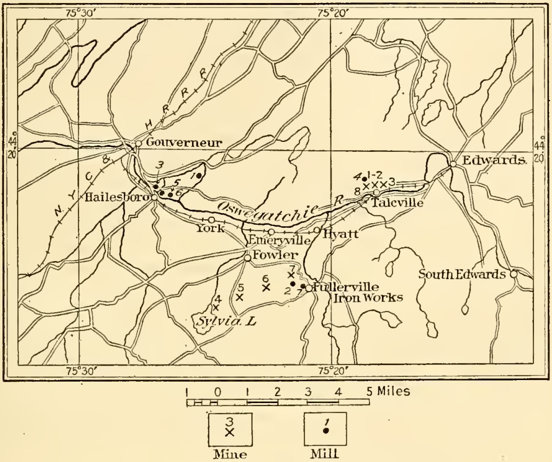

FIGURE 11.—Map showing talc mines and mills in New York.

Company.	Mine.	Mill.
International Pulp Co	1. United States 2. No. 2½ 3. No. 3	1. Columbia. 3. No. 3. 5. No. 5. 6. No. 6.
Union Talc Co	4. Balmat 5. Wight 6. Arnold	7. Keller.
Ontario Talc Co	7. Ontario	2. Ontario.
Uniform Fibrous Talc Co	8. Uniform Fibrous	4. Uniform Fibrous.

At the Wight mine, which is perhaps generally known as the new opening, the rocks strike regularly northeast and southwest, dip northwest at an angle of about 33°, and contain four layers of talc within a thickness of 200 feet. The two upper layers ("veins") of talc were opened up years ago (1876), one in an open pit and the other by an incline. The output was ground in an adjacent steam mill, one of the first talc mills operated in the Gouverneur region.[1] The Wight mine in the bottom layer of talc is opened by an incline

[1] McDonald, A. J., The talc industry: In the "Centennial Souvenir History of Gouverneur commemorating Old Home Week," 1905, pp. 212–216.

at an angle of 33° and a length (May, 1913) of 150 feet. There are two levels. The lowest, at 140 feet, has a length of 125 feet and exposes a body of talc about 25 feet in thickness. There is enough beautifully white foliated talc, chiefly on the hanging wall but partly on the footwall, to suggest the possibility of making a special grade of it. Its great purity, luster, and structure fit it for special uses. By far the greater portion of the talc is distinctly of high fibrous quality. In some places the fibers are long and parallel, as in asbestos. The waste in mining is very small. The hanging wall is usually much more regular than the footwall. No crosscuts have yet been made into the hanging wall to the three overlying layers of talc within 200 feet, but it is evident that these upper layers contain much talc, easily available from the working of the lower layer now being developed.

The Arnold mine is within half a mile of the Wight mine, and they are much alike, although the former has much the most extensive workings. The incline has a length of 260 feet to a number of levels ranging from 200 to 600 feet in length. No talc was taken out of this mine in 1912, but shipments were made continuously from the large pile of talc previously mined. As the surface supply nears depletion, the mine will soon be opened and put in operation.

The Balmat mine is near the southeast corner of Sylvia Lake. Its underground workings consist of a slope at an angle of 40° and 350 feet in length with 5 levels, some of which extend about 300 feet from each side of the slope. The 20-foot layer of talc is almost wholly of fine fibrous quality. The contrast between the smoothness of the hanging wall and the unevenness of the foot wall is evident.

The American mill once stood near the Balmat mine. Since it burned, years ago, the talc from the Balmat, as well as that of the Wight and the Arnold mines has been hauled to the mills at Keller and Columbia, much of it at $1 a ton.

In the development of the talc industry of the Gouverneur region the portion of the field southwest of Talcville must necessarily grow to predominating importance and demand convenient railroad facilities.

Ontario Talc Co.—The Ontario Talc Co.'s mine and mill are near Fullerville, a short distance southwest of the middle of the talc belt. The mill is run by water power and the mine by steam, but preparation is being made to install a hydroelectric plant to furnish power for both.

The Ontario mine is operated by an incline having an average dip of about 45° NW. The length of the incline in May, 1913, is 225 feet and develops 3 levels, of which the upper two are 300 feet in extent, mainly to the southwest. The talc lens thickens from about 20 feet on the second level to 30 feet on the third level, and a start has been made to extend the slope for a lower level to maintain the steady production. On the second level a crosscut of 20 feet through the hanging wall discovered a second talc lens 10 feet in thickness, which was followed for about 100 feet. Although there is a small amount of the pink amphibole, hexagonite, present, there is very little waste in the material mined. Much of the talc is remarkably pure, being white, lustrous, and eminently foliated, though retaining for the most part its fibrous structure. Some of the long-fiber variety resembles asbestos. The Ontario mill is well equipped with jaw crusher and Gardiner mills, conical and long-cylinder pebble mills, and with two silk bolts which separate the product into two grades.

Uniform Fibrous Talc Co.—The Uniform Fibrous Talc Co., with its mine and mill together near Talcville by the railroad and its hydroelectric power plant in the same vicinity, is conveniently located for economic operation and shipment.

Production began in 1911, and was greatly increased in 1912 as the mine developed. A shaft opens the mine to a depth of about 200 feet to a level that is expanding in a large body of talc, whose dimensions and ultimate average quality can be determined only when the mine and plant are developed to their full capacity. A small proportion of the talc is foliated, but the fibrous form predominates and fits the product for the purpose of the paper trade. This mine is the southwesternmost of the Talcville group, which has been for many years the locality of chief production in the district.

The fireproof steel concrete mill is equipped to about half its capacity with conical and cylindrical pebble mills, such as have been found most efficient in grinding the Gouverneur talc.

The power plant is built of reinforced concrete. A twin turbine direct connected to a 75-kilowatt alternator supplies the present requirement of power, but another unit of similar capacity can be added if needed.

United States mine.—The United States mine, known also as the Freeman mine, was for years a large producer, especially under the lease of the International Pulp Co. which expired in 1911. A feature of the mine is the recurrence of a pink variety of hornblende, hexagonite.

The mine has recently been leased by a New Jersey company and some talc shipped to Perth Amboy for milling.

St. Lawrence Talc Co. mine.—About 15 miles nearly southwest of Gouverneur a talc mine was operated in 1912 in the vicinity of Natural Bridge. The talc is associated with serpentine and limestone. Near by are highly crystalline, for the most part gneissoid rocks. The talc where opened to view lacks distinct schistosity or fibrous structure, and is rather massive. The sides of the talc body are very irregular. Its maximum width is more than 20 feet with a length as yet undetermined. Although in general the talc is highly magnesian, some of it, as shown by laboratory tests with nitrate of cobalt, contains much alumina suggesting pyrophyllite.

The shaft has a depth of more than 100 feet and is being deepened. In the upper part it has been widened to admit an incline that delivers the rock from the mine to the crushers, from which the rock passes automatically through a conical pebble mill, Newago screen, and one or more long cylinder pebble mills. The mill, although not yet wholly completed, is operated by electricity. A side track connects the mill with the New York Central Railroad system.

NORTH CAROLINA.

In Cherokee, Jackson, and Swain counties of western North Carolina there was a production in 1912 of 1,573 short tons of talc, valued at $50,453, while in the eastern portion of the State in Alleghany and Moore counties 1,969 tons of pyrophyllite were produced, valued at

$12,851, making a total production of 3,542 tons, valued at $63,304. This includes a small amount of soapstone produced in Alleghany County. The quantity of talc and pyrophyllite mined in 1912 was nearly the same as in 1911, but its value was $6,203 greater in 1912, because more of the material was made into pencils. The compact grade of both talc and pyrophyllite is used for pencils, but for gas tips only talc is used. North Carolina ranks first among the States in producing the higher grades. There were 8 producers, 3 of pyrophyllite in Moore County; 1 of soapstone in Alleghany County; all the others produced talc—2 in Swain County, 1 in Jackson County, and 1 in Cherokee County. The available resources in both talc and pyrophyllite are large, and the outlook improves with the increased production of the better grades.

VERMONT.

Vermont ranks next to New York in the production of talc and is increasing its annual output more rapidly than any other State. Vermont had four companies producing talc in 1912, besides two companies producing soapstone. The total production of talc by Vermont in 1912 was 42,413 tons, valued at $275,679, an increase of nearly 44 per cent in quantity and of 38 per cent in value, as compared with that of 1911. The three new mills at Chester, Rochester, and Waterbury will doubtless further increase the production in 1913.

The talc belt of Vermont associated with crystalline schists running nearly north and south through the State has been mined more or less successfully at Johnson, Waterbury, Moretown, East Granville, Rochester, Stockbridge, Pittsfield, Reading, Perkinsville, Chester, Windham, and Athens in a distance of 100 miles.

Although the talc of Vermont is in large measure used in the manufacture of paper, much of it is less valuable in the general market for that purpose than the fibrous talc of New York. Vermont talc may command a price of $6 a ton; New York talc commands $10 a ton. On the other hand in Vermont the mines, on moderate mountain slopes to principal lines of drainage and transportation, afford the opportunity of using gravity to great advantage in economic mining.

American Mineral Co.—The only production of talc in the northern portion of the State in 1912 was at Johnson, on the St. Johns & Lake Champlain Railroad. The deposit is somewhat lenticular, but very irregular, 50 feet in width and nearly 100 feet in length. It contains a thickness of a good grade of white talc from 1 to 5 or 6 feet. The mine is opened by an irregular slope and level conforming to the folded condition of the gneiss, mica, chlorite schists, and quartzite with which the talc is associated.

The mill is near and is connected with the mine by a tramway. Abbe mills and a Newago screen are used, and the final production is bolted to two grades.

Magnesia Talc Co.—The Magnesia Talc Co. was organized in 1912 and began to build a mill about a mile southwest of the town of Waterbury, on the Vermont Central Railroad. A layer of talc 6 feet in thickness has been opened for 50 feet at the plant, but the mill is not fully equipped and production has not commenced.

Eastern Talc Co.—The Eastern Talc Co. is operating four mines, the Pach, Williams, McPherson, and Greeley, and two mills, with a third mill nearing completion. The mines are approximately on the same belt, which extends from East Granville to a little west of south for 15 miles to Pittsfield where talc was mined years ago. All the talc of these mines is now or will soon be transported from mine to mill and railroad by gravity, thus greatly reducing the cost of production.

At East Granville the Pach mine and mill near the Vermont Central Railroad have been in operation throughout the year. The mine is near the top of a steep slope 300 feet above the mill, with which it is connected by a 2-bucket tramway 1,500 feet in length. The main adit, though somewhat irregular, runs approximately north and south for a distance of 1,200 feet and opens several lenses of talc in a belt about 80 feet in width. The mine is advantageously situated for operation at lower levels.

The mill on White River near Rochester is supplied with talc almost wholly from the Williams and McPherson mines, 3 miles southeast of Rochester and 1,100 feet above the mill, to which the talc has hitherto been hauled in wagons. A new mill of larger capacity near the mill on White River is approaching completion and will be connected by a railroad with the two mines mentioned.

The Williams mine has been operated for many years. The mine is opened by a 400-foot shaft and 5 levels, of which the longest is 700 feet, in a talc belt having a maximum width of about 50 feet. Some of the talc of the Rochester region is of better grade than that of East Granville and is milled separately by different machinery.

The McPherson mine was opened in 1912, and although some talc has been hauled away, there is a good supply in the bunkers awaiting the completion of the new railroad for shipment. The mine is to be operated by an incline which has already reached a depth of 25 feet and developed a level of about 100 feet in a talc belt nearly 50 feet in width. The quality of the talc at the McPherson mine is better than the average of the region.

The Greeley mine recently opened by the Vermont Central Railroad on White River 5 miles below Rochester is shipping talc of about the same grade as that of the Pach mine at East Granville. There are two adits entering a steep slope within 100 feet of the railroad and delivering their products by chutes.

American Soapstone Finish Co.—The principal talc center in the southern part of Vermont is Chester, on the Rutland Railroad, where there are two talc mills, one for each of the neighboring mines.

The American Soapstone Finish Co. operates a mine which is in reality an open cut, a quarry. The talc belt is 25 feet in width and has been taken out to a depth of 25 feet for a distance northeast and southwest of 30 feet. To the southwest the talc continues with a prominent wall on the right, but to the northeast the belt widens as if inclosing a large horse. The output is hauled 3 miles by wagon and ground near the station.

Vermont Talc & Soapstone Co.—The Vermont Talc & Soapstone Co. operates a mine nearly 10 miles southwest of Chester and hauls the talc to the new mill by the railroad in Chester for grinding. The removal of the mill interfered somewhat with the production of the mine in 1912. The mine is opened by a shaft to a depth of 70 feet and from its foot a level extends 100 feet to the northeast. To the southwest the talc has been traced nearly 300 feet. The total width of the talc belt well exposed in a ledge above the mine is 40 feet; some of the rock has been sawed out for soapstone. The walls, particularly the hanging wall, are remarkable for their distinctness.

The mine employs steam power, but the mill, lately completed, uses electricity. The mill is 300 feet in length, with ample storage, and is equipped with a Raymond mill and separator. Although much of the rock is gray, in this mill it yields a remarkably white, smooth flour.

VIRGINIA.

Although Virginia with an output of 3,255 short tons of talc, valued at $17,168, ranks fifth among the States in the production of talc, it holds premier rank in the production of soapstone, as is set forth on subsequent pages. There were 4 producers of talc in 1912, all in the nothern portion of the State, 3 in Fairfax County and 1 in Orange County. The former sell their talc in the rough, or ground; the one in Orange County sells at least part of the output as crayons. The talc quarried is obtained from talc schist associated more or less closely with massive bodies of igneous rocks in which a small amount of soapstone has been quarried. Commercial talc does not occur in the great soapstone belt of Albemarle and Nelson counties.

SOAPSTONE.

PRODUCTION.

The production of soapstone in the United States in 1912 was not only greater than that of any other country but greater than that of all other countries combined. The total production of soapstone in the United States in 1912 was 25,981 short tons, valued at $609,480, a decided gain both in quantity and in value as compared with the production of 1911. There were five producing States, Maryland, North Carolina, Rhode Island, Vermont, and Virginia, but the output of Virginia exceeded by far the combined output of all the other States. Furthermore, the resources of Virginia are such that its large production may be expected to continue long.

The following table shows the production of soapstone in 1912:

Production of soapstone in 1912, by States, in short tons.

	Quantity.	Value.		Quantity.	Value.
Maryland North Carolina Rhode Island Vermont	3,923	$50,193	Virginia	22,058	$559,287
			Total	25,981	609,480

PRICES.

The prices of soapstone vary greatly, not only with the form in which it is sold, but also with the size and quality of the stone which determine the purposes to which it can be applied.

In the rough as quarried, soapstone is reported as valued at $2 a ton; when sawed into slabs its value is increased to more than $15 a ton; and when manufactured into laundry tubs its average value is about $30 a ton.

USES.

The qualities which render soapstône useful are its slow conduction of heat and electricity, its difficult fusibility and chemical stability in resisting the action of solvents, as well as its softness.

Soapstone finds its most extensive application in the manufacture of laundry tubs. The larger slabs are used for table tops and acid tanks in chemical, biologic, photographic, and many other laboratories, as well as for switchboards, flooring, and panels in electric stations. In some parts of the country hearthstones and stoves are made of it; it has a still wider application in stove and furnace lining, and when ground it is useful for furnace facing. Foot warmers and griddles are made of it, and a larger use is found in the manufacture of fireless cookers.

MODE OF OCCURRENCE.

The occurrences of soapstone have not been studied in detail, but it is evident, in places where more or less detailed work has been done, that soapstone is derived from the alteration of a basic rock such as pyroxenite. The long narrow belts which it forms approximately parallel to the general trend of the neighboring rocks may suggest derivation by alteration from sedimentary rocks, but it is believed more probable that such rocks are intrusive and that the rock bodies are dikes rather than strata.

Where the alteration is complete and the pyroxene has changed to talc, the soapstone is softest, most easily worked, and best for certain purposes. Remnants of unaltered pyroxene render the rock harder and susceptible of a degree of polish that gives it a more attractive appearance. The pyroxene remnants may be partly soluble in acid, and the soapstone from such quarries is not desirable for purposes in which acids are employed.

QUARRYING SOAPSTONE AND PREPARING IT FOR MARKET.

Soapstone is taken from the ground in quarries by regular quarrying methods in essentially the same manner as marble. Channeling and other machinery are used, and the stone is usually removed in large blocks which are handled by cranes and cars.

The mills are close to the quarries to avoid the transportation of waste material. It is said that as much as 80 to 90 per cent of the soapstone mined is waste, partly on account of the presence of pyrite which may decompose and discolor the soapstone, partly on account of its hardness, but chiefly on account of the presence of small fissures which may cause the rock to break.

The large blocks are sawed by gang saws into slabs, which are planed, sawed, bored, grooved, and otherwise shaped for the purpose designed. Unlike the talc industry, the soapstone industry includes both extraction from the earth and manufacture into final form.

SOAPSTONE INDUSTRY BY STATES.

MARYLAND.

In Maryland small bodies of soapstone and talc have been found associated with serpentine scattered throughout the Piedmont region. According to the Maryland Geological Survey [1] soapstone has been

[1] Maryland mineral industries, 1896–1907: Maryland Geol. Survey, vol. 8, pt. 2, 1908, p. 160.

quarried at irregular intervals from an extensive deposit found northwest of Marriottsville, in Carroll County, where a quarry is reported to have been in operation for 10 months in 1912 before the plant was destroyed by fire. Most of the material quarried was sold rough as quarried, some of it was sawed into slabs and made into laundry tubs, and the remainder was ground for other purposes. Less extensive deposits have been reported in Cecil, Harford, and Montgomery counties.

NORTH CAROLINA.

A small production of soapstone sawed into slabs is reported from Alleghany County, N. C. The production in 1912 was only half as great as in 1911. It is the only production south of Virginia and appears to supply the local demand only.

RHODE ISLAND.

The Rhode Island Soapstone Co. is the only company operating in the State. Its quarry is located at Manville, in Providence County, and the production, though small, was increased nearly 20 per cent in 1912 as compared with that of 1911. The output is chiefly for local use.

VERMONT.

For years the production of soapstone in Vermont has been an important industry and ranks next to that of Virginia. The production in 1910 showed an increase over that of 1909, and in 1911 the increase continued, but in 1912 there was a decided decline, amounting to nearly 35 per cent as compared with the production of 1911. There are two producers—the Union Soapstone Co., at Chester, on the Rutland Railroad, and the Vermont Soapstone Co., with quarry and mill at Perkinsville, 7 miles from the Rutland Railroad.

The Union Soapstone Co. once operated several quarries in the vicinity of Chester and sold the waste product to be ground by the American Soapstone Finish Co. In 1912 the small production came from the Davis quarry only.

The quality of the soapstone in Vermont is not sufficiently good to meet all the demands of the trade. Although the smaller slabs used at Perkinsville are obtained in the quarries of that vicinity, the larger slabs used in the mill at that point as well as at Boston are obtained from the large quarries in Virginia.

A more complete account of the soapstone quarries of Vermont may be found in the report of the State geologist of Vermont for 1909–10.

VIRGINIA.

Virginia is by far the most important producer of soapstone in the United States. It not only exceeds in quantity and value that of the other States, but that of all other countries combined. In 1912 Virginia produced 22,058 short tons of soapstone, valued at $559,287.

In 1912 there were seven producing quarries operated, respectively, by the Old Dominion Soapstone Co., the Virginia Soapstone Co., the Phoenix Co., the Piedmont Co., the Bull Run Talc & Soapstone Co., John B. Hort & Son, and the Cuthbert Land & Development Co.

The Virginia Soapstone Co. has a large quarry which supplies stone for two mills, one at Schuyler and the other at Alberene. The quarry at Alberene, in Albemarle County, has been in operation for many years and is now in the fifth pit along the line of strike about N. 35° E., developing the quarry through a length on the soapstone belt of more than 500 feet. The width of the quarry is from 128 to 157 feet, and the greatest depth attained in the first pit now filled by waste is over 200 feet. The grain of the rock dips 35° to 55° SE. with considerable regularity from Alberene to Phoenix, inclusive, a distance of about 25 miles.

The soapstone at the Schuyler quarries in Nelson County is massive with indistinct foliation or schistose structure parallel to the grain of the rock. In a few places slips develop shear zones approximately parallel to the rock grain and afford channels for water circulation.

There are a few veins with the same general course; that is, northeast and southwest with dip southeast, in general parallel to the grain of the rock. The veins consist chiefly of white minerals, possibly for the most part quartz, feldspar, and calcite or dolomite, with some pyrite. Some of the veins are foliated talc. The veins are faulted by compressive strains nearly at right angles to the grain of the rock. Veins increase with depth in the quarry, and the rock becomes on the whole less talcose and harder. With increase of depth the danger and expense of quarrying increase and appear ordinarily to limit the depth of profitable quarrying to 200 feet from the surface.

In the vicinity of Schuyler the soapstone is generally overlain on the southeast by greenstone and underlain on the northwest by mica and talc schists. However, the rocks vary much on both sides of the soapstone throughout the quarry belt.

At Schuyler water power develops compressed air for operating the quarry machinery. Steam power is used for engines and derricks and electricity for lighting.

At the Old Dominion mine, Albemarle County, the soapstone belt has a width of 170 feet. The quarry is developed in several pits to a depth of 60 feet and to several hundred feet in length.

Southeast of the main soapstone belt of the Old Dominion in a railroad cut there is a fine exposure of a dike of pyroxenite in slates practically parallel to the slaty structure. The dike has a thickness of 40 feet and contains but little talc, although it illustrates the genesis of the soapstone.

The Phoenix and Piedmont quarries in Nelson County are near the south end of the soapstone quarry belt. Although not so old as the quarries of the Virginia Soapstone and Old Dominion companies, they are well displayed, and each quarry has its mill near by. The general relations of the soapstone at the southern end are essentially the same as at the northern end, but the lack of convenient railroad facilities for transportation places them at a disadvantage.

There are a number of inactive quarries in the soapstone belt between Schuyler and Phoenix. Some of them produced a few years ago, but for one reason or another have closed. In some quarries the soapstone contains much pyrite, which injures its quality; at others the lack of transportation facilities kept them from successfully competing with other producers.

Attention should be called also to the quarries in operation a few years ago in Campbell and Amelia counties, from which no production was reported in 1912. In Orange County a company has recently opened some talc and soapstone properties near Verdierville, and produced talc, but no soapstone, in 1912.

The most important contribution concerning the talc and soapstone of Virginia is by T. L. Watson, State geologist, in a volume entitled "Mineral resources of Virginia," published by the Virginia Jamestown Exposition Commission in 1907.

GAS, COKE, TAR, AND AMMONIA.

By Edward W. Parker.

INTRODUCTION.

Since the first volume of Mineral Resources of the United States was published, covering the calendar year 1882, each report has included a chapter on the manufacture of coke. In these reports, however, the term "coke" has been limited to the product, commonly known as oven coke, obtained by the distillation or partial combustion of bituminous coal in retorts or ovens. Coke obtained as a by-product in the manufacture of illuminating gas, known as "gas-house coke," was not considered as coming within the scope of the reports, which, from the first, have been limited to statistics of the product suitable for use in the blast furnace, the foundry, and the smelter, though not restricted to such uses. During the first decade covered by the statistics and history recorded in these reports all coke of this kind produced in the United States was made from coal carbonized in "beehive" ovens, the name being derived from the shape of the combustion chamber, which is similar to that of the conventional beehive. The product was so different in appearance, quality, and use from the soft, spongy by-product obtained in gas manufacture that the two could easily be differentiated. In 1893 the first step was taken in a line of progress which will eventually eliminate the beehive and similar types of ovens, though in 1912 the total number of "partial combustion" ovens in the United States was 102,230, which at an average cost of $350 represents an investment of over $35,000,000. This first step was the construction at Syracuse, N. Y., of 12 Semet-Solvay retort ovens, from which were produced in 1893, 12,850 short tons of coke. At the end of 1912, or in a period of 20 years, 5,211 retort ovens were in blast (less than 5 per cent of the number of beehive type), which produced more than 25 per cent of the total output of coke in the United States.[1]

The development of the retort oven, whose coke production has been recorded in the annual reports of this series, created a demand for information regarding the quantity and value of by-products recovered, and since 1897 (the second year in which the reports on this subject were prepared by the present writer) a section of the chapter has been devoted to the statistics of by-product coke making.

[1] For a historical review of the development of retort or by-product coke making in the United States, see report on the manufacture of coke in 1912, issued by the United States Geological Survey as an advance chapter of Mineral Resources of the United States.

As this branch of the industry grew in actual and relative importance a demand arose for information regarding the production of gas, coke, tar, and ammonia at gas works, in order that the total supply of these coal products might be ascertained. In compliance with this demand a special report on the production of gas, coke, tar, and ammonia was published in Mineral Resources for 1898, and was followed by other similar chapters in the reports for 1902, 1903, 1904, 1905, 1907, and 1908. The present report is therefore the eighth of its kind, the reports having been distributed somewhat irregularly over a period of 15 years. The reports for 1905, 1907, 1908, and 1912 include also the statistics of water-gas production. Comparison of the statistics of production at coal-gas works, in retort ovens, and at water-gas works in 1912 shows some interesting developments, and a comparison of the figures for 1912 with those for 1908 and earlier years is even more striking.

In the total production of gas in 1912 the output of water gas exceeded the combined production of coal gas and surplus gas from retort ovens by more than 40 per cent in quantity and by more than 240 per cent in value. The quantity of surplus gas produced from retort ovens—that is, gas produced in excess of that required to heat the ovens and therefore available for use or sale, was in turn over 50 per cent more than that obtained from gas works, but the value of the gas produced at gas works, most of it used as illuminating gas, exceeded that from retort ovens, which is used chiefly as fuel, by 589 per cent.

A comparison of the statistics for 1912 with those for 1908 shows that the number of coal-gas works (including retort-oven plants), which had decreased from 516 in 1907 to 506 in 1908, further decreased to 458 in 1912. Part of this decrease was due to consolidations of former competing companies into one organization; part was due to changes from coal gas to water gas; and part was due, particularly in small towns, to the replacement of gas by electricity for illumination. The number of retort-oven plants increased from 25 in 1908 to 34 in 1912, and the number of coal-gas works decreased from 481 to 424. The quantity of coal carbonized in gas works increased from 3,553,920 short tons in 1908 to 3,957,060 tons in 1912, but the quantity of coal gas produced and sold decreased from 37,355,886,000 cubic feet to 35,202,124,000 cubic feet. The coal carbonized in retort ovens, on the other hand, increased from 5,699,058 short tons to 14,767,543 tons and the quantity of surplus gas produced and sold (or used for other purposes than heating the ovens) increased from 16,205,925,000 cubic feet to 54,491,248,000 cubic feet.

It should further be observed that the quantity of coal gas (including that made both at gas works and at retort ovens) sold for illumination was 31,864,052,000 cubic feet in 1912, against 32,485,571,000 cubic feet in 1908, a decrease of more than 620,000,000 cubic feet; whereas the quantity used as fuel increased from 21,076,242,000 cubic feet to 57,829,320,000 cubic feet. The influence exerted by the largely increased production of retort-oven gas is exhibited in the apparent marked decline in values. The total value of gas sold for illumination in 1912 was less than that of 1908 by $6,000,000, or more than 25 per cent, whereas the decrease in quantity was less than

2 per cent. The value of the fuel gas increased less than 50 per cent, whereas the quantity produced increased nearly 175 per cent. The average value of illuminating gas was 55 cents per thousand cubic feet in 1912, against 73 cents in 1908, and the average value of fuel gas was 33 cents, against 65 cents in 1908. Even in States where retort-oven gas did not affect production and values the general tendency was toward lower prices in 1912, though there were a few exceptions to this rule.

As compared with the decrease from 481 in 1908 to 424 in 1912 in the number of coal-gas works (exclusive of retort-oven plants) it is interesting to note that reports were received from 604 water-gas companies in 1912 against 552 in 1908, and that the total production of water gas increased nearly 19 per cent. The decreased consumption of artificial gas for illumination and its increased use as fuel (for which its convenience and its freedom from smoke and ashes render it growingly popular with homekeepers) are as strikingly presented in the statistics of the production of water gas as in those of the manufacture of coal gas. The water gas sold for illumination from 1908 to 1912 decreased 11 per cent in quantity and 10 per cent in value, whereas that sold for fuel increased more than 100 per cent in quantity and 86 per cent in value. Practically all the water gas sold for fuel is used for domestic purposes or in relatively small gas engines. The same may be said of coal gas made at gas works, but the larger part of fuel gas produced at retort ovens is used in iron and steel works or other large industrial establishments. In this lies the explanation of the higher average values of water gas ($92.4 cents per thousand cubic feet for illumination and 89 cents per thousand cubic feet for fuel in 1912), compared with those of coal gas.

The production of coke, tar, and ammonia increased with the increase in the production of gas at gas works and retort ovens, and the increase was accompanied by advances in price. The average value per ton for coke advanced from $3.44 to $3.87, owing to the larger proportion of retort coke in the total; tar was valued at 2.5 cents per pound in 1908 and at 2.8 cents in 1912; ammonia (reduced to equivalent in NH_3) was 6.4 cents a pound in 1908 and 9.2 cents a pound in 1912: ammonium sulphate was nearly 1 cent a pound higher in 1912 than in 1908.

PRODUCTION.

The total quantity of artificial gas produced in the United States in 1912, reported by 1,062 establishments, was 228,076,510,000 cubic feet. Of this production about 7 per cent (15,685,342,000 cubic feet) was lost or unaccounted for, so that the quantity sold or utilized amounted to 212,391,168,000 cubic feet. This was valued at $148,282,725, or about 70 cents per thousand cubic feet. In 1908, the latest previous year for which the statistics were collected, the net production (that is, the total production less the gas unaccounted for) was 156,909,310,000 cubic feet, valued at $133,571,122, or about 85 cents per thousand cubic feet. There was a general decrease in prices in 1912 compared with 1908, except in the value of oil and water gas, but the chief cause of the apparent decline of nearly 20 per cent in the mean average price was the largely increased production at retort-coke ovens of gas that was extensively used at manufacturing plants connected with the coke works and charged to the consuming establishments at merely nominal prices, much of it at less than 10 cents per thousand cubic feet. The average price of oil and water gas sold for illumination in 1912 was a fraction of a cent higher than in 1908, the figures being, respectively, 92.4 cents and 92 cents per thousand cubic feet. The average price for this gas sold for fuel shows a decline from 98 cents per thousand cubic feet in 1908 to 89 cents in 1912. The average price for coal gas, which includes the surplus gas from retort ovens, was 70 cents per thousand cubic feet in 1908 and 41 cents in 1912. The decline in the average price of this gas used as fuel was nearly 50 per cent—from 65 cents per thousand cubic feet in 1908 to 33 cents in 1912. The average price of illuminating gas declined from 73 cents to 55 cents. It should be noted that the quantity of illuminating gas used in 1912 was less than in 1908, coal gas falling off about 620,000,000 cubic feet, and oil and water gas more than 8,600,000,000 cubic feet. This decrease in the consumption of illuminating gas is due in part to the more extended use of gas-saving devices, such as the Welsbach burner, and in part to the increased use of electric light, the latter probably predominating. On the other hand, the use of gas as fuel shows a marked increase—from 47,619,193,000 cubic feet in 1908 to 112,390,847,000 cubic feet in 1912. This increase, for reasons already stated, was chiefly in coal gas—from a little over 21,000,000,000 cubic feet in 1908 to nearly 58,000,000,000 cubic feet in 1912—though the use of oil and water gas as fuel also shows an increase of more than 100 per cent—from 26,500,000,000 cubic feet in 1908 to 54,500,000,000 cubic feet in 1912.

The associated products in the manufacture of gas from coal in 1912 consisted of 12,490,757 short tons of coke, valued at $48,380,009; 134,796,438 gallons of tar, valued at $3,802,047; 51,527,074 pounds of anhydrous ammonia (the ammonia liquor being reduced, when strength of liquor was reported, to its equivalent in NH_3), valued at $4,776,386; 35,242,549 gallons of ammonia liquor (strength not reported), valued at $1,002,807; and 99,070,777 pounds of ammonium sulphate, valued at $3,740,075. In 1908 the associated products consisted of 6,253,125 tons of coke, valued at $21,507,045; 110,430,663 gallons of tar (including 9,168,834 gallons of water-gas tar), valued at $2,766,700; 30,615,835 pounds of anhydrous ammonia, or its equivalent, valued at $2,065,169; and 44,093,437 pounds of ammonium sulphate, valued at $1,322,807.

The total quantity and value of gas, coke, tar, and ammonia (reduced, when possible, to equivalent in NH_3), and of ammonium sulphate produced at gas works and in by-product ovens in 1903, 1904, 1905, 1907, 1908, and 1912 are shown in the following table:

Production of gas, coke, tar, and ammonia, and value thereof, at coal-gas works and by-product coke ovens in the United Ststes, 1903–1905, 1907–8, and 1912.

	1903		1904	
	Quantity.	Value.	Quantity.	Value.
Gas sold........1,000 cubic feet..	31,049,462	$30,315,776	34,814,991	$32,090,998
Coke........short tons..	3,941,282	13,634,095	4,716,049	14,693,126
Tar........gallons..	62,964,393	2,199,969	69,498,085	2,114,421
Ammonia (reduced to NH_3)........pounds..	17,643,507	1,291,732	19,750,032	1,487,196
Ammonium sulphate........do....	12,400,032	389,028	28,225,210	771,995

	1905		1907	
	Quantity.	Value.	Quantity.	Value.
Gas sold........1,000 cubic feet..	40,454,215	$32,937,456	54,819,685	$36,462,304
Coke........short tons..	5,751,378	18,844,866	8,093,144	30,332,644
Tar........gallons..	80,022,043	2,176,944	103,577,760	2,651,527
Ammonia (reduced to NH_3)........pounds..	22,455,857	1,728,254	37,560,858	2,601,057
Ammonium sulphate........do....	38,663,682	997,452	48,882,237	1,525,472

	1908		1912	
	Quantity.	Value.	Quantity.	Value.
Gas sold........1,000 cubic feet..	53,561,811	$37,227,901	89,693,372	$36,681,884
Coke........short tons..	6,253,125	21,507,045	12,490,757	48,380,009
Tar........gallons..	101,261,829	2,537,118	134,796,438	3,802,047
Ammonia (reduced to NH_3)........pounds..	30,615,835	2,065,169	51,527,074	4,776,386
Ammonium sulphate........do....	44,093,437	1,322,807	99,070,777	3,740,075
Ammoniacal liquor........gallons..	....	....	35,242,549	1,002,807

In the reports on the production of gas, coke, tar, and ammonia for the years prior to 1905 the statistics were limited to the operations of coal-gas works and retort-oven plants, the statistics of water-gas production being compiled for the first time in 1905. The first year for which the statistics of the production of oil gas were collected, was 1907, and those statistics are included with the production of water gas in 1907, 1908, and 1912.

In the following table the coal carbonized in gas works is separated from that made in by-product ovens, the statistics covering also the gas, coke, and tar produced in 1903, 1904, 1905, 1907, 1908, and 1912. As previously stated, in giving the production of gas in by-product ovens, only the "surplus" gas is considered—that is, the gas over and above that used for heating the ovens. The gases that come off in the earlier stages of the process, being richer in illuminants and in calorific value, are sold; those that come off later are relatively lean in illuminants, but possess sufficient calorific value to heat or regenerate the ovens. The total quantity of coal carbonized in 1912 was 18,724,603 short tons, of which 14,767,543 tons were coked in retort ovens, and 3,957,060 tons were used in gas works. The coke production from retort ovens was 11,115,164 tons, and from gas works, 1,375,593 tons. The surplus gas from coke ovens amounted to nearly 54,500,000,000 cubic feet; that from gas works to a little over

35,200,000,000 cubic feet. The quantity of gas sold at gas works per ton of coal carbonized was 8,896 cubic feet, as compared with 3,680 cubic feet of surplus gas from retort ovens.

Coal consumed and gas, coke, and tar produced at coal-gas works and in by-product coke ovens in the United States, 1903–1912.

Kind of product.	Gas works.	By-product coke plants.	Total.
1903.			
Coal coked..........short tons..	3,238,085	2,605,453	5,843,538
Coal gas produced and sold..........1,000 cubic feet..	....	....	33,483,431
Coke produced and sold..........short tons..	2,058,888	1,882,394	3,941,282
Tar produced and sold..........gallons..	....	....	62,964,393
1904.			
Coal coked..........short tons..	3,485,208	3,572,949	7,058,157
Coal gas produced and sold..........1,000 cubic feet..	30,109,449	4,705,542	34,814,991
Coke produced and sold..........short tons..	2,107,820	2,608,229	4,716,049
Tar produced and sold..........gallons..	41,726,970	27,771,115	69,498,085
1905.			
Coal coked..........short tons..	3,558,831	4,628,981	8,187,812
Coal gas produced and sold..........1,000 cubic feet..	30,722,279	9,731,936	40,454,215
Coke produced and sold..........short tons..	2,289,030	3,462,348	5,751,378
Tar produced and sold..........gallons..	43,642,189	36,379,854	80,022,043
1907.			
Coal coked..........short tons..	4,030,074	7,460,587	11,490,661
Coal gas produced and sold..........1,000 cubic feet..	34,302,954	20,516,731	54,819,685
Coke produced and sold..........short tons..	2,510,106	5,583,038	8,093,144
Tar produced and sold..........gallons..	49,581,965	53,995,795	103,577,760
1908.			
Coal coked..........short tons..	3,553,920	5,699,058	9,252,978
Coal gas produced and sold..........1,000 cubic feet..	37,355,886	16,205,925	53,561,811
Coke produced and sold..........short tons..	2,051,899	4,201,226	6,253,125
Tar produced and sold..........gallons..	58,541,220	42,720,609	101,261,829
1912.			
Coal coked..........short tons..	3,957,060	14,767,543	18,724,603
Coal gas produced and sold..........1,000 cubic feet..	35,202,124	54,491,248	89,693,372
Coke produced and sold..........short tons..	1,375,593	11,115,164	12,490,757
Tar produced and sold..........gallons..	40,489,855	94,306,583	134,796,438

PRODUCTION OF COAL GAS.

Reports to the Geological Survey of the production of coal gas in 1912 were received from 458 coal-gas and by-product coke works, and indicate a decrease of 48 in the number of gas-making establishments compared with 1908, when reports were received from 506 establishments. The reason for the decrease in the number of coal-gas works has already been discussed in the preceding pages. Of the 458 establishments reporting in 1912, 34 were by-product coke works and 424 were gas works. In 1908 there were 481 gas works, and 25 by-product coke works. The 34 by-product coke works in

1912 produced surplus gas to the amount of 54,491,248,000 cubic feet out of a total of 89,693,372,000 cubic feet of gas produced and sold. The 424 gas works produced 35,202,124,000 cubic feet in 1912. In 1908 the 25 coke works in operation produced 16,205,925,000 cubic feet, and the 481 coke works produced 37,355,886,000 cubic feet of gas. In these figures the quantity of gas lost through leakage, fire, or otherwise, reported in the tables as unaccounted for, is not included. This item in 1908 amounted to 3,382,856,000 cubic feet, and in 1912 it was 3,675,629,000 cubic feet. The total quantity of gas sold in 1912 was 89,693,372,000 cubic feet, valued at $36,681,884, or an average of 41 cents per thousand cubic feet. In 1908 the total gas sold was 53,561,813,000 cubic feet, valued at $37,227,901—an average of 70 cents per thousand cubic feet. The value of the gas produced at coke works in 1912 was $4,650,517, or about 8½ cents per thousand cubic feet, and the value of the gas produced at gas works was $32,031,367, or 91 cents per thousand cubic feet. In 1908 the coke-oven gas was valued at $2,557,483, or about 15 cents per thousand cubic feet, and the gas from gas works was valued at $34,670,418, or 93 cents per thousand cubic feet, indicating a decrease in value of 2 cents per thousand cubic feet in 1912 in the commercial product at gas works, which is used largely for domestic purposes, lighting and heating, whereas the average value of the coke-works gas was about 15 cents in 1908 and 9 cents in 1912. The reason for this apparent decline is found in the relatively larger proportion of the coke-oven gas used at industrial plants associated with the coke ovens, and the smaller proportion sold for distribution through city mains. The quantity and value of gas produced and sold at by-product coke works and coal-gas works of the United States in 1908 and 1912, by States, are shown in the following tables:

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of the United States in 1908, by States.

State.	Number of establishments.	Quantity of coal carbonized.	Total quantity gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
				Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	
		Short tons.	*1,000 cu. ft.*	*1,000 cu. ft.*			*1,000 cu. ft.*			*1,000 cu. ft.*			*1,000 cu. ft.*
Alabama	12	725,345	2,080,280	99,525	$118,662	$1.19	1,917,295	$433,708	$0.23	2,016,820	$552,370	$0.27	63,460
Arkansas	4	6,998	63,102	22,583	32,915	1.46	32,789	41,495	1.27	55,372	74,410	1.34	7,730
California	1	1,700	13,847	6,344	13,280	2.09	6,432	13,240	2.06	12,776	26,520	2.08	1,071
Oregon	2												
Colorado	7	94,307	950,303	200,402	202,571	1.01	661,407	602,661	.91	861,809	805,232	.93	88,494
Connecticut	7	79,037	762,977	420,443	501,763	1.19	290,343	341,147	1.17	710,786	842,910	1.19	52,191
Delaware	2												
District of Columbia	2	445,250	1,632,663	1,484,474	567,083	.38	83,199	78,108	.94	1,567,673	645,191	.41	64,990
Maryland	7												
Florida	2												
Louisiana	1	13,729	104,207	30,208	45,113	1.49	61,341	79,470	1.30	91,549	124,583	1.36	12,658
Mississippi	6												
Georgia	9	72,357	681,293	309,311	341,239	1.10	339,665	353,212	1.04	648,976	694,451	1.07	32,317
Idaho	2												
Montana	2												
North Dakota	2	21,207	218,805	48,656	85,563	1.76	150,501	220,102	1.46	199,157	305,665	1.53	19,648
South Dakota	2												
Wyoming	1												
Illinois	45	663,999	3,896,481	2,399,196	1,268,604	.53	1,249,411	1,285,861	1.03	3,648,607	2,554,465	.70	247,874
Indiana	32	151,644	1,405,554	699,092	672,426	.96	599,481	571,288	.95	1,298,573	1,243,714	.96	106,981
Iowa	17	75,905	715,008	278,676	320,163	1.15	362,691	406,378	1.12	641,367	726,541	1.13	73,641
Kansas	2	13,464	128,478	51,660	62,974	1.22	63,293	82,511	1.30	114,953	145,485	1.27	13,525
Nebraska	4												
Kentucky	13	106,465	996,972	319,415	332,184	1.04	547,406	398,790	.73	866,821	730,974	.84	130,151
Maine	7	20,823	221,303	152,896	212,864	1.39	49,877	64,968	1.30	202,773	277,832	1.37	18,530
Massachusetts	41	998,277	6,159,518	5,157,464	3,398,047	.66	732,677	728,251	.99	5,890,141	4,126,298	.70	269,377
Michigan	47	706,301	4,744,748	2,637,794	1,767,700	.67	1,826,068	1,551,368	.85	4,463,862	3,319,068	.74	280,886
Minnesota	8	201,392	1,275,096	957,250	776,268	.81	227,026	238,648	1.05	1,184,276	1,014,916	.86	90,820
Missouri	16	180,056	1,758,100	679,813	701,069	1.03	938,048	773,320	.82	1,617,861	1,474,389	.91	140,239
New Hampshire	5	23,047	225,059	108,990	135,497	1.24	89,215	108,923	1.22	198,205	244,420	1.23	26,854
Vermont	2												
New Jersey	14	434,771	2,190,611	1,231,183	719,289	.58	937,556	576,644	.62	2,168,739	1,295,933	.60	21,872
New Mexico	1												
Oklahoma	4	25,671	250,423	45,114	61,167	1.36	178,739	175,092	.98	223,853	236,259	1.06	26,570
Utah	1												
New York	50	1,425,600	9,318,961	6,586,267	4,716,808	.72	2,450,394	890,514	.36	9,036,661	5,607,322	.62	282,300

North Carolina	7	31,612	300,120	130,340	187,181	1.44	124,564	149,473	1.20	254,904	336,654	1.32	45,216
South Carolina	2												
Ohio	27	525,272	4,543,232	2,606,741	1,811,447	.69	1,269,751	712,634	.56	3,876,492	2,524,081	.65	666,740
Pennsylvania	27	1,727,956	6,153,919	2,356,360	2,314,198	.98	3,683,135	496,369	.13	6,039,495	2,810,567	.47	114,424
Rhode Island	3	53,057	515,071	258,868	256,982	.99	210,111	208,577	.99	468,979	465,559	.99	46,092
Tennessee	7	68,615	637,100	300,970	306,891	1.01	299,080	301,665	1.01	600,050	608,556	1.01	37,050
Texas	8	30,461	284,650	53,717	98,362	1.83	185,534	240,218	1.29	239,251	338,580	1.42	45,399
Virginia	13	84,693	793,416	434,215	436,141	1.00	212,835	235,679	1.11	647,050	671,820	1.04	146,366
West Virginia	2												
Washington	9	65,866	582,148	239,261	299,006	1.25	288,337	372,188	1.29	527,598	671,194	1.27	54,550
Wisconsin	21	703,373	3,341,224	2,178,343	836,473	.38	1,008,041	895,469	.89	3,186,384	1,731,942	.54	154,840
Total	506	9,252,978	56,944,669	32,485,571	23,599,930	.73	21,076,242	13,627,971	.65	53,561,813	37,227,901	.70	3,382,856

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of the United States in 1912, by States.

State.	Number of establishments.	Quantity of coal carbonized.	Total quantity of gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
				Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	
		Short tons.	1,000 cu. ft.	1,000 cu. ft.			1,000 cu. ft.			1,000 cu. ft.			1,000 cu. ft.
Alabama Arkansas	15 1	1,938,852	8,014,984	215,128	$238,093	$1.11	7,748,900	$654,643	$0.08	7,964,028	$892,736	$0.11	50,956
California Oregon	1 3	3,036	29,705	12,001	23,546	1.96	12,605	24,251	1.92	24,606	47,797	1.94	5,099
Colorado	7	106,722	1,064,826	115,217	123,698	1.07	866,927	807,747	.93	982,144	931,445	.95	82,682
Connecticut Rhode Island	8 2	178,207	1,614,113	887,315	841,212	.95	620,291	576,091	.93	1,507,606	1,417,333	.94	106,507
Delaware District of Columbia	3 2	19,866	189,347	56,272	50,593	.90	110,543	98,584	.89	166,815	149,177	.89	22,532
Florida Louisiana Mississippi	2 1 6	17,172	145,836	26,960	39,147	1.45	96,612	129,618	1.17	123,572	168,765	1.37	22,264
Georgia	10	60,056	547,707	207,786	228,631	1.10	267,600	299,947	1.10	475,386	528,578	1.10	72,321
Idaho Montana North Dakota South Dakota Wyoming	3 4 2 1 1	31,740	323,148	78,187	115,151	1.43	212,243	321,588	1.52	290,430	436,739	1.50	32,718
Illinois	39	2,568,504	14,058,336	4,920,099	1,595,957	.32	8,904,138	1,496,081	.16	13,824,237	3,092,038	.22	234,099
Indiana	31	3,391,707	19,630,711	709,297	622,568	.88	18,778,239	1,763,112	.09	19,487,536	2,385,680	.12	143,175
Iowa	15	82,998	781,462	308,110	333,038	1.08	393,782	400,801	1.02	701,892	733,839	1.05	79,570
Kansas Oklahoma Nebraska	1 1 1	6,761	64,476	16,100	23,990	1.49	41,474	56,949	1.37	57,574	80,939	1.41	6,902
Kentucky	10	58,329	870,851	193,224	199,836	1.03	611,492	440,008	.72	804,716	639,844	.80	66,135
Maine	7	26,202	263,082	129,607	165,021	1.27	112,205	125,385	1.12	241,812	290,406	1.20	21,270
Maryland	8	472,875	1,102,036	1,065,130	104,634	.10	35,129	49,304	1.40	1,100,259	153,938	.14	1,777
Massachusetts	35	1,090,250	6,971,088	4,828,334	2,638,423	.55	1,905,381	1,690,586	.89	6,733,715	4,329,009	.64	237,373
Michigan	50	1,057,562	7,081,177	3,689,900	1,795,429	.49	2,937,809	2,264,689	.77	6,627,709	4,060,118	.61	453,468
Minnesota	10	232,802	1,672,941	876,105	559,276	.64	694,196	685,371	.99	1,570,301	1,244,647	.79	102,640
Missouri	11	179,651	1,732,842	558,763	474,416	.85	1,047,545	855,949	.82	1,606,308	1,330,365	.83	126,534
New Hampshire Vermont	5 2	26,250	272,523	142,825	179,472	1.26	113,594	138,697	1.22	256,419	318,169	1.24	16,104
New Jersey	10	433,026	2,632,189	2,148,009	863,601	.40	424,325	438,382	1.03	2,572,334	1,301,983	.51	59,855
New Mexico Utah	1 2	31,460	346,500	30,092	37,750	1.25	293,873	256,711	.87	323,965	294,461	.91	22,535
New York	42	1,894,002	9,953,075	3,415,919	2,465,181	.72	5,957,027	2,839,641	.48	9,372,946	5,304,822	.57	580,129

North Carolina	6	15,876	150,347	58,084	81,327	1.40	70,866	126,479	1.59	128,950	207,806	1.61	21,397
South Carolina	1												
Ohio	17	415,328	1,402,606	1,138,373	417,921	.38	191,717	159,961	.83	1,330,090	577,882	.43	72,516
Pennsylvania	25	2,876,942	5,489,244	1,664,557	1,352,129	.81	3,303,501	275,471	.08	4,968,058	1,627,600	.33	521,186
Tennessee	6	72,353	667,403	298,910	306,470	1.03	299,322	304,113	1.02	598,232	610,583	1.02	69,171
Texas	4	9,581	90,220	3,697	4,806	1.30	70,652	100,232	1.42	74,349	105,038	1.41	15,871
Virginia	13	337,830	881,328	406,492	418,488	1.03	343,449	317,124	.92	749,941	735,612	.98	131,387
West Virginia	3												
Washington	9	99,123	980,224	384,122	450,369	1.17	522,712	633,385	1.21	906,834	1,083,754	1.22	73,390
Wisconsin	21	989,540	4,344,674	3,279,437	849,483	.26	841,171	751,328	.89	4,120,608	1,600,811	.39	224,066
Total	458	18,724,603	93,369,001	31,864,052	17,599,656	.55	57,829,320	19,082,228	.33	89,693,372	36,681,884	.41	3,675,629

In the preceding tables showing the production of coal gas by States the gas sold for illumination is separated approximately from that sold for fuel. It is impossible to separate exactly the fuel gas and the illuminating gas, for although in many places, in order to encourage the use of gas for cooking, additional meters are installed and a lower price is charged for such gas; there are just as many places where the gas for both lighting and cooking passes through the same meter, so that only approximate estimates of the quantities used for the two purposes are obtainable. Where gas is used in large quantities for generation of power separate meters are generally installed, and the quantity so used can therefore be more accurately determined than the quantity used otherwise than for illumination by domestic consumers. The manufacture and transportation of gas necessarily involves a considerable loss through leakage, fire, and other accidents, and in the total production of 93,369,001,000 cubic feet in 1912, 3,675,629,000 cubic feet, or 3.9 per cent, were reported as lost or unaccounted for. This loss in 1912 was considerably less than that reported in 1908, when out of a total of 56,944,669,000 cubic feet, the loss was 3,382,856,000 cubic feet, or 5.9 per cent. The largest percentages of loss in 1912 were reported in the production of Texas, and in the combined production of California and Oregon, in each case more than 17 per cent. The smallest percentages of loss were reported in Maryland (0.2), in the combined production of Alabama and Arkansas (0.6), and in Indiana (0.7). In 1908 the largest losses were shown in the output of Virginia and West Virginia, and the smallest were reported in the output of New Jersey, Pennsylvania, and New York.

The following table shows the total quantity of gas produced in each State, according to rank, in 1908 and 1912, with the quantity and percentage of gas sold, and of gas lost or unaccounted for:

Rank of States in coal-gas production and the quantity sold and unaccounted for in 1908 and 1912, by States.

1908.

Rank.	State.	Total production.	Gas sold.		Gas unaccounted for.	
			Quantity.	Percentage.	Quantity.	Percentage.
		1,000 cu. ft.	1,000 cu. ft.		1,000 cu. ft.	
1	New York	9,318,961	9,036,661	97.0	282,300	3.0
2	Massachusetts	6,159,518	5,890,141	95.6	269,377	4.4
3	Pennsylvania	6,153,919	6,039,495	98.1	114,424	1.9
4	Michigan	4,744,748	4,463,862	94.1	280,886	5.9
5	Ohio	4,543,232	3,876,492	85.3	666,740	14.7
6	Illinois	3,896,481	3,648,607	93.6	247,874	6.4
7	Wisconsin	3,341,224	3,186,384	95.4	154,840	4.6
8	New Jersey	2,190,611	2,168,739	99.0	21,872	1.0
9	Alabama	2,080,280	2,016,820	96.9	63,460	3.1
10	Missouri	1,758,100	1,617,861	92.0	140,239	8.0
11	Delaware, District of Columbia, and Maryland	1,632,663	1,567,673	96.0	64,990	4.0
12	Indiana	1,405,554	1,298,573	92.4	106,981	7.6
13	Minnesota	1,275,096	1,184,276	92.9	90,820	7.1
14	Kentucky	996,972	866,821	86.9	130,151	13.1
15	Colorado	950,303	861,809	90.7	88,494	9.3
16	Virginia and West Virginia	793,416	647,050	81.6	146,366	18.4
17	Connecticut	762,977	710,786	93.2	52,191	6.8
18	Iowa	715,008	641,367	89.7	73,641	10.3
19	Georgia	681,293	648,976	95.3	32,317	4.7
20	Tennessee	637,100	600,050	94.2	37,050	5.8
21	Washington	582,148	527,598	90.6	54,550	9.4
22	Rhode Island	515,071	468,979	91.1	46,092	8.9
23	North Carolina and South Carolina	300,120	254,904	84.9	45,216	15.1
24	Texas	284,650	239,251	84.1	45,399	15.9
25	New Mexico, Oklahoma, and Utah	250,423	223,853	89.4	26,570	10.6
26	New Hampshire and Vermont	225,059	198,205	88.1	26,854	11.9
27	Maine	221,303	202,773	91.6	18,530	8.4
28	Idaho, Montana, North Dakota, South Dakota, and Wyoming	218,805	199,157	91.0	19,648	9.0
29	Kansas and Nebraska	128,478	114,953	89.5	13,525	10.5
30	Forida, Louisiana, and Mississippi	104,207	91,549	87.9	12,658	12.1
31	Arkansas	63,102	55,372	87.7	7,730	12.3
32	California and Oregon	13,847	12,776	92.3	1,071	7.7
	Total	56,944,669	53,561,813	94.1	3,382,856	5.9

1912.

Rank.	State.	Total production.	Gas sold: Quantity.	Gas sold: Percentage.	Gas unaccounted for: Quantity.	Gas unaccounted for: Percentage.
1	Indiana	19,630,711	19,487,536	99.3	143,175	0.7
2	Illinois	14,058,336	13,824,237	98.3	234,099	1.7
3	New York	9,953,075	9,372,946	94.2	580,129	5.8
4	Alabama and Arkansas	8,014,984	7,964,028	99.4	50,956	.6
5	Michigan	7,081,177	6,627,709	93.6	453,468	6.4
6	Massachusetts	6,971,088	6,733,715	96.6	237,373	3.4
7	Pennsylvania	5,489,244	4,968,058	90.5	521,186	9.5
8	Wisconsin	4,344,674	4,120,608	94.9	224,066	5.1
9	New Jersey	2,632,189	2,572,334	97.7	59,855	2.3
10	Missouri	1,732,842	1,606,308	92.7	126,534	7.3
11	Minnesota	1,672,941	1,570,301	93.9	102,640	6.1
12	Connecticut and Rhode Island	1,614,113	1,507,606	93.4	106,507	6.6
13	Ohio	1,402,606	1,330,090	94.9	72,516	5.1
14	Maryland	1,102,036	1,100,259	99.8	1,777	.2
15	Colorado	1,064,826	982,144	92.2	82,682	7.8
16	Washington	980,224	906,834	92.5	73,390	7.5
17	Virginia and West Virginia	881,328	749,941	85.1	131,387	14.9
18	Kentucky	870,851	804,716	92.4	66,135	7.6
19	Iowa	781,462	701,892	89.8	79,570	10.2
20	Tennessee	667,403	598,232	89.6	69,171	10.4
21	Georgia	547,707	475,386	86.8	72,321	13.2
22	New Mexico and Utah	346,500	323,965	93.5	22,535	6.5
23	Idaho, Montana, North Dakota, South Dakota, and Wyoming	323,148	290,430	89.9	32,718	10.1
24	New Hampshire and Vermont	272,523	256,419	94.1	16,104	5.9
25	Maine	263,082	241,812	91.9	21,270	8.1
26	Delaware and District of Columbia	189,347	166,815	88.1	22,532	11.9
27	North Carolina and South Carolina	150,347	128,950	85.8	21,397	14.2
28	Florida, Louisiana, and Mississippi	145,836	123,572	84.7	22,264	15.3
29	Texas	90,220	74,349	82.4	15,871	17.6
30	Kansas, Oklahoma, and Nebraska	64,476	57,574	89.3	6,902	10.7
31	California and Oregon	29,705	24,606	82.8	5,099	17.2
	Total	93,369,001	89,693,372	96.1	3,675,629	3.9

The statistics of production of gas reported to the Geological Survey in the years for which this information has been obtained show a considerably more rapid increase in the quantity of gas used for fuel than for illumination. The greater part of this more rapid gain in fuel-gas consumption has been due to the increasing output from by-product retort coke ovens and to less extent to the increasing popularity of gas for cooking and heating. The quantity of coal gas used for illumination from 1908 to 1912 shows an actual decrease of about 620,000,000 cubic feet, and an even larger decrease is shown in the consumption of oil and water gas for illumination. Economies in the use of gas for illumination have been effected by installing gas-saving devices, such as the Welsbach burner, and such devices probably decrease somewhat the consumption of illuminating gas. The greater part of the decrease, however, is probably due to the substitution of electric light for gas light. On the other hand, the quantity of coal gas sold for fuel increased approximately 36,750,000,000 cubic feet, from 21,076,000,000 feet in 1908 to 57,829,000,000 cubic feet in 1912. The percentage of illuminating gas used decreased from 60.7 in 1908 to 35.5 in 1912, and the percentage of gas used for fuel increased from 39.3 to 64.5. This increase in the quantity and percentage of gas used for fuel is naturally due to the increased output from coke ovens—from 16,206,000,000 cubic feet in 1908 to 54,490,000,000 cubic feet in 1912.

The following table shows the total quantity of coal gas consumed in 1908 and 1912, with the quantity and percentage used for illuminating and for fuel purposes:

Quantity of illuminating and fuel coal gas sold in 1908 and 1912, by States.

1908.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Percentage.	Quantity.	Percentage.
	1,000 cu. ft.	*1,000 cu. ft.*		*1,000 cu. ft.*	
Alabama	2,016,820	99,525	4.9	1,917,295	95.1
Arkansas	55,372	22,583	40.8	32,789	59.2
California and Oregon	12,776	6,344	49.7	6,432	50.3
Colorado	861,809	200,402	23.3	661,407	76.7
Connecticut	710,786	420,443	59.2	290,343	40.8
Delaware, District of Columbia, and Maryland	1,567,673	1,484,474	94.7	83,199	5.3
Florida, Louisiana, and Mississippi	91,549	30,208	33.0	61,341	67.0
Georgia	648,976	309,311	47.7	339,665	52.3
Idaho, Montana, North Dakota, South Dakota, and Wyoming	199,157	48,656	24.4	150,501	75.6
Illinois	3,648,607	2,399,196	65.8	1,249,411	34.2
Indiana	1,298,573	699,092	53.8	599,481	46.2
Iowa	641,367	278,676	43.5	362,691	56.5
Kansas and Nebraska	114,953	51,660	44.9	63,293	55.1
Kentucky	866,821	319,415	36.8	547,406	63.2
Maine	202,773	152,896	75.4	49,877	24.6
Massachusetts	5,890,141	5,157,464	87.6	732,677	12.4
Michigan	4,463,862	2,637,794	59.1	1,826,068	40.9
Minnesota	1,184,276	957,250	80.8	227,026	19.2
Missouri	1,617,861	679,813	42.0	938,048	58.0
New Hampshire and Vermont	198,205	108,990	55.0	89,215	45.0
New Jersey	2,168,739	1,231,183	56.8	937,556	43.2
New Mexico, Oklahoma, and Utah	223,853	45,114	20.2	178,739	79.8
New York	9,036,661	6,586,267	72.9	2,450,394	27.1
North Carolina and South Carolina	254,904	130,340	51.1	124,564	48.9
Ohio	3,876,492	2,606,741	67.2	1,269,751	32.8
Pennsylvania	6,039,495	2,356,360	39.0	3,683,135	61.0
Rhode Island	468,979	258,868	55.2	210,111	44.8
Tennessee	600,050	300,970	50.2	299,080	49.8
Texas	239,251	53,717	22.5	185,534	77.5
Virginia and West Virginia	647,050	434,215	67.1	212,835	32.9
Washington	527,598	239,261	45.3	288,337	54.7
Wisconsin	3,186,384	2,178,343	68.4	1,008,041	31.6
Total	53,561,813	32,485,571	60.7	21,076,242	39.3

1912.

State.	Total sales.	Illuminating quantity.	Illuminating percentage.	Fuel quantity.	Fuel percentage.
Alabama and Arkansas	7,964,028	215,128	2.7	7,748,900	97.3
California and Oregon	24,606	12,001	48.8	12,605	51.2
Colorado	982,144	115,217	11.7	866,927	88.3
Connecticut and Rhode Island	1,507,606	887,315	58.9	620,291	41.1
Delaware and District of Columbia	166,815	56,272	33.7	110,543	66.3
Florida, Louisiana, and Mississippi	123,572	26,960	21.8	96,612	78 2
Georgia	475,386	207,786	43.7	267,600	56.3
Idaho, Montana, North Dakota, South Dakota, and Wyoming	290,430	78,187	26.9	212,243	73.1
Illinois	13,824,237	4,920,099	35.6	8,904,138	64.4
Indiana	19,487,536	709,297	3.6	18,778,239	96.4
Iowa	701,892	308,110	43.9	393,782	56.1
Kansas, Oklahoma, and Nebraska	57,574	16,100	28.0	41,474	72.0
Kentucky	804,716	193,224	24.0	611,492	76.0
Maine	241,812	129,607	53.6	112,205	46.4
Maryland	1,100,259	1,065,130	96.8	35,129	3.2
Massachusetts	6,733,715	4,828,334	71.7	1,905,381	28.3
Michigan	6,627,709	3,689,900	55.7	2,937,809	44.3
Minnesota	1,570,301	876,105	55.8	694,196	44.2
Missouri	1,606,308	558,763	34.8	1,047,545	65.2
New Hampshire and Vermont	256,419	142,825	55.7	113,594	44.3
New Jersey	2,572,334	2,148,009	83.5	424,325	16.5
New Mexico and Utah	323,965	30,092	9.3	293,873	90.7
New York	9,372,946	3,415,919	36.4	5,957,027	63.6
North Carolina and South Carolina	128,950	58,084	45.0	70,866	55.0
Ohio	1,330,090	1,138,373	85.6	191,717	14.4
Pennsylvania	4,968,058	1,664,557	33.5	3,303,501	66.5
Tennessee	598,232	298,910	49.9	299,322	50.1
Texas	74,349	3,697	5.0	70,652	95.0
Virginia and West Virginia	749,941	406,492	54.2	343,449	45.8
Washington	906,834	384,122	42.4	522,712	57.6
Wisconsin	4,120,608	3,279,437	79.6	841,171	20.4
Total	89,693,372	31,864,052	35.5	57,829,320	64.5

THE PRODUCTION OF OIL AND WATER GAS.

Since the manufacture of coke in retort ovens assumed, in 1897, proportions large enough to give it rank as an independent industry, the problems connected with the by-products obtained have created a desire for statistics of these products, and, in addition, those which are the output of gas houses. In order to meet this demand the Geological Survey prepared a special report on the production of gas, coke, tar, and ammonia in 1898. Similar reports were prepared for the calendar years 1903, 1904, 1905, 1907, and 1908. The publication of these reports has in turn created a desire for information concerning the production of oil and water gas, and in response to numerous requests the reports on the production of gas, tar, and ammonia in 1905, 1907, and 1908 were supplemented by a section on the production of oil and water gas. A similar section for 1912 has been added to the present report.

It is of particular interest to note that, although the production of coal gas showed a decrease from 1907 to 1908, and again from 1908 to 1912, the production of oil and water gas showed an increase in both periods. In fact, the production of oil and water gas has developed with somewhat marked rapidity in recent years, and a number of companies that formerly produced coal gas now make wholly or in part water gas, which is enriched by the use of oil. Other plants, especially those in cities adjoining large oil-producing fields, are manufacturing illuminating gas from crude petroleum. The statistics of the production of oil gas and water gas are combined in this chapter. In 1907 there were 516 coal-gas companies reporting to the Geological Survey, and in 1912 there were 458, a decrease in five years of 58. In 1907 there were 13 less than in 1905, two years before. The number of companies reporting a production of oil and water gas to the Geological Survey has, on the other hand, increased from 477 in 1905 to 520 in 1907, to 552 in 1908, and to 604 in 1912, and the quantity of oil and water gas produced and sold increased from 103,347,497,000 cubic feet to 122,697,796,000 cubic feet. This indicates a normal increase; but it should be observed that the consumption of oil and water gas, as of coal gas, for illumination has decreased, and that the decrease in the consumption of oil and water gas for illumination is more than ten times the decrease in the consumption of coal gas for illumination. The quantity of oil and water gas sold for illumination in 1908 was 76,804,546,000 cubic feet, valued at $70,294,158, or 92 cents per thousand cubic feet; in 1912 the quantity of oil and water gas sold for illumination was 68,136,269,000 cubic feet, valued at $62,931,596, or 92.4 cents per thousand cubic feet. The oil and water gas sold for fuel increased from 26,542,951,000 cubic feet, valued at $26,049,063, or 98 cents per thousand cubic feet, in 1908, to 54,561,527,000 cubic feet, valued at $48,669,245, or 89 cents per thousand cubic feet, in 1912. The larger part of the oil and water gas used as fuel is consumed in households for cooking and heating. In many places this gas is passed through the same mains and the same meter as the illuminating gas and is sold at the same price. In other places separate meters are used and reductions are made in the price of the gas used for cooking and heating. The total difference is not much, however, as the average price for illuminating gas was 92.4 cents per thousand cubic feet in 1912 and the average price for fuel gas was 89 cents. In 1908 about 75 per cent of the total quantity of oil and water gas produced was sold for illumination and 25 per cent was sold for fuel, whereas in 1912 only 56 per cent of the oil and water gas was used for illumination and 44 per cent for fuel. Of the total oil and water gas produced in 1912, 12,009,713,000 cubic feet, or 9 per cent, was lost or unaccounted for. The gas lost or unaccounted for at the coal-gas and retort-oven works was 3.9 per cent, the larger loss of water gas being due to the much larger proportion of that gas distributed through city mains and not directly to manufacturing establishments.

The quantity and value of oil and water gas produced and sold in the United States in 1908 and 1912, by States, are shown in the following tables:

Quantity and value of oil and water gas produced and sold in the United States in 1908, by States.

State.	Number of establishments.	Total quantity of gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
			Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	
		1,000 cu. ft.	*1,000 cu. ft.*			*1,000 cu. ft.*			*1,000 cu. ft.*			*1,000 cu. ft.*
Alabama	4	110,751	16,748	$19,552	$1.16	83,048	$96,663	$1.16	99,796	$116,215	$1.16	10,955
Arizona	6	79,658	18,821	36,431	1.94	50,554	93,182	1.84	69,375	129,613	1.87	10,283
Arkansas Oklahoma	3 1	106,056	46,755	60,951	1.30	47,925	62,629	1.31	94,680	123,580	1.31	11,376
California	61	10,623,330	5,404,197	5,204,785	.96	4,456,994	4,648,571	1.04	9,861,191	9,853,356	1.00	762,139
Colorado	5	263,130	50,518	48,016	.95	191,740	174,798	.92	242,258	222,814	.92	20,872
Connecticut	20	2,226,247	1,258,076	1,283,952	1.02	802,289	767,319	.96	2,060,365	2,051,271	1.00	165,882
Delaware	3	338,654	207,133	208,503	1.00	97,420	98,165	1.01	304,553	306,668	1.01	34,101
District of Columbia Maryland	2 6	3,689,883	2,483,454	2,484,509	1.00	940,463	935,676	.99	3,423,917	3,420,185	1.00	265,966
Florida	10	257,384	114,139	196,125	1.72	123,535	190,974	1.55	237,674	387,099	1.63	19,710
Georgia	5	410,755	179,469	201,070	1.12	229,331	256,882	1.12	408,800	457,952	1.12	1,955
Illinois	30	11,611,045	6,916,479	5,980,419	.86	3,556,139	3,164,859	.89	10,472,618	9,145,278	.88	1,138,427
Indiana	21	1,471,746	669,785	637,332	.95	668,204	630,052	.94	1,337,989	1,267,384	.95	133,757
Iowa	30	1,346,140	578,424	653,233	1.13	668,648	732,886	1.10	1,247,072	1,386,119	1.11	99,068
Kansas Nebraska	1 11	865,437	348,170	416,153	1.20	470,775	550,930	1.17	818,945	967,083	1.18	46,492
Kentucky Tennessee	6 2	703,834	330,709	336,843	1.02	248,206	197,941	.80	578,915	534,784	.92	124,919
Louisiana Mississippi	1 2	1,017,557	392,724	1,032,034	2.63	520,200	538,830	1.04	912,924	1,570,864	1.72	104,633
Maine	3	134,337	88,285	114,756	1.30	35,264	46,040	1.31	123,549	160,796	1.30	10,788
Massachusetts	34	5,135,351	4,100,519	3,571,597	.87	769,662	714,973	.93	4,870,181	4,286,570	.88	265,170
Michigan	22	1,323,095	571,644	583,380	1.02	665,187	549,791	.83	1,236,831	1,133,180	.92	86,264
Minnesota	9	1,737,636	1,286,998	1,297,160	1.01	287,446	298,983	1.04	1,574,444	1,596,143	1.01	163,192
Missouri	10	2,886,507	1,087,138	1,101,372	1.01	1,581,891	1,265,706	.80	2,669,029	2,367,078	.89	217,478
Montana North Dakota	1 3	31,746	11,166	20,129	1.80	18,058	30,441	1.69	29,224	50,570	1.73	2,522
Nevada New Mexico	3 1	36,446	6,200	14,170	2.29	25,321	49,593	1.96	31,521	63,763	2.02	4,925
New Hampshire	10	215,526	119,691	168,414	1.41	73,932	99,322	1.34	193,623	267,736	1.38	21,903
New Jersey	25	6,665,534	3,241,345	3,142,411	.97	3,186,822	3,105,072	.97	6,428,167	6,247,483	.97	237,367
New York	55	41,455,459	35,511,916	29,334,778	.83	3,762,431	3,565,075	.95	39,274,347	32,899,853	.84	2,181,112
North Carolina South Carolina	6 2	137,949	69,903	103,796	1.48	50,351	67,558	1.34	120,254	171,354	1.42	17,695
Ohio	13	375,678	218,034	213,228	.98	106,509	72,460	.68	324,543	285,688	.88	51,135

Oregon	3	868,520	313,550	288,189	.92	467,817	427,332	.91	781,367	715,521	.92	87,153
Pennsylvania	66	10,768,369	9,544,895	9,754,341	1.02	975,938	1,085,242	1.11	10,520,833	10,839,583	1.03	247,536
Rhode Island	6	1,155,538	629,811	641,284	1.02	428,854	427,920	1.00	1,058,665	1,069,204	1.01	96,873
South Dakota	6	109,267	49,186	66,498	1.35	53,259	69,725	1.31	102,445	136,223	1.33	6,822
Texas	11	671,360	286,206	364,749	1.27	306,458	389,983	1.27	592,664	754,732	1.27	78,696
Vermont	9	128,245	46,273	60,403	1.31	74,339	97,275	1.31	120,612	157,678	1.31	7,633
Virginia	6	568,113	336,715	336,532	1.00	134,593	132,977	.99	471,308	469,509	1.00	96,805
West Virginia	2											
Washington	4	420,385	190,532	202,844	1.06	194,811	209,093	1.07	385,343	411,937	1.07	35,042
Wisconsin	12	290,535	78,938	114,210	1.45	188,537	204,145	1.08	267,475	318,355	1.19	23,060
Total	552	110,237,203	76,804,546	70,294,158	.92	26,542,951	26,049,063	.98	103,347,497	96,343,221	.93	6,889,706

Quantity and value of oil and water gas produced and sold in the United States in 1912, by States.

State.	Number of establishments.	Total quantity of gas produced.	Gas sold for illuminating purposes.			Gas sold for fuel purposes.			Total gas sold.			Quantity of gas unaccounted for.
			Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	Quantity.	Value.	Price per 1,000 cubic feet.	
		1,000 cu. ft.	*1,000 cu. ft.*			*1,000 cu. ft.*			*1,000 cu. ft.*			*1,000 cu. ft.*
Alabama	4	134,250	46,412	$47,368	$1.02	85,696	$86,685	$1.01	132,108	$134,053	$1.01	2,142
Arizona	6	118,376	18,314	32,057	1.75	80,457	127,910	1.40	98,771	159,967	1.62	19,605
California	62	14,636,735	3,992,826	3,410,152	.85	8,985,076	7,781,684	.86	12,977,902	11,191,836	.86	1,658,833
Colorado	5	308,031	34,348	37,290	1.09	251,538	222,867	.89	285,886	260,157	.91	22,145
Connecticut	21	3,270,990	1,694,205	1,731,569	1.02	1,344,363	1,245,917	.93	3,038,568	2,977,486	.98	232,422
Delaware	3	473,429	253,769	244,015	.96	165,484	158,519	.96	419,253	402,534	.96	54,176
District of Columbia	2	5,525,790	2,123,962	1,869,604	.88	2,987,444	2,601,984	.87	5,111,406	4,471,588	.87	414,384
Maryland	6											
Florida	10	560,344	184,163	243,281	1.32	288,953	361,945	1.25	473,116	605,226	1.28	87,228
Georgia	4	926,281	386,046	385,264	1.00	475,889	459,446	.97	861,935	844,710	.98	64,346
Illinois	35	2,558,672	1,051,442	1,072,464	1.02	1,314,746	1,345,945	1.02	2,366,188	2,418,409	1.02	192,484
Indiana	19	2,508,894	857,970	728,221	.85	1,415,459	1,153,754	.82	2,273,429	1,881,975	.83	235,465
Iowa	43	2,058,107	1,046,169	1,092,454	1.04	886,382	950,778	1.07	1,932,551	2,043,232	1.06	125,556
Kansas	1											
Oklahoma	2	1,309,360	444,399	530,106	1.19	803,932	957,702	1.19	1,248,331	1,487,808	1.19	61,029
Nebraska	15											
Kentucky	5	947,031	459,614	469,422	1.02	450,830	357,884	.79	910,444	827,306	.91	36,587
Tennessee	4											
Louisiana	2	1,143,558	416,364	437,048	1.05	625,309	657,008	1.05	1,041,673	1,094,056	1.05	101,885
Mississippi	2											
Maine	3	211,584	60,399	72,753	1.20	125,643	147,660	1.18	186,042	220,413	1.18	25,542
Massachusetts	38	10,923,242	8,188,654	7,673,139	.94	2,281,947	2,064,770	.90	10,470,601	9,737,909	.93	452,641
Michigan	21	2,224,141	679,070	548,126	.81	1,251,776	979,534	.78	1,930,846	1,527,660	.79	293,295
Minnesota	10	2,778,783	975,828	903,865	.93	1,554,035	1,220.548	.78	2,529,863	2,124,413	.84	248,920
Missouri	13	4,322,174	1,339,326	1,091,591	.82	2,650,667	2,159,736	.81	3,989,993	3,251,327	.81	332,181
Montana	2	34,902	10,408	16,253	1.56	21,473	33,701	1.57	31,881	49,954	1.57	3,021
North Dakota	3											
Nevada	3											
New Mexico	1	65,398	9,295	16,580	1.78	46,699	71,151	1.52	55,994	87,731	1.57	9,404
Utah	1											
New Hampshire	8	339,571	186,285	235,327	1.26	124,394	149,790	1.20	310,679	385,117	1.24	28,892
New Jersey	22	10,150,608	4,392,788	4,476,347	1.02	4,475,305	4,616,085	1.03	8,868,093	9,092,432	1.03	1,282,515
New York	64	45,807,509	25,216,308	21,396,939	.85	16,276,007	12,973,535	.80	41,492,315	34,370,474	.83	4,315,194
North Carolina	8	528,338	198,736	252,633	1.27	279,628	351,048	1.26	478,364	603,681	1.26	49,974
South Carolina	4											
Ohio	10	1,213,016	452,879	403,285	.89	669,952	544,439	.81	1,122,831	947,724	.84	90,185

Oregon	4	1,499,660	520,405	483,275	.93	782,011	727,547	.93	1,302,416	1,210,822	.93	197,244
Pennsylvania	62	13,009,863	10,687,074	10,772,549	1.01	1,393,677	1,412,379	1.01	12,080,751	12,184,928	1.01	929,112
Rhode Island	5	1,440,437	751,906	708,560	.94	632,803	594,056	.94	1,384,709	1,302,616	.94	55,728
South Dakota	10	197,114	79,035	113,567	1.44	102,479	151,271	1.48	181,514	264,838	1.46	15,600
Texas	16	1,149,840	303,559	361,049	1.19	717,246	870,874	1.21	1,020,805	1,231,923	1.20	129,035
Vermont	8	175,688	55,143	71,888	1.30	97,438	130,890	1.34	152,581	202,778	1.32	23,107
Virginia	11	1,000,285	610,806	568,176	.93	260,602	281,516	1.08	871,408	849,692	.98	128,877
West Virginia	3											
Washington	5	678,204	298,936	310,024	1.04	326,785	342,077	1.05	625,721	652,101	1.04	52,483
Wisconsin	18	477,304	109,426	125,355	1.15	329,402	376,610	1.14	438,828	501,965	1.14	38,476
Total	604	134,707,509	68,136,269	62,931,596	.924	54,561,527	48,669,245	.89	122,697,796	111,600,841	.91	12,009,713

PRODUCTION OF COKE.

The production of coke in by-product ovens and at gas works increased from 6,253,125 short tons, valued at $21,507,045, in 1908 to 12,490,757 tons, valued at $48,380,009, in 1912. The increase in quantity was almost exactly 100 per cent and the gain in value was nearly 130 per cent. The average value per ton in 1912 was $3.87 and in 1908 it was $3.44. The average yield of coal in coke was 72.7 per cent in 1912 against 63.9 per cent in 1908. The increase in production, the relatively larger gain in values, and the higher percentage yield of coal in coke were all due to the progress made during the last few years in the manufacture of coke in by-product ovens, which is discussed at length in the general chapter on coke. The quantity of coke produced in gas-house retorts decreased from 2,051,899 short tons in 1908 to 1,375,593 tons in 1912, whereas the quantity produced in by-product ovens increased from 4,201,226 tons to 11,115,164 tons. The oven coke, being a fuel suitable for blast-furnace, foundry, or smelter use, commands a much higher price in the same markets than gas-house coke, which is suitable only for domestic purposes, for steam boilers, or for relatively low-temperature heating. The average value per ton for gas and oven coke in 1912 was $3.87.

The total quantity of coal carbonized or coked at gas works and in by-product ovens in 1912 was 18,724,603 short tons, of which 14,767,543 tons were coked in by-product ovens and 3,957,060 tons were used at gas works. These figures compare with a total of 9,252,978 tons of coal carbonized in 1908, of which 5,699,058 tons were coked in by-product ovens and 3,553,920 tons at gas works. The number of gas works reporting production and sales of coke in 1912 was 397, against 442 in 1908, a decrease of 45; the number of by-product plants increased from 25 to 34, indicating a combined net decrease of 36 plants, from 467 in 1908 to 431 in 1912.

Many gas companies also operate electric-light plants, and some coke produced at gas works, as well as considerable quantities of tar, is used as fuel in electric plants. Coal-gas companies also make water gas, and water-gas companies use coke from the coal-gas benches for firing their plants. Some coke is also used in carbonizing coal in coal-gas works. The total quantity of coke made at gas works and retort ovens in 1912 was 13,431,508 short tons. The quantity sold, which is considered the commercial production, was 12,490,757 short tons, so that approximately 1,000,000 tons were consumed at the works.

The following tables give the production of coke at gas works and retort ovens in 1908 and 1912 by States, arranged according to their rank in production. The tables show some decided changes in rank. Indiana has advanced from thirteenth to first place, principally because of the operations of the large plant of retort ovens at Gary; Illinois has advanced from fifth to third place; New York has dropped from second to fifth place, and Wisconsin from fourth to seventh.

Rank of States in production of coke in gas works and by-product ovens in 1908 and 1912.

1908.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
			Short tons.			*Per cent.*
1	Pennsylvania	24	1,286,371	$4,168,935	$3.24	73.9
2	New York	44	878,399	2,887,465	3.29	61.9
3	Massachusetts	40	613,169	2,005,005	3.27	61.6
4	Wisconsin	20	501,752	2,270,516	4.53	71.7
5	Illinois	44	500,451	2,107,167	4.21	65.2
6	Alabama	9	489,788	1,417,074	2.89	67.7
7	Michigan	47	438,866	1,694,362	3.86	62.1
8	Ohio	27	347,479	846,722	2.44	63.2
9	Delaware, District of Columbia, and Maryland	10	307,333	1,131,979	3.68	69.1
10	New Jersey	13	258,565	632,768	2.45	69.9
11	Missouri	16	107,831	375,705	3.48	59.9
12	Minnesota	8	90,664	362,676	4.00	45.0
13	Indiana	29	78,985	247,641	3.14	53.9
14	Kentucky	10	44,835	132,459	2.95	43.1
15	Connecticut	6	40,311	135,577	3.36	52.3
16	Iowa	16	37,041	176,078	4.75	50.8
17	Washington	8	32,622	164,346	5.04	50.9
18	Virginia and West Virginia	15	31,867	116,413	3.65	37.6
19	Colorado	6	26,788	79,978	2.99	30.6
20	Tennessee	5	25,390	87,458	3.44	38.6
21	Georgia	8	22,724	74,877	3.30	31.5
22	Rhode Island	3	20,633	84,882	4.11	38.9
23	North Carolina and South Carolina	7	14,121	39,688	2.81	51.1
24	New Hampshire and Vermont	7	12,699	69,967	5.51	55.1
25	New Mexico, Oklahoma, and Utah	6	12,667	35,068	2.77	49.3
26	Texas	6	8,733	39,714	4.55	39.8
27	Idaho, Montana, North Dakota, South Dakota, and Wyoming	8	8,375	53,832	6.43	44.5
28	Maine	7	5,330	25,690	4.82	25.6
29	Florida, Louisiana, and Mississippi	7	4,089	18,999	4.65	41.9
30	Arkansas	3	3,221	11,713	3.64	54.4
31	Kansas and Nebraska	5	1,667	9,692	5.81	12.9
32	California and Oregon	3	359	2,599	7.24	21.1
	Total	467	6,253,125	21,507,045	3.44	63.9

1912.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
1	Indiana	30	2,693,846	$12,840,038	$4.77	80.7
2	Pennsylvania	24	2,079,601	6,312,725	3.04	72.6
3	Illinois	36	1,894,616	8,650,249	4.57	75.0
4	Alabama and Arkansas	14	1,374,195	3,560,377	2.59	71.7
5	New York	39	1,047,210	4,098,949	3.91	69.9
6	Michigan	50	657,975	2,605,034	3.96	70.8
7	Wisconsin	20	644,909	2,728,842	4.23	68.2
8	Massachusetts	32	553,998	1,800,396	3.25	72.5
9	New Jersey	8	280,191	727,190	2.60	75.6
10	Maryland	6	306,232	1,336,255	4.36	65.1
11	Ohio	16	280,328	1,041,408	3.71	69.8
12	Virginia and West Virginia	15	209,414	632,597	3.02	71.1
13	Minnesota	10	98,475	419,765	4.26	66.1
14	Missouri	11	33,607	140,997	4.20	63.1
15	Connecticut and Rhode Island	10	66,079	324,377	4.91	57.7
16	Colorado	7	55,346	198,581	3.59	59.8
17	Washington	8	15,353	82,579	5.38	56.3
18	Iowa	15	42,355	235,823	5.57	63.8
19	Kentucky	9	42,891	130,927	3.05	55.0
20	Tennessee	6	31,843	91,212	2.86	64.0
21	Georgia	10	13,535	56,580	4.18	59.8
22	New Mexico and Utah	3	12,699	65,665	5.17	65.8
23	Idaho, Montana, North Dakota, South Dakota, and Wyoming	11	13,358	82,485	6.17	59.2
24	New Hampshire and Vermont	7	11,479	59,921	5.22	67.6
25	Maine	6	8,180	45,355	5.54	50.3
26	Delaware and District of Columbia	4	8,314	45,417	5.46	63.1
27	North Carolina and South Carolina	7	5,696	23,837	4.18	58.7
28	Florida, Louisiana, and Mississippi	7	4,640	19,159	4.13	58.5
29	Texas	4	2,548	12,445	4.88	58.8
30	California and Oregon	4	989	5,682	5.75	61.2
31	Nebraska and Oklahoma	2	855	5,142	6.01	....
	Total	431	12,490,757	48,380,009	3.87	72.7

PRODUCTION OF COAL TAR.

Of the 458 companies that reported production of coal gas in 1912, 428 reported sales of coal tar. In 1908 production of coal tar was reported to the Geological Survey by 471 companies out of a total of 506. The production (meaning sales) increased from 101,261,829 gallons in 1908 to 134,796,438 gallons in 1912. The value increased from $2,537,118 to $3,802,047. The increase in quantity was 33,534,609 gallons, or 33 per cent, and the gain in value was $1,264,929, or almost exactly 50 per cent. The average value per gallon was 2.8 cents in 1912, against 2.5 cents in 1908. These figures indicate that the demand has not only kept pace with the increased production, but has somewhat exceeded it. From 1893 to 1908 the prices for coal tar steadily declined.

The growing demand since 1908 has been due chiefly to the extending use of prepared tar for roads and to the employment of creosoting oils for preserving railroad ties. The increase in the use first named is caused by the greater road wear due to automobile traffic, and the transportation companies have been driven to the second use by the rapidly advancing prices of timber. Outside of tar used on roads and of creosoting oils, the chief manufactures from crude tar in this country are refined tar for saturating roofing felt and various grades of pitch made for roofing, waterproofing, paving, briquetting, and like uses. The lighter tar oils, such as benzol and toluol, are recovered from the gas rather than from the tar, although a small amount is distilled from tar. The increase in demand for the lighter petroleum oils for use in motors has tended to encourage the recovery of the light tar oils from coke-oven gas.

The manufacture of aniline oil and salts from coal-tar oils has not reached the economic importance in the United States that it has attained in some European countries, notably Germany, where large and manifold chemical industries are based on the utilization of coal-tar derivatives. This backwardness is due partly to competition with foreign products, made possible chiefly by the higher cost of the labor in this country. The value of the imports into the United States of chemical products from coal tar amounts annually to more than $10,000,000. The duty averages about 10 per cent ad valorem. As a matter of fact, however, the value of the primary coal-tar derivatives forms only a small percentage of the value of the imported coal-tar products, the value of the acids and other reagents employed in their manufacture contributing by far the larger part of the ultimate value.

The yield of tar per ton of coal consumed in 1912 ranged from 4.08 gallons in Indiana to 18.56 in the combined production of Delaware and the District of Columbia. The general average yield was 7.53 gallons. The average value per gallon ranged from 2.1 cents in Maryland to 6.5 cents in the combined production of Kansas, Nebraska, and Oklahoma. The following tables show the production of coal tar in the United States in 1908 and 1912, by States:

Rank of States in coal-tar production in 1908 and 1912.

1908.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per gallon.	Yield per ton of coal.
			Gallons.		*Cents.*	*Gallons.*
1	Pennsylvania	25	18,720,845	$401,052	2.1	10.76
2	New York	48	14,688,079	315,664	2.1	10.33
3	Massachusetts	38	10,493,400	284,664	2.7	10.65
4	Michigan	42	7,834,757	182,571	2.3	11.45
5	Ohio	27	6,774,193	192,682	2.8	12.32
6	Illinois	45	6,248,695	140,199	2.2	8.13
7	Alabama	11	6,244,491	176,854	2.8	8.62
8	Wisconsin	18	5,557,537	135,311	2.4	8.01
9	Delaware, District of Columbia, and Maryland	11	4,129,124	91,804	2.2	9.27
10	New Jersey	13	4,127,126	123,662	3.0	9.52
11	Missouri	15	3,874,454	89,403	2.3	21.60
12	Minnesota	8	2,391,667	61,677	2.6	11.88
13	Indiana	30	1,587,817	40,395	2.5	10.76
14	Kentucky	11	1,397,492	29,676	2.1	13.39
15	Colorado	6	926,094	42,621	4.6	9.92
16	Virginia and West Virginia	15	924,805	24,503	2.6	10.92
17	Connecticut	6	819,317	29,011	3.5	10.62
18	Washington	9	668,005	36,295	5.4	10.14
19	Iowa	16	658,454	18,444	2.8	8.82
20	Tennessee	7	646,760	24,422	3.8	9.43
21	Rhode Island	3	628,968	16,843	2.7	11.85
22	Georgia	9	299,424	11,021	3.7	4.14
23	Maine	7	278,105	10,120	3.6	13.36
24	New Mexico, Oklahoma, and Utah	6	264,209	7,731	2.9	10.29
25	North Carolina and South Carolina	8	253,520	10,467	4.1	8.56
26	New Hampshire and Vermont	6	238,847	12,076	5.0	10.78
27	Kansas and Nebraska	6	202,384	5,617	2.8	15.03
28	Idaho, Montana, North Dakota, South Dakota, and Wyoming	7	128,170	8,455	6.6	8.49
29	Texas	6	101,580	5,788	5.7	4.63
30	Florida, Louisiana, and Mississippi	6	79,110	4,244	5.4	8.74
31	Arkansas	3	65,200	2,926	4.5	11.01
32	California and Oregon	3	9,200	920	10.0	5.41
	Total	471	101,261,829	2,537,118	2.5	10.30

1912.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per gallon.	Yield per ton of coal.
1	New York	39	17,858,399	$457,358	2.6	9.62
2	Pennsylvania	23	18,132,334	447,076	2.5	6.24
3	Illinois	36	13,165,175	405,753	3.1	6.13
4	Alabama and Arkansas	15	14,828,590	403,005	2.7	7.72
5	Indiana	30	13,750,210	397,540	2.9	4.08
6	Michigan	47	9,809,590	262,331	2.7	9.71
7	Massachusetts	32	9,431,923	257,283	2.7	11.43
8	Wisconsin	19	7,939,375	195,781	2.5	8.06
9	New Jersey	8	5,292,763	158,601	3.0	12.30
10	Ohio	16	4,076,070	106,988	2.6	9.91
11	Maryland	6	3,366,070	71,862	2.1	7.14
12	Virginia and West Virginia	15	2,898,877	71,233	2.5	8.90
13	Minnesota	10	2,328,277	117,419	5.0	10.75
14	Missouri	11	2,265,388	71,120	3.1	12.60
15	Connecticut and Rhode Island	10	1,884,425	68,689	3.6	11.08
16	Colorado	6	1,044,018	42,057	4.0	12.31
17	Washington	9	1,117,669	53,856	4.8	11.42
18	Kentucky	9	1,139,061	36,699	3.2	12.51
19	Iowa	15	899,980	36,163	4.0	11.05
20	Tennessee	6	958,446	34,140	3.6	11.80
21	Georgia	10	668,561	24,237	3.6	11.42
22	Idaho, Montana, North Dakota, South Dakota, and Wyoming	11	304,091	16,137	5.3	11.76
23	Delaware and District of Columbia	4	348,653	10,139	2.9	18.56
24	New Mexico and Utah	3	348,456	12,566	3.6	11.08
25	New Hampshire and Vermont	7	200,548	6,842	3.4	11.55
26	Maine	6	212,042	9,172	4.3	8.88
27	North Carolina and South Carolina	7	137,413	5,685	4.1	10.55
28	Kansas, Nebraska, and Oklahoma	3	154,680	10,089	6.5	10.84
29	Florida, Louisiana, and Mississippi	8	119,744	5,864	4.9	8.53
30	Texas	4	88,680	4,661	5.3	9.69
31	Oregon	3	26,930	1,701	6.3	10.40
	Total	428	134,796,438	3,802,047	2.8	7.53

THE PRODUCTION OF OIL AND WATER GAS TAR.

A notable development in the production of artificial gas in 1912 was in the recovery and sale of tar in the manufacture of oil and water gas. In 1908, when the production of water gas was a little over 103,000,000,000 cubic feet, the recovery of tar amounted to 9,168,834 gallons, in addition to which about 5,500,000 gallons were reported as produced but not sold. The total production was, therefore, a little less than 0.15 gallon per thousand cubic feet, and the quantity sold was 0.09 gallon per thousand cubic feet. In 1912, when the production of water gas was 122,700,000,000 cubic feet, the quantity of tar recovered and sold was 33,930,273 gallons, or nearly 0.28 gallon per thousand cubic feet of gas. About 32,000,000 gallons were reported as produced and not sold, making the total production 0.54 gallon per thousand cubic feet. As a further indication of the fact that water-gas tar has been found a useful element in the economy of gas production, the average value per gallon has advanced from 2.5 cents in 1908 to 2.8 cents in 1912, the average value per gallon for water-gas tar in the later year being the same as that of tar produced at coal-gas works and in retort ovens. The total value of the water-gas tar produced and sold in 1908 was $229,582; in 1912 the value of the oil and water gas tar produced and sold was $963,546. In addition to the tar recovered as a by-product in oil and water gas works, a considerable quantity of a residue designated as "carbon" was also produced. This is recovered principally from oil-gas works. The greater part of this carbon is used at the works for fuel, but 47,851 short tons were sold or used otherwise than for fuel in 1912, when this product had a total value of $533,763. At the works of the Los Angeles Gas & Electric Corporation, at Los Angeles, Cal., a briquetting plant has been installed for the manufacture of this carbon into briquets suitable for domestic consumption, and about 10,000 tons of the output of carbon was so used in 1912.

The following table gives approximately the quantity and value of the tar produced and sold at oil and water gas works in 1908 and 1912, by States, with the average price received at the works:

Quantity and value of tar produced and sold at water-gas and oil-gas works in the United States in 1908 and 1912.

1908.

State.	Total quantity.	Total value.	Price per gallon.
	Gallons.		*Cents.*
California and Washington	724,031	$35,471	4.9
Connecticut, Massachusetts, and New Hampshire	2,364,190	58,540	2.5
Delaware and Maryland	137,917	2,072	1.5
Florida, Louisiana, Mississippi, and Texas	558,714	15,207	2.7
Georgia and South Carolina	22,800	1,061	4.7
Illinois	21,600	524	2.4
Indiana and Ohio	557,322	12,360	2.2
Iowa	361,760	7,505	2.1
Michigan, Minnesota, and Wisconsin	615,055	19,316	3.1
Missouri, Nebraska, and South Dakota	458,637	10,357	2.3
New Jersey	114,900	1,805	1.6
New York	2,894,727	58,620	2.0
Pennsylvania	337,181	6,744	2.0
Total	9,168,834	229,582	2.5

Quantity and value of tar produced and sold at water-gas and oil-gas works in the United States in 1908 and 1912—Continued.

1912.

State.	Total quantity.	Total value.	Price per gallon.
	Gallons.		*Cents.*
Alabama, Florida, Louisiana, Mississippi, and Texas	668,702	$16,465	2.5
California, Montana, and Washington	544,344	32,210	5.9
Colorado	250,987	2,393	1.0
Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island	1,883,645	49,589	2.6
Delaware and Maryland	766,277	17,726	2.3
Georgia, North Carolina, and South Carolina	439,626	14,698	3.3
Illinois	403,214	10,819	2.7
Indiana and Ohio	1,603,622	44,081	2.7
Iowa	642,124	23,666	3.7
Kentucky and Tennessee	234,578	7,561	3.2
Michigan, Minnesota, and Wisconsin	2,639,804	70,344	2.7
Missouri, Nebraska, and South Dakota	2,389,440	69,722	2.9
New Jersey	673,188	14,526	2.2
New York	11,381,118	222,982	2.0
Pennsylvania	9,172,354	361,153	3.9
Virginia and West Virginia	237,250	5,611	2.4
Total	33,930,273	963,546	2.8

PRODUCTION OF AMMONIA.

About one-third of the establishments producing gas and coke from coal report the recovery of ammonia, the returns being either for ammoniacal liquor, anhydrous ammonia, or ammonium sulphate. In making the reports on the quantity of ammonia liquor produced, somewhat different methods are employed. Some companies reported the production in liquor ounces selling at a certain price per 100 liquor ounces of a specific strength; others reported the production in gallons, sales being made at a certain price per pound or by the ammonia (NH_3) contained; others reported the production in gallons of ammonia liquor at so much per gallon, according to the strength of the liquor. Then, again, the strength of the liquor is reported by some producers in ounces, by others in degrees Twaddell, and by still others in the percentage of anhydrous ammonia (NH_3).

In preparing the statistics of ammonia production for previous reports the compilations were made according to the strength of liquor. For the present report, where the strength of liquor has been reported, the production of liquor has been reduced to the equivalents in anhydrous ammonia and is distributed, when possible without divulging individual figures, according to States. The total quantity of anhydrous ammonia thus derived in 1912 was 51,527,074 pounds, valued at $4,776,386. In addition to this there were 35,242,549 gallons of liquor, valued at $1,002,807, the strength of which was not reported. In 1908 the quantity of anhydrous ammonia, or its equivalent, produced and sold amounted to 30,615,835 pounds, valued at $2,065,169. The production of ammonium sulphate in 1912 amounted to 99,070,777 pounds, valued at $3,740,075, against 44,093,437 pounds, valued at $1,322,807, in 1908.

In the following table are shown the quantity and value of ammonia liquor, anhydrous ammonia, and ammonium sulphate produced and sold in 1912, by States:

Quantity of coal carbonized and quantity and value of ammoniacal liquor, anhydrous ammonia, and ammonium sulphate produced and sold by by-product coke works and gas works in 1912, by States.

State.	Number of operators.	Coal carbonized.	Ammoniacal liquor.		Anhydrous ammonia.		Ammonium sulphate.		Total value.
			Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Short tons.	*Gallons.*		*Pounds.*		*Pounds.*		
Alabama	6	1,910,912			1,348,578	$102,980	(a)	(a)	(a)
Colorado	3	101,422			377,007	24,732			$24,732
Connecticut	4	74,084	(a)	(a)	(a)	(a)			28,878
District of Columbia	2	18,528	(a)	(a)					(a)
Georgia	1	30,351			(a)	(a)			(a)
Illinois	17	2,510,773	2,122,379	$297,468	9,479,336	862,884	4,912,878	$340,172	1,500,524
Indiana	9	3,415,031	1,115,642	157,876	12,114,805	1,284,548	(a)	(a)	(a)
Iowa	5	287,556			134,554	9,552			9,552
Kentucky	2	75,246	(a)	(a)	(a)	(a)			(a)
Maine	1	13,947	(a)	(a)					(a)
Maryland	1	462,998			(a)	(a)	(a)	(a)	(a)
Massachusetts	13	985,287	2,927,075	51,602	390,791	15,411	(a)	(a)	(a)
Michigan	16	959,102			5,699,369	521,905			521,905
Minnesota	3	182,586	(a)	(a)	(a)	(a)			65,595
Missouri	1	159,086	(a)	(a)					(a)
New Hampshire	2	14,894	(a)	(a)	(a)	(a)			(a)
New Jersey	2	410,059	(a)	(a)	(a)	(a)			(a)
New York	14	1,836,907	17,318,775	125,919	1,686,305	136,245	17,717,860	473,120	735,284
North Dakota	1	8,509			(a)	(a)			(a)
Ohio	6	399,573			2,000,311	165,567	(a)	(a)	(a)
Pennsylvania	15	2,862,730	717,448	95,660	7,973,058	682,712	8,653,980	245,727	1,024,099
Rhode Island	1	85,863			(a)	(a)			(a)
Tennessee	3	66,033			248,608	16,782			16,782
Utah	1	27,353			(a)	(a)			(a)
Vermont	1	3,908			(a)	(a)			(a)
Virginia	3	26,086	(a)	(a)	(a)	(a)			3,407
Washington	4	87,219	(a)	(a)	(a)	(a)			17,677
West Virginia	1	252,849			(a)	(a)			(a)
Wisconsin	7	931,734	(a)	(a)	4,909,536	468,864			(a)
Other States			11,041,230	274,282	5,164,816	484,204	67,786,059	2,681,056	5,568,150
Total	145	18,200,626	35,242,549	1,002,807	1,527,074	4,776,386	99,070,777	3,740,075	9,519,268

a Included in "Other States."

The production of anhydrous ammonia in 1908, by States, was as follows:

Production of ammonia in 1908, by States.

State.	Coal carbonized.	Anhydrous ammonia (NH_3) or its equivalent.
	Short tons.	*Pounds.*
Alabama and Georgia	740,794	1,171,757
Colorado, Utah, and Washington	134,766	379,089
Connecticut and Rhode Island	104,004	390,037
District of Columbia, Maryland,[a] Virginia, and West Virginia	462,267	422,124
Illinois	659,681	3,163,293
Indiana	84,902	285,267
Iowa and Missouri	179,888	844,646
Kentucky and Tennessee	120,363	482,593
Maine, New Hampshire, and Vermont	33,515	233,981
Massachusetts	908,580	1,184,240
Michigan	608,716	2,934,297
Minnesota and North Dakota	192,524	524,098
New Jersey	415,123	2,024,947
New York	1,354,963	4,541,153
Ohio	518,370	3,008,241
Pennsylvania	1,723,487	5,610,440
Wisconsin	650,483	3,415,632
Total	8,892,426	30,615,835
Quantity of ammonium sulphate produced and sold (pounds)	44,093,437	

[a] Production of Maryland reported as ammonium sulphate.

In the following table the total ammonia in 1907, 1908, and 1912 is given, together with the quantity of coal carbonized and the value of the ammonia and ammonium sulphate produced:

Production of ammonia at gas and by-product coke works of the United States in 1907, 1908, and 1912.

	1907	1908	1912
Coal carbonized ... short tons	10,461,646	8,892,626	18,200,626
Anhydrous ammonia (NH_3), or its equivalent, produced and sold ... pounds	37,560,858	30,615,835	51,527,074
Ammoniacal liquor (strength not reported) ... gallons			35,242,549
Ammonia produced and sold as sulphate ... pounds	48,882,237	44,093,437	99,070,777
Value received for anhydrous ammonia (NH_3) or its equivalent	$2,601,057	$2,065,169	$4,776,386
Value received for ammoniacal liquor			1,002,807
Value received for ammonium sulphate	1,525,472	1,322,807	3,740,075
Total value received	4,126,529	3,387,976	9,519,268

AGGREGATE PRODUCTION AND VALUE.

In the following tables are given the quantity and value of the gas, tar, coke, and ammonia produced in the United States in 1908 and 1912, by States. The aggregate value of this production in 1912 was $98,383,208 as against $64,660,040 in 1908.

Production of coal gas and by-products in the United States in 1908 and 1912, by States.

1908.

State.	Coal gas produced and used for illuminating and fuel purposes.	By-products.			Gas unaccounted for.
		Tar.	Anhydrous ammonia, NH_3.	Coke.	
	1,000 cu. ft.	*Gallons.*	*Pounds.*	*Short tons.*	*1,000 cu. ft.*
Alabama	2,016,820	6,244,491	1,171,757 (Alabama and Georgia)	489,788	63,460
Georgia	648,976	299,424		22,724	32,317
Arkansas	55,372	65,200	....	3,221	7,730
California and Oregon	12,776	9,200	....	359	1,071
Colorado	861,809	926,094		26,788	88,494
Washington	527,598	668,005	379,089 (Colorado, Washington, and Utah)	32,622	54,550
Utah					
New Mexico	223,853 (Utah, New Mexico, and Oklahoma)	264,209	....	12,667	26,570
Oklahoma					
Connecticut	710,786	819,317	390,037 (Connecticut and Rhode Island)	40,311	52,191
Rhode Island	468,979	628,968		20,633	46,092
Delaware			....		
District of Columbia	1,567,673 (Delaware, District of Columbia, and Maryland)	4,129,124		307,333	64,990
Maryland			*a* 422,124 (Maryland, Virginia, and West Virginia)		
Virginia	647,050 (Virginia and West Virginia)	924,805		31,867	146,366
West Virginia					
Florida, Louisiana, and Mississippi	91,549	79,110	....	4,089	12,658
Idaho			....		
Montana			....		
South Dakota	199,157 (Idaho, Montana, South Dakota, Wyoming, and North Dakota)	128,170	....	8,375	19,648
Wyoming			....		
North Dakota			524,098 (North Dakota and Minnesota)		
Minnesota	1,184,276	2,391,667		90,664	90,820
Illinois	3,648,607	6,248,695	3,163,293	500,451	247,874
Indiana	1,298,573	1,587,817	285,267	78,985	106,981
Iowa	641,367	658,454	844,646 (Iowa and Missouri)	37,041	73,641
Missouri	1,617,861	3,874,454		107,831	140,239
Kansas and Nebraska	114,953	202,384	....	1,667	13,525
Kentucky	866,821	1,397,492	482,593 (Kentucky and Tennessee)	44,835	130,151
Tennessee	600,050	646,760		25,390	37,050
Maine	202,773	278,105	233,981 (Maine, New Hampshire and Vermont)	5,330	18,530
New Hampshire and Vermont	198,205	238,847		12,699	26,854
Massachusetts	5,890,141	10,493,400	1,184,240	613,169	269,377
Michigan	4,463,862	7,834,757	2,934,297	438,866	280,886
New Jersey	2,168,739	4,127,126	2,024,947	258,565	21,872
New York	9,036,661	14,688,079	4,541,153	878,399	282,300
North Carolina and South Carolina	254,904	253,520	....	14,121	45,216
Ohio	3,876,492	6,774,193	3,008,241	347,479	666,740
Pennsylvania	6,039,495	18,720,845	5,610,440	1,286,371	114,424
Texas	239,251	101,580	....	8,733	45,399
Wisconsin	3,186,384	5,557,537	3,415,632	501,752	154,840
Total	53,561,813	101,261,829	30,615,835	6,253,125	3,382,856
Ammonium sulphate	....	....	44,093,437	....	....

a Production of Maryland reported as ammonium sulphate.

Value of coal gas and by-products produced in the United States in 1908 and 1912, by States.

1908.

State.	Total value of illuminating and fuel coal gas.	Value of by-products. Tar.	Anhydrous ammonia, NH_3 (or its equivalent) and ammonium sulphate.	Coke.	Total.	Total value of all products.
Alabama	$552,370	$176,854	} $328,713	{$1,417,074	}$2,008,539	$3,255,360
Georgia	694,451	11,021		74,877		
Arkansas	74,410	2,926	....	11,713	14,639	89,049
California and Oregon	26,520	920	....	2,599	3,519	30,039
Colorado	805,232	42,621	}	79,978	}	
Washington	671,194	36,295	} 14,398	164,346		
Utah	}			}	} 380,437	2,093,122
New Mexico	} 236,259	7,731		} 35,068		
Oklahoma	}		....	}	}	
Connecticut	842,910	29,011	} 15,902	{ 135,577	} 282,215	1,590,684
Rhode Island	465,559	16,843		84,882		
Delaware	}		....	}	}	
District of Columbia	} 645,191	91,804	}	} 1,131,979		
Maryland	}		} 221,758	}	} 1,586,457	2,903,468
Virginia	} 671,820	24,503	}	} 116,413		
West Virginia	}		}	}	}	
Florida, Louisiana, and Mississippi	124,583	4,244	....	18,999	23,243	147,826
Idaho	}		....	}	}	
Montana	}		....	}		
South Dakota	} 305,665	8,455	....	} 53,832		
Wyoming	}		....	}	} 533,251	1,853,832
North Dakota	}		} 46,611	}		
Minnesota	1,014,916	61,677	}	362,676	}	
Illinois	2,554,465	140,199	262,289	2,107,167	2,509,655	5,064,120
Indiana	1,243,714	40,395	12,272	247,641	300,308	1,544,022
Iowa	726,541	18,444	} 66,358	{ 176,078	} 725,988	2,926,918
Missouri	1,474,389	89,403		375,705		
Kansas and Nebraska	145,485	5,617	....	9,692	15,309	160,794
Kentucky	730,974	29,676	} 22,189	{ 132,459	} 296,204	1,635,734
Tennessee	608,556	24,422		87,458		
Maine	277,832	10,120	} 15,054	{ 25,690	} 132,907	655,159
New Hampshire and Vermont	244,420	12,076		69,967		
Massachusetts	4,126,298	284,664	457,376	2,005,005	2,747,045	6,873,343
Michigan	3,319,068	182,571	250,515	1,694,362	2,127,448	5,446,516
New Jersey	1,295,933	123,662	170,064	632,768	926,494	2,222,427
New York	5,607,322	315,664	434,900	2,887,465	3,638,029	9,245,351
North Carolina and South Carolina	336,654	10,467	....	39,688	50,155	386,809
Ohio	2,524,081	192,682	163,913	846,722	1,203,317	3,727,398
Pennsylvania	2,810,567	401,052	599,808	4,168,935	5,169,795	7,980,362
Texas	338,580	5,788	....	39,714	45,502	384,082
Wisconsin	1,731,942	135,311	305,856	2,270,516	2,711,683	4,443,625
Total	37,227,901	2,537,118	3,387,976	21,507,045	27,432,139	64,660,040

Production of coal gas and by-products in the United States in 1908 and 1912, by States.

1912.

State.	Coal gas produced and used for illuminating and fuel purposes.	By-products.			Gas unaccounted for.
		Tar produced and sold.	Anhydrous ammonia, NH_3.	Coke produced and sold.	
	1,000 cu. ft.	*Gallons.*	*Pounds.*	*Short tons.*	*1,000 cu. ft.*
Alabama Arkansas	7,964,028	14,828,590	1,348,578	1,374,195	50,956
California Oregon	24,606	26,930	....	989	5,099
Colorado	982,144	1,044,018	377,007	55,346	82,682
Connecticut Rhode Island	1,507,606	1,884,425	625,306	66,079	106,507
Delaware District of Columbia	166,815	348,653	....	8,314	22,532
Florida Louisiana Mississippi	123,572	119,744	....	4,640	22,264
Georgia	475,386	668,561	82,116	13,535	72,321
Idaho Montana North Dakota South Dakota Wyoming	290,430	304,091	12,524	13,358	32,718
Illinois	13,824,237	13,165,175	9,479,336	1,894,616	234,099
Indiana	19,487,536	13,750,210	12,114,805	2,693,846	143,175
Iowa	701,892	899,980	134,554	42,355	79,570
Kansas Oklahoma Nebraska	57,574	154,680	....	855	6,902
Kentucky	804,716	1,139,061	164,588	42,891	66,135
Maine	241,812	212,042	....	8,180	21,270
Maryland	1,100,259	3,366,070	1,637,735	306,232	1,777
Massachusetts	6,733,715	9,431,923	390,791	553,998	237,373
Michigan	6,627,709	9,809,590	5,699,369	657,975	453,468
Minnesota	1,570,301	2,328,277	593,314	98,475	102,640
Missouri	1,606,308	2,265,388	....	33,607	126,534
New Hampshire Vermont	256,419	200,548	35,052	11,479	16,104
New Jersey	2,572,334	5,292,763	308,358	280,191	59,855
New Mexico Utah	323,965	348,456	104,397	12,699	22,535
New York	9,372,946	17,858,399	1,686,305	1,047,210	580,129
North Carolina South Carolina	128,950	137,413	....	5,696	21,397
Ohio	1,330,090	4,076,070	2,000,311	280,328	72,516
Pennsylvania	4,968,058	18,132,334	7,973,058	2,079,601	521,186
Tennessee	598,232	958,446	248,608	31,843	69,171
Texas	74,349	88,680	....	2,548	15,871
Virginia West Virginia	749,941	2,898,877	1,459,344	209,414	131,387
Washington	906,834	1,117,669	142,082	15,353	73,390
Wisconsin	4,120,608	7,939,375	4,909,536	644,909	224,066
Total	89,693,372	134,796,438	51,527,074	12,490,757	3,675,629
Ammoniacal liquor ... gallons	....	....	35,242,549	....	....
Ammonium sulphate ... pounds	....	....	99,070,777	....	....

Value of coal gas and by-products produced in the United States in 1908 and 1912, by States.

1912.

State.	Total value of illuminating and fuel coal gas.	Value of by-products.				Total value of all products.
		Tar.	Anhydrous ammonia, NH_3 ammonia liquor, and ammonium sulphate.	Coke.	Total.	
Alabama, Arkansas	$892,736	$403,005	$1,076,637	$3,560,377	$5,040,019	$5,932,755
California, Oregon	47,797	 1,701	....	5,682	7,383	55,180
Colorado	931,445	42,057	24,732	198,581	265,370	1,196,815
Connecticut, Rhode Island	1,417,303	68,689	58,295	324,377	451,361	1,868,664
Delaware, District of Columbia	149,177	10,139	2,683	45,417	58,239	207,416
Florida, Louisiana, Mississippi	168,765	5,864	....	19,159	25,023	193,788
Georgia	528,578	24,237	5,748	56,580	86,565	615,143
Idaho, Montana, North Dakota, South Dakota, Wyoming	436,739	16,137	626	82,485	99,248	535,987
Illinois	3,092,038	405,753	1,500,524	8,650,249	10,556,526	13,648,564
Indiana	2,385,680	397,540	2,496,387	12,840,038	15,733,965	18,119,645
Iowa	733,839	36,163	9,552	235,823	281,538	1,015,377
Kansas, Oklahoma, Nebraska	80,939	10,089	....	5,142	15,231	96,170
Kentucky	639,844	36,699	11,674	130,927	179,300	819,144
Maine	290,406	9,172	514	45,355	55,041	345,447
Maryland	153,938	71,862	366,041	1,336,255	1,774,158	1,928,096
Massachusetts	4,329,009	257,283	517,510	1,800,396	2,575,189	6,904,198
Michigan	4,060,118	262,331	521,905	2,605,034	3,389,270	7,449,388
Minnesota	1,244,647	117,419	65,595	419,765	602,779	1,847,426
Missouri	1,330,365	71,120	50,608	140,997	262,725	1,593,090
New Hampshire, Vermont	318,169	6,842	3,130	59,921	69,893	388,062
New Jersey	1,301,983	158,601	205,766	727,190	1,091,557	2,393,540
New Mexico, Utah	294,461	12,566	8,456	65,665	86,687	381,148
New York	5,304,822	457,358	735,284	4,098,949	5,291,591	10,596,413
North Carolina, South Carolina	207,806	5,685	....	23,837	29,522	237,328
Ohio	577,882	106,988	181,957	1,041,408	1,330,353	1,908,235
Pennsylvania	1,627,600	447,076	1,024,099	6,312,725	7,783,900	9,411,500
Tennessee	610,583	34,140	16,782	91,212	142,134	752,717
Texas	105,038	4,661	....	12,445	17,106	122,144
Virginia, West Virginia	735,612	71,233	147,974	632,597	851,804	1,587,416
Washington	1,083,754	53,856	17,677	82,579	154,112	1,237,866
Wisconsin	1,600,811	195,781	469,112	2,728,842	3,393,735	4,994,546
Total	36,681,884	3,802,047	9,519,268	48,380,009	61,701,324	98,383,208

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